Universitá degli Studi di Milano - Bicocca

TESI
per il Dottorato in Economia Politica

Relationships and Economic Transactions

presentata e discussa da

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A Martin, senza il quale probabilmente non sarei qui,
e ai miei genitori, senza i quali sicuramente non sarei qui

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General Introduction

The *Leitmotive* of my dissertation is the role that the networks of relations existing among economic agents play in their behavior and, thus, in economic outcomes. Indeed, the notion that agents' actions are plunged in a larger relational context, the so called 'embeddedness of economics' (Granovetter [1985]), is not an innocuous artefact of social life (Fafchamps et al. [2010]). Networks shape agents' incentives and constraints, affecting their behavior and outcomes (Bandiera et al. [2010]). Besides the theoretical modeling of networks, the assessment of their actual incidence on economic outcomes is an incredibly exciting challenge for empirical Economists. The research collected in this thesis contributes towards showing not only the theoretical enrichment brought about by taking networks into account, but also the crucial role that they actually play in economic outcomes.

Economics has sometimes been accused of being a Science that has lost its Social component. It has been blamed for considering agents as atoms outside their molecule, abstracting from their relationships and from the structure of links where they are embedded. In particular, many have described the 'under-socialised conception of man' as a limitation of the neoclassical economic theory (Granovetter [1985]).

The charge brought to economics is actually shared with other sciences as well, as a result of the tendency, booming since the late XVIII century, to reduce complex phenomena into smaller elements. While this atomistic approach has provided great scientific achievements, its limitations are becoming

apparent. In the vivid words of Barabási [2002]: "Have you ever seen a child take apart a favorite toy? Did you then see the little one cry after realizing he could not put all the pieces back together again? Well, here is a secret that never makes the headlines: We have taken apart the universe and have no idea how to put it back together. After spending trillions of research dollars to disassemble nature in the last century, we are just now acknowledging that we have no clue how to continue - except to take it apart further".

Similarly to what is happening in other sciences, economics is now looking with renewed interest at the 'toy' in its entirety, as a complementary approach with respect to disassembling it. Lazaer [1991] for instance asserts that: "Economics is sometimes accused of being sterile, unrealistic, and inhumane. (...) This stereotype has had some truth, but it is becoming much less accurate. In labor economics and other areas, previously non-economic issues are being systematically incorporated into economic analyses." Indeed, psychological and institutional issues are now largely recognized as crucial elements of economic phenomena, as attested by the attribution of recent Nobel prizes in economics.

There is another element that is proving essential on many dimensions: networks. A large body of research in physics, sociology and more recently in economics has studied the key role of networks in different phenomena. The literature on social networks has been growing literally exponentially, as Figure 1 suggests.

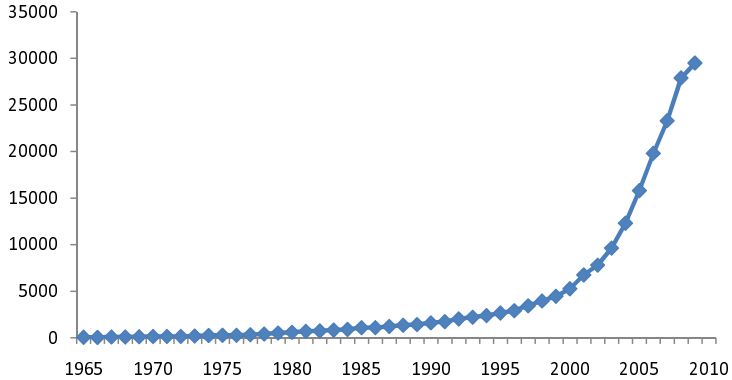

Figure 1: Number of articles indexed in Google Scholar containing 'Social Network' [Source: Google Scholar].

In social sciences the explosion of research on networks has been preceded by a boom of studies on social capital, which is a related concept. Researchers have struggled to find a consistent definition of social capital and maybe Bowls and Gintis [2002] are right in saying that: "Perhaps social capital, like Voltaire's God, would have had to be invented even if it did not exist. It may even be a good idea. A good term it certainly is not. 'Capital' refers to a thing possessed by individuals; even a social isolate like Robinson Crusoe had an axe and a fishing net. By contrast, the attributes said to make up social capital describe relationships among people" (and would have been unintelligible to Robinson before Friday showed up).

The real issue for economics is whether social capital refers to an element that is important in economic phenomena. In the words of Putnam [2000], in what Durlauf [2002] describes as the most exhaustive defense of the importance of social capital yet to appear: "Whereas physical capital refers to physical objects and human capital refers to properties of individual, social capital refers to connections among individuals - social networks and the norms of reciprocity and trustworthiness that arise from them". Relationships among economic agents are a major component of social capital (Burt [1992], Arrow and Borzekowski [2004]) and the embeddedness and position of agents in relational structures of interaction, *i.e.* in networks, have potentially crucial implications for economics.

From a theoretical perspective, network analysis allows to define and characterize the structure (conceptualized as lasting patterns of relationships among units) where economic phenomena are embedded. Since the network structural environment provides opportunities for or constraints on individual action (Wasserman and Faust [1994]), the natural step forward consists in evaluating the magnitude of its effects. However, the empirical research has struggled with the scarcity of available data and tools to study the role of social networks in economic outcomes. Although the theoretical work still appears to account

for the majority of publications, empirical studies are advancing, thanks to the technological progress in managing and analyzing large and complex data bases. Beyond the recognition and exploration of the theoretical enrichment provided by taking networks into account, the most exciting challenge of the 'network revolution' is the empirical assessment of whether networks have first order effects.

The literature on organizational network can be divided in a number of research streams. Within each branch, studies focus either on the formation or the consequences of networks. At the individual level, the most prominent one studies social networks, investigating the formation of ties and relating the characteristics of networks and an individual's position within networks to significant outcomes, such as employment and mobility. At the firm level, another branch focuses on ties between firms and explores why organizations form alliances and what the consequences are.

A comprehensive review of the studies adopting a network perspective should stress its multidisciplinary dimension across sociology (see Granovetter [1995], Moody [2004], and Watts [2004]), physics (see Barabási [2002], Dorogovtsev and Mendes [2002]) and economics (see Jackson [2008]) at least (and would probably require another book of its own). The aim of this thesis is not to provide a unifying and unified framework of the causes and the effects of networks. The objective is instead to explore not only theoretically but also empirically some instances where networks are key to economics. The review of the respective and more circumscribed literature is presented in the three chapters and what follows in this general introductory section is devoted to situating the chapters in the larger context of research on networks.

While networks play a crucial role on many dimensions, one of the most prominent and investigated features is that they are privileged channels of information diffusion. In the words of Jackson [2006]: "The most obvious and perhaps pervasive role of network is as a conduit of information, and one of

the most extensively documented role for social networks in economics is that of contacts in labor markets." They facilitate the spreading of awareness about new vacancies and they also reduce the imperfect information affecting labor markets. The first and second chapter of this thesis explore instances where social networks are information channels. They both belong to the stream of network literature focusing on links at the individual level and their relevance with respect to labor outcomes.

The first chapter focuses on the hiring stage and the potential wage differential imputable to being hired through social networks. The chapter develops a theoretical framework that takes into account the effects of moral hazard concerns and the diversity of networks and cultures on the choice of hiring channels. This model rationalizes the emergence of either informal or formal hiring channels and of either positive or negative wage differentials for workers hired through informal channels, depending on circumstances. In particular, the prevalent way of perceiving the use of networks as hiring channel is determinant. Indeed, a worker hired through a personal contact may either feel indebted and grateful or, on the contrary, she may think that she is somehow favored and does not really need to exert as much effort as the other workers. Conditional on being employed, in contexts where favoritism is prevalent, social networks are likely to be adopted as hiring channels for unskilled jobs and to result in wage penalties and even more, the stronger the ties. In contexts where gratitude predominates, however, the opposite happens.

The empirical analysis is based on firm and individual matched data from the 2003 Investment Climate Assessment survey of the World Bank on Senegal's manufacturing formal sector. It estimates an endogenous switching model, allowing for both endogenous selection and switching effects of formal and informal hiring channels. The results for Senegal are consistent with the theoretical predictions in case of favoritism: informal hiring channels are preferred to fill unskilled vacancies and are associated with a wage penalty. Moreover,

the probability of having been hired through a social network and the absolute value of wage penalties are increasing in the strength of ties.

The second chapter focuses on the role played by networks during the career progression, independently of the hiring channel. It takes into account multiple mechanisms whereby networks have an impact on career outcomes and their dynamic coevolution. Indeed, professional links affect salary not only directly if they are valuable to the employer, but also indirectly through mobility since they represent privileged channels of information diffusion about job opportunities. Moreover, professional links have an impact on labor outcomes, but at the same time a worker's network is substantially shaped by career choices. The chapter develops therefore a dynamic framework where the utility of workers is affected by the characteristics of their professional network and by the mobility decisions they make during their career. The optimal value depends on professional networks directly through current utility to the extent that links are valuable to the employer and indirectly through the effect that they have on mobility decisions.

The empirical analysis is based on individual and firm matched information provided by BoardEx Ltd, a UK supplier of data to headhunting companies, describing the career history of thousands of Executives in US, UK, France, and Germany. The data support the main hypotheses of the theoretical setting and the insight that professional networks are relevant both because they are valuable for the employer and because they facilitate job mobility. These findings are robust to alternative definitions of career value and specifications accounting for mobility and link endogeneity. We also find that contemporaneous colleagues are not a useful component of a worker's network. Moreover, networks characterized on average by ties between nodes that have been colleagues for a long time have a lower direct and indirect effect on labor outcomes. Finally, networks where many links are represented by workers that have been colleagues a long time before are less valuable to the employer.

Both the first and second chapter of this thesis belong to the same literature on the role played by social networks in labor outcomes and in particular wages. However, they deal with different issues and are very different both from a theoretical and empirical point of view.

The first chapter indeed focuses on the networks at the hiring stage, while the second during the career. They both sketch a theoretical framework, but in the first chapter the model is static and in the second one dynamic. Moreover, they focus on different problems. In the former, labor markets are affected by incomplete information. As a result, problems of selection (*i.e.*, the type of workers is not observable before hiring) and moral hazard issues (*i.e.*, the effort of workers is costly to observe) may arise. Networks may reduce selection problems, if they represent information channels. At the same time, networks may reduce moral hazard concerns, if they are able to exert pressure and monitor their members' behavior. The network ability to represent a commitment device and reduce shirking is regarded as crucial for instance in microcredit, but has not been considered in the context of labor markets. Since, selection problems have been extensively explored in the context of informal hiring channels, the first chapter focuses instead on the idea that social networks may play a role as far as moral hazard is concerned.

The second chapter instead focuses on career and mobility decisions. Networks are useful to the extent that they spread information about professional opportunities and are considered as valuable assets by the employer. Indeed, beyond diffusing information, there is at least a second way whereby professional networks may be considered a form of social capital. In fact, Glaeser et al. [2002] define "individual social capital as a person's social characteristics - including social skills, charisma, and the size of his Rolodex - which enables him to reap market and non-market returns from interactions with others". In this sense, employers may take into account the characteristics of professional contacts of workers and in particular their contacts with workers outside the

firm.

Each chapter comprises an empirical analysis, since I agree with Mansky [2000] that "empirical analysis is essential to determine which theories should be taken seriously as descriptions of the world as it is, rather than as it might hypothetically be". However, the data and identification strategies are different. The empirical application of the first chapter is to the manufacturing sector of a developing and African country, where it has been suggested that informal hiring channels are even more widely adopted than in developed countries. The second chapter instead relies on information about an *élite* of high-skilled jobs in four OECD countries. Finally, the networks of interest are self-reported and based on ethnicity and kinship in the first chapter, while professional factual potential links in the second chapter.

Networks are crucial not only as far as information diffusion is concerned, but also on a number of other dimensions. An important, already mentioned, feature of networks is their ability to provide commitment. In the first chapter of this thesis, as well as in the microcredit literature, networks are indeed regarded as commitment devices for individuals. However, relationships are also able to provide commitment when the agents are larger units of analysis, like firms or countries. Indeed, networks constitute a structure, different from that of markets or of hierarchies, able to play a great role in firm outcomes. An example is the famous Toyota 'just in time' production system, where commitment to quality is achieved through a tight production network.

The third chapter investigates the relations between organizations and suggests that they may provide them with commitment ability. It models risky projects with autocorrelated productivity shocks as creating an option value of investing over time so that later investments benefit from the information revealed by the realization of earlier investments. However, once a firm has invested in a production project, lobbies within it (*e.g.*, some divisions of the firm may have divergent interests from those of the Head Office or Board of Di-

rectors) or outside it (*e.g.*, there may be political pressure as well as pressure from upstream or downstream trading partners) may pressurize into paying out early revenues from such investments precisely when the autocorrelation of productivity implies the firm should be reinvesting them in the project. An alliance with one or more other firms characterized by joint ownership of a production project may then provide a commitment mechanism against lobbies' pressure and therefore enable more efficient levels of investment. The same argument applies when decision makers are governments instead of firms, as often the case for infrastructure projects in developing countries.

The Business Environment and Enterprises Performance survey data corroborate the model's prediction that organizations under conditions favorable to internal or external lobbying pressure are more likely than other firms to choose joint ventures, a common form of joint ownership, as their corporate governance structure. Moreover, the estimation of an instrumental variable probit model suggests that this effect is actually downward biased, consistently with the theoretical model. Indeed, although joint ventures are more necessary when a firm is under potential lobbying pressure, they also contribute to reducing such pressure.

In conclusion, the three chapters of this thesis explore some instances where networks are key to economics, (hopefully) contributing to the shift from atomistic explanations toward a more relational understanding of economic phenomena. Network analysis offers a framework to assess the interactions across agents and the structure that links decision makers may represent the key to eventually build the bridge between micro and macro, between individual behaviors and aggregate outcomes. The moment has arrived to go all the way through and assess the role of social networks in economic outcomes.

Chapter 1

Social Networks and Wages in Senegal's Labor Market

1.1 Introduction

An impressive number of vacancies is filled through informal hiring channels, which comprise family, friends, and in general social networks to which individuals belong, rather than through the formal labor market. Granovetter [1973], Rees [1966] and Corcoran [1980] find that about half of the jobs in the United States are filled through personal contacts and Ioannides and Loury [2004] notice that the role played by networks increased over time. Sociologists and economists have first looked at the supply side of the labor market. Holzer [1988], for example, showed that when multiple search methods are possible, workers prefer social networks to formal hiring channels, because the former are less expensive and characterized by a higher probability of being hired than the latter. On the demand side, the traditional wisdom among economists[1] is that informal hiring channels may help to mitigate selection problems arising in recruitment. For instance, Montgomery [1991], Saloner [1985] and Simon and Warner [1992] all argue that informal hiring channels may reduce information

[1]For an interesting review of economic and sociological competing theories providing a rational for the use of informal hiring channels, see Fernandez et al. [2000].

asymmetry between employers and employees and provide a better matching of unobservable characteristics. Montgomery assumes that social networks are based on homophily of unobservable characteristics, so that people tend to refer others like themselves. Saloner's results rest instead on the referees' willingness to safeguard their reputation. Simon and Warner posit that the use of informal hiring channels reduces employers' uncertainty about applicants productivity.

All these models predict that hiring through social networks should always be preferred to formal channels. Moreover, the enhanced selection that is guaranteed by informal hiring channels should be specially exploited for vacancies requiring high skills and should imply wage premia for workers hired through social networks. However, in the real world, formal and informal hiring channels coexist and their adoption greatly varies in different contexts. First of all, the practice of hiring through social networks is even more pronounced in developing countries than in industrialized ones.[2] Moreover, many empirical studies suggest that vacancies for unskilled occupations are more likely to be filled through social networks than jobs requiring high skills,[3] while some find the opposite[4]. Finally, wage differentials imputable to informal hiring channels are far from being found always positive.[5] For instance, Pellizzari [2009] finds that, out of 15 industrialized countries, in Austria, Belgium and the Netherlands networked workers enjoy wage premia, in Greece, Italy, Portugal and UK they suffer wage penalties, while in the 8 remaining countries there are no significant wage differentials due to the adopted hiring channel.

The discrepancies between theoretical predictions and empirical studies

[2]See Ben-Porath [1980] and Fafchamps [2006], who suggests that reliance on interpersonal relationships and networks can be seen as a symptom that formal institutions do not work well.

[3]See Rees [1966], Rees and Schultz [1970], Corcoran [1980], Banerjee [1984], Pistaferri [1999], Antoninis [2006], Munshi and Rosenzweig [2006], and Pellizzari [2009].

[4]Kugler [2003], for example, argues that the use of referrals is more widespread in high-skilled occupations.

[5]While Simon and Warner [1992] and Kugler [2003] conclude that workers hired through social networks get wage premia with respect to employees hired through formal channels, penalties are found by Pistaferri [1999] and Bentolila et al. [2010].

suggest that theories focusing on adverse selection overlook some crucial aspect of the phenomenon. This paper aims at reconciling theory and empirical findings on the choice of hiring channel and its potential effect on wages. It does so, first of all by taking into account that, besides selection issues, incomplete information may also imply problems of moral hazard. Second, it considers that networks differ in their tightness[6], while the existing theoretical literature does not consider the variety of social networks. We argue that the strength of links is important, because tight networks are able to exert peer pressure to ensure proper behavior of members who are hired through them.[7] Indeed, Shapiro and Stiglitz [1984] show that, when observing employees' effort is costly for firms, employers need to increase workers' expected value of not shirking with respect to shirking. That is, firms need to rise either the monitoring or the salary of their workers.[8] However, the role played by peer pressure may decrease the monitoring costs for workers hired through social networks with respect to other employees.[9] Third, even networks characterized by similar tightness may play a very different role in the job market depending on the culture. There are contexts in which a worker hired through a social network reciprocates the working opportunity by exerting more effort

[6]A tight network is characterized by very strong ties. Different concepts of strong ties populate the literature. Hennig and Lieberg [1996] and Wahba and Zenou [2005] define strong ties as those based on a repeated and regular relationship, while Grieco [1987], Lin [1999] and others measure the strength of the ties by the degree of commitment, reciprocity, trust and mutual obligation. Our preferred notion is the one proposed by Granovetter [1973]: "The strength of a tie is a (probably linear) combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie.".

[7]Several studies support this insight. Adler and Kwon [2002] suggest that tight networks encourage compliance with rules and reduce the need for formal controls. Similarly, Grieco [1987] argues that social networks can reinforce social control at the work place. Moreover, Fisman [2003] provides evidence that enforcement is particularly effective within ethnic groups in Africa. Finally, Binzel and Fehr [2010], Glaeser et al. [1990], Barr [2004] and Miller and Rosenbaum [1997] provide experimental evidence of the positive relationship between social proximity and trustworthiness.

[8]In the Ivorian manufacturing sector the trade-off between wage and monitoring has been analyzed by Azam and Lesueur [1997].

[9]In enriching the employer search framework with the efficiency wage theory, we carry out a step along the research path wished by Sicilian [1995]. In a similar spirit Kugler [2003] also argues that referees can exert peer pressure on co-workers and thus lower monitoring cost, but within a matching framework.

than workers hired through the formal channel, while a culture of favoritism encourages networked employees to work less than the others. Our model integrates all these aspects and explains why either formal or informal hiring channels are adopted and why either positive or negative wage differentials may emerge for workers hired through informal channels, depending on circumstances. Moreover, it accounts for the stylized facts that developing countries rely even more on social networks as hiring channels than industrialized ones and that informal hiring channels are often adopted to fill unskilled vacancies.

The paper also contributes to the empirical literature by investigating the determinants of hiring channels at worker, network and firm level and the impact of the adopted hiring channel on wages in the Senegalese formal manufacturing sector. While most of the empirical literature on social networks as hiring channels is largely confined to developed countries studies, very few studies have analyzed the crucial role of social networks in less developed countries' labor markets[10] and none takes into account the fact that social networks differ in their tightness. Moreover, to our knowledge the only existing analysis of informal hiring channels concerning Sub-Saharan Africa refers to the colonial period (Fafchamps and Moradi [2009]). However, this region is pervaded with informality to a greater extent than other developing countries[11] and social networks play a crucial role in their labor markets[12]. At the same time, Senegal is a rare example of a Sub-Saharan African country characterized by a dynamic economy moving away from the ubiquitous informality to a market economy, thus providing a unique opportunity to investigate the remains of informality in an economy that is developing toward formal markets.

We adopt an empirical approach that to our knowledge has not been applied

[10]Notable exceptions are Egypt's studies by Assaad [1997] and Wahba and Zenou [2005].

[11]An example of the economic relevance of informality in Africa is provided by Azam et al. [2001] concerning the credit market.

[12]Luke and Munshi [2006] and Magruder [2010] find that traditional social networks, such as those based on kinship, are pivotal for labor markets respectively in Kenya and South Africa. Barr and Oduro [2002] stress the importance of ethnic networks for labor outcomes in Ghana.

before to investigating informal hiring channels. Estimating an endogenous switching model, we find that informal hiring channels are preferred to fill unskilled vacancies and are associated with a wage penalty. Moreover, the probability of having been hired through a social network and the absolute value of wage penalties is increasing with the strength of ties. These findings are consistent with our theoretical predictions in contexts where favoritism is widespread.

Section 1.2 analyzes the case of Senegal, providing details on the data and some descriptive statistics characterizing sampled firms and workers. Section 1.3 presents a theoretical framework that accounts for the elements intuitively singled out above and corroborated by the analysis of rough data. Section 1.4 presents econometric evidence supporting the hypotheses and the predictions of our theoretical framework. Finally, section 1.5 concludes.

1.2 Descriptive statistics

The empirical analysis relies on the Investment Climate Assessment (ICA) survey for Senegal, run by the World Bank in 2003. It provides information about 262 firms and 1637 of their workers in the formal[13] manufacturing[14] sector. One of the salient features of this data set is that it matches workers and firms, which allows controlling for idiosyncratic characteristics of both.

Social networks based on family, friends are the main channel of matching between firms and workers in the dataset. On the demand side, the majority

[13]The survey defines the formal sector as made up by registered firms. However, there are many other firms that do not officially exist (and thus do not pay taxes). The latter firms make up the so-called informal sector of the economy, which represents a notable part of the economy and employs a great number of workers. Data available for 2001 indicate that it represented almost 55% of GDP and that about 1.2 million people worked in informal firms. However, the informal sector of the economy is likely to hire almost only through social networks. Thus, the formal sector is a more interesting ground to pin down the determinants of firms' choices concerning the hiring channel.

[14]The fact that sampled firms belong to the manufacturing sector implies that it is not possible to reach conclusions about the Senegalese economy in general. However, the manufacturing sector is a large part of it, accounting for 12% of GDP in 2008 (African Economic Outlook [2009]).

Table 1.1: Characteristics of sampled firms by their main hiring channels.

	Firms mainly hiring through channel:			
	formal	informal	Difference	Total
total number of interviewed firms	104	152	-48	256
firm located in Dakar	98	145	-47	243
public firm	8	4	4*	12
mean number of employees	194	72	122**	130
	(592)	(180)	(51)	(425)
owner and director	59	105	-46**	164
sector: agro-industry	40	53	-13	93
chemical/paint products	13	17	-4	30
building materials	10	8	2	18
furniture	1	5	-4	6
metals	10	15	-5	25
paper industry	12	24	-12	36
plastics	3	12	-9*	15
textile and leather	8	15	-7	23
wood	7	3	4*	10

Note: Standard deviation in brackets. Significance levels: *: 10% **: 5% ***: 1%.

of firms use sometimes formal and sometimes informal hiring channels, and 60% of the sampled firms declare to mainly rely on informal networks in order to fill their vacancies. On the supply side, 65% of interviewed workers found their job through social networks.[15]

In order to get some insights about the phenomenon, it is useful to analyze the characteristics of both firms and workers thoroughly. Some characteristics of the sampled firms are reported in Table 1.1, which distinguishes between firms that declare to mainly rely on formal and on informal hiring. All sampled firms are located in an urban area and 95% of them in the capital city, reflecting the distribution of manufacturing employees in the country.[16] Enterprises where the owner is also the director of the firm are also those that more often use informal hiring channels, while bigger firms tend to rely more on formal hiring channels.

[15]Notice that the focus of this paper is on the hiring channel and not on the characteristics of the contract hold by workers. Indeed, the ICA survey does not provide information on workers' contract, *i.e.*, whether it is written and complete, whether it specifies benefits and social insurance, etc. However, Combarnous [2001] shows that in Côte d'Ivoire workers who found their job through informal channels usually have incomplete contracts, while employees holding complete contracts often applied to a vacancy announcement.

[16]Indeed, more than 2 million people live in Dakar, while less than 250 thousands in the other cities. Thus, the concentration in Dakar of interviewed workers is almost representative.

Having noticed these characteristics at the firm level, we now investigate the characteristics of sampled workers.[17] Table 1.2 reports available information about sampled employees, distinguishing between those hired through formal channels and those who found their job through social networks. Workers who found their job through networks of relatives, friends are about 65% of interviewed workers. The survey also provides information concerning two types of social networks. The first one is the network binding the owner or manager of the firm with employees belonging to her ethnic group. The second one includes members of her extended family working in the firm. Rough data suggest that the ethnic group is one of the social networks whereby workers may be hired, since employees that belong to the same ethnic group as the head of the firm are 21% among workers hired through an informal network and 13% in the formal labor market. Since family ties are likely to be tighter than merely ethnic ones, the comparison between their effects enables to test the role played by network tightness in the labor market.

Our data set provides evidence that workers are hired more often through social contacts for jobs requiring lower qualifications. Indeed, 76% of unskilled workers found their job through their family or friends. The percentage falls to 60% for skilled blue collars and to 41% for skilled white collars and managers.[18] Workers who found their job through informal contacts are also less educated, experienced, and younger than employees hired on the formal labor market. Finally, the mean of the natural logarithm of real monthly salary[19] is significantly lower for workers hired through social networks.

While the rigor of econometrics is necessary to disentangle the relative

[17]Notice that the information available concerns neither the pool of applicants, nor just-hired workers, but workers employed at the time the survey took place.

[18]The survey categorizes workers into ten types of jobs. We group them into four occupational categories: manager, skilled white collar (engineer, scientist, economist, programmer, mathematician, accountant), skilled blue collar and other skilled (technician, supervisor, maintenance and repairing man, medical staff, clerk, secretary), and unskilled (other production worker, guard, cook).

[19]Real wages are computed adjusting reported salaries at the time of hiring for the harmonized consumer price index, provided by the Senegalese Forecasting and Statistics Direction (Direction de la Prévision et de la Statistique).

Table 1.2: Characteristics of sampled workers by their hiring channel.

	Workers hired through channel:			
	formal	informal	Difference	Total
number of workers	555	1018	-463	1573
same ethnicity as firm's head	71	214	-143***	285
same family as firm's head	30	150	-120***	180
job: managers	32	23	9***	55
skilled white collar	101	71	30***	172
skilled blue collar	238	351	-113***	589
unskilled workers	183	569	-386***	752
mean education (years)	13.0	10.5	2.5***	11.4
	(4.73)	(4.62)	(0.26)	(4.81)
mean previous experience (years)	5.0	4.1	0.9***	4.5
	(6.39)	(6.06)	(0.34)	(6.19)
mean age at hiring (years)	29.9	28.8	1.1***	29.2
	(7.41)	(8.34)	(0.42)	(8.04)
gender: male	555	1018	-463	1573
marital status: married	555	1018	-463*	1573
origin: Dakar	220	426	-206	646
other in Senegal	311	546	-235	857
other	24	45	-21	69
weekly work hours	43.2	43.3	-0.1	43.2
	(8.51)	(9.98)	(0.50)	(9.48)
mean ln real monthly salary	11.2	10.9	0.3***	11.0
	(0.87)	(0.86)	(0.05)	(0.88)

Note: Standard deviation in brackets. Significance levels: *: 10% **: 5% ***: 1%.

role played by different variables, the analysis of crude data suggests several potentially relevant dimensions, which are integrated in the theoretical framework developed in section 1.3. In particular, the incidence of informal hiring channels varies with job characteristics and network tightness.

1.3 A model of hiring through formal and informal channels

The need of a theoretical framework accounting for what we observe in reality and in the data described in section 1.2 motivates our modeling exercise. In order to understand the use of social networks as hiring channels, the key point is investigating why and when firms and applicants prefer to rely on them. Since adverse selection has long been investigated in the context of hiring channel choice without managing to account for empirical evidence, we abstract from it for the sake of tractability and we focus instead on other

crucial characteristics of the phenomenon that received little attention until now. Moreover, we simultaneously take into account the choices of employers and applicants.

1.3.1 Setting

We model a formal-sector firm that can hire labor either through the formal channel, at a market wage w^F, or from a pool of workers who are linked to that firm by a social network.[20] In the latter case, the wage is determined by the bargaining between the firm and the worker.[21] Assume that the outcome is determined by the Generalized Nash Bargaining Solution (Rubinstein [1982]), so that the wage paid to a worker, when hired by the informal channel, maximizes $(w^N_{i,j} - \underline{w}^N_{i,j})^{\eta_i}(\overline{w}^N_{i,j} - w^N_{i,j})^{1-\eta_i}$. In this function, η_i is the worker's bargaining power, $\underline{w}^N_{i,j}$ is the minimum wage that employee i is willing to accept through informal channels for working for firm j, rather than only accepting jobs through formal channels, and $\overline{w}^N_{i,j}$ is the maximum wage that the firm is prepared to pay this worker rather than hiring another one via the formal channel. The latter two variables ($\underline{w}^N_{i,j}$ and $\overline{w}^N_{i,j}$) are determined endogenously, as described below. In conclusion, if the firm hires through informal channels, the corresponding wage will be determined as follows:

$$w^N_{i,j} = \eta_i \overline{w}^N_{i,j} + (1 - \eta_i)\underline{w}^N_{i,j}. \tag{1.1}$$

This expression simply says that the agreed wage will be a linear combination of the two extreme points of the bargaining set, being closer to the top the higher is the worker's bargaining power.

We assume that the firm can observe worker's individual output only by costly monitoring her. For the sake of simplicity, the worker can either shirk or

[20] Table 1.5 in the appendix summarizes the variables introduced in the model.

[21] A vacancy posted through formal channels is likely to announce a wage. However, when informal hiring channels are used, wage is much more likely to be the object of some negotiation and to depend on the bargaining power of a specific candidate.

exert some effort, and that effort may be influenced by how she was hired. A worker hired through the formal channel chooses $e_i^F \in \{0, e\}$, while somebody hired through social networks $e_i^N \in \{0, e + \delta\varphi_{i,j}\}$. Indeed, the characteristics of the social network whereby a worker is hired, and namely its tightness ($\varphi_{i,j}$), are likely to influence the extent of her effort. In some contexts workers hired through social networks may be eager to reciprocate the working opportunity, while elsewhere they may feel that they don't need to exert as much effort as the others (*i.e.*, the sign of δ is culturally driven).

Denote $q_{i,j}^k$ the probability that worker i hired through channel $k \in \{F, N\}$ gets fired by firm j, and assume that the monitoring technology is such that the worker will only be fired if she is caught shirking, which happens with probability $\mu_{i,j}^k$ when she does. The payoff of a worker hired by the formal channel is:

$$U_{i,j}^F = \left(1 - q_{i,j}^F\right) w^F - \gamma e_i^F$$

where γ is the per-unit cost of effort. However, a worker hired through a social network also feels peer pressure by members of her hiring channel not to compromise its reputation. Indeed, if she is caught shirking and fired, she will be punished by the network that served as hiring channel to an extent that depends on its tightness. Therefore the payoff of a worker hired by the informal channel is:

$$U_{i,j}^N = \left(1 - q_{i,j}^N\right) \left(w_{i,j}^N + \zeta_{i,j}\right) - \gamma e_i^N - q_{i,j}^N \varphi_{i,j}$$

where $\zeta_{i,j}$ is the non-monetary gain that a worker may derive from working with or for a member of her social networks. This parameter captures the benefits that the worker can get from being an active member of the network, including gifts in special occasions like weddings and various kinds of help.[22]

[22]The potential role played by non-pecuniary benefits is stressed in Fontaine [2007] and Bentolila et al. [2010]. It is likely that such benefits depend somehow on network tightness. However, the model is agnostic concerning the specific functional form describing this potential relationship, since the latter is far from being obvious. While this simplification

Lemma 1 (No-Shirking Conditions)**.** *When formal and informal channels are adopted the no-shirking conditions are respectively:*

$$\mu^F \geq \frac{\gamma e}{w^F} \tag{1.2}$$

$$\mu_{i,j}^N \geq \frac{\gamma(e + \delta\varphi_{i,j})}{w_{i,j}^N + \zeta_{i,j} + \varphi_{i,j}} \tag{1.3}$$

Proof is provided in the appendix. The no-shirking conditions (1.2) and (1.3) suggest that the intensity of monitoring that maximizes the firm's profit depends on the chosen hiring channel. This result is a direct consequence of the fact that the utility function of workers depends on their hiring channel. Indeed, when a social network is adopted as hiring channel, its tightness (as well as the cultural parameter δ) determines the level of monitoring inducing effort. Moreover, the larger the non-monetary benefit enjoyed by networked workers, the lower the monitoring needed to induce their effort.

It can be readily checked that no-shirking conditions (1.2) and (1.3) will hold as an equality, as this is the value of $\mu_{i,j}^k$ that maximizes the firm's profit per worker. Assuming that labor productivity is ϑ, and denoting ξ_j the unit cost of monitoring, the profit of firm j when hiring worker i through formal and informal channels are respectively:

$$\Pi_{i,j}^F = \vartheta e_i^F - \left(1 - q_{i,j}^F\right) w^F - \xi_j \mu^F$$

such that $e_i^F = e$ and $q_{i,j}^F = 0$ if $\mu^F \geq \frac{\gamma e}{w^F}$, and $e_i^F = 0$ and $q_{i,j}^F = \mu^F$ if $\mu^F < \frac{\gamma e}{w^F}$;

$$\Pi_{i,j}^N = \vartheta e_i^N - \left(1 - q_{i,j}^N\right) w_{i,j}^N - \xi_j \mu_{i,j}^N$$

such that $e_i^N = e + \delta\varphi_{i,j}$ and $q_{i,j}^N = 0$ if $\mu_{i,j}^N \geq \frac{\gamma(e+\delta\varphi_{i,j})}{w_{i,j}^N+\zeta_{i,j}+\varphi_{i,j}}$, and $e_i^N = 0$ and $q_{i,j}^N = \mu_{i,j}^N$ if $\mu_{i,j}^N < \frac{\gamma(e+\delta\varphi_{i,j})}{w_{i,j}^N+\zeta_{i,j}+\varphi_{i,j}}$.

entails that tightness explicitly appears only with a negative sign into the worker's utility function, the key point is of course accounting for the net impact of tightness on it.

Therefore, per worker profit when the firm hires through respectively formal and informal channel may simply be written as:

$$\Pi_j^F = \vartheta e - w^F - \xi_j \frac{\gamma e}{w^F} \tag{1.4}$$

$$\Pi_{i,j}^N = \vartheta(e + \delta\varphi_{i,j}) - w_{i,j}^N - \xi_j \frac{\gamma(e + \delta\varphi_{i,j})}{w_{i,j}^N + \zeta_{i,j} + \varphi_{i,j}} \tag{1.5}$$

which of course have to be non-negative, so that there exist a $w_{i,j\ max}^N$, a w_{min}^F, and a w_{max}^F.

In the sub-game perfect equilibrium, workers hired through formal and informal channels know that the firm will respectively choose $\mu^F = \frac{\gamma e}{w^F}$ and $\mu_{i,j}^N = \frac{\gamma(e+\delta\varphi)}{w_{i,j}^N + \zeta_{i,j} + \varphi_{i,j}}$, so that their payoff is in fact:

$$U^F = w^F - \gamma e \tag{1.6}$$

and

$$U_{i,j}^N = w_{i,j}^N + \zeta_{i,j} - \gamma(e + \delta\varphi) \tag{1.7}$$

We are now in a position to determine the bounds $\left[\underline{w}_{i,j}^N, \overline{w}_{i,j}^N\right]$ of the bargaining problem in proposition 1, whose proof is provided in the appendix.

Proposition 1 (Bargaining Set)**.** *The upper and lower bound of the bargaining set are determined as follows:*

1. *the firm prefers hiring through social networks worker i if $w_{i,j}^N \leq \overline{w}_{i,j}^N$, where $\overline{w}_{i,j}^N$ is the maximum of $w_{i,j}^N$ fulfilling:*

$$-\vartheta\delta\varphi_{i,j} + w_{i,j}^N + \xi_j \frac{\gamma(e + \delta\varphi_{i,j})}{w_{i,j}^N + \zeta_{i,j} + \varphi_{i,j}} \leq w^F + \xi_j \frac{\gamma e}{w^F} \tag{1.8}$$

2. *the worker will accept a job from the informal channel if:*

$$w_{i,j}^N \geq \underline{w}_{i,j}^N = w^F - \zeta_{i,j} + \gamma\delta\varphi_{i,j} \tag{1.9}$$

Proposition 1 thus specifies the acceptable range of values of the informal wage for making a transaction by this channel. If the monitoring cost is relatively low and the cultural context is such that workers hired through social networks are willing to exert extra effort to reciprocate ($\delta > 0$), the upper bound is increasing with network tightness, reciprocity, and productivity. If instead networked workers exert less effort than employees hired through the formal channel ($\delta < 0$), the upper bound is decreasing with network tightness, extent of favoritism (the absolute value of δ), and productivity.

At the other end of the range, the lower bound is smaller the larger the non-monetary benefits that the worker gets from this informal transaction. When workers hired through social networks are eager to reciprocate the working opportunity, the lower bound increases with network tightness, while it decreases when networked workers exert less effort.

1.3.2 The choice of the hiring channel

For the firm to hire through the informal channel, such a transaction must be worthwhile for both the firm and the worker. In other words, as a familiar saying suggests, 'it takes two for tango'. Figure 1.1, which depicts the set determined by proposition 1, makes clear that this condition may fail if either the firm, or the worker, is not interested in making that transaction. For example, if the market wage is higher than $\widehat{w}^F$, defined as the point where $\overline{w}^N_{i,j}$ and $\underline{w}^N_{i,j}$ coincide, workers do not want a job through social networks because firms are not willing to pay them enough through such a hiring channel. Only within the area labeled 'informal hiring channel' both sides are willing to use the informal channel. This remark allows us to establish the following proposition

Proposition 2 (Choice of Hiring Channel)**.** *When $\delta > 0$ (i.e., in a culture of gratitude),*

1. *informal hiring channels will be used:*

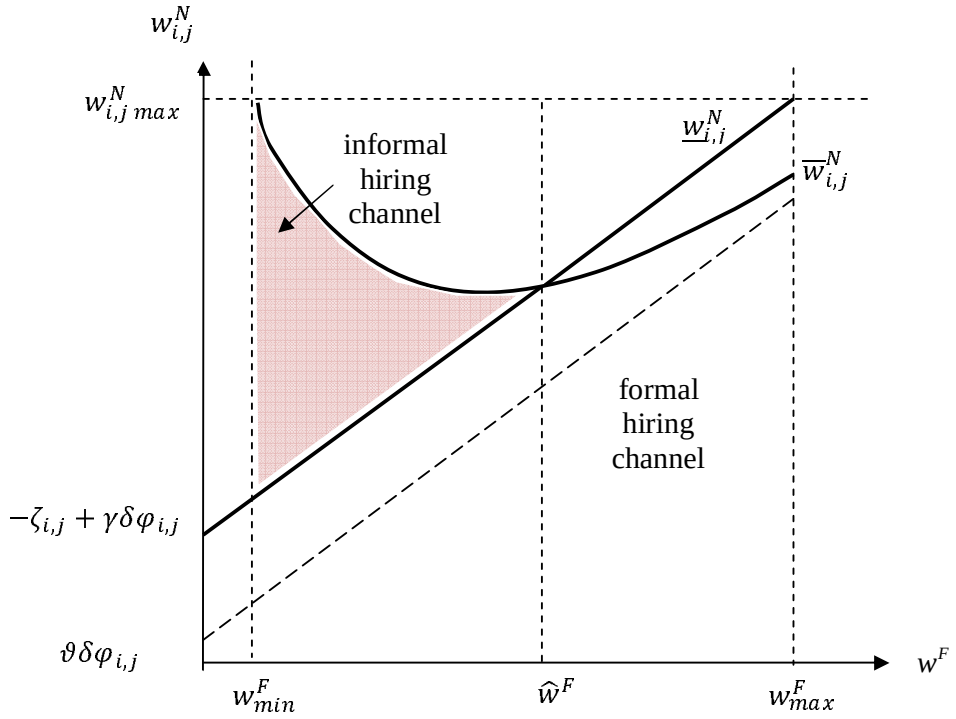

Figure 1.1: The choice of hiring channel and the wages of workers hired through formal and informal hiring channels.

- *always if* $\vartheta \geq \gamma - \zeta_{i,j}/\delta\varphi_{i,j}$, *or*
- *only when* w^F *is below the threshold level* $\widehat{w}^F$ *if* $\vartheta + \zeta_{i,j}/\delta\varphi_{i,j} < \gamma$;

2. *informal and formal hiring channels are indifferent if* $\vartheta + \zeta_{i,j}/\delta\varphi_{i,j} < \gamma$ *and* $w^F = \widehat{w}^F$;

3. *formal hiring channels will be used otherwise.*

When $\delta < 0$ *(i.e., in a culture of favoritism),*

1. *informal hiring channels will be used:*

   - *always if* $\gamma \geq \vartheta + \zeta_{i,j}/\delta\varphi_{i,j}$, *or*
   - *only when* w^F *is below the threshold level* $\widehat{w}^F$ *if* $\gamma - \zeta_{i,j}/\delta\varphi_{i,j} < \vartheta$;

2. *informal and formal hiring channels are indifferent if* $\gamma - \zeta_{i,j}/\delta\varphi_{i,j} < \vartheta$ *and* $w^F = \widehat{w}^F$;

3. *formal hiring channels will be used otherwise.*

Indeed, only informal hiring channel are used when the area labeled 'informal hiring channel' becomes open-ended, that is when either $\zeta_{i,j} > \varphi_{i,j}\delta(\gamma - \vartheta)$ or, if $\zeta_{i,j} \to 0$, when $\delta(\gamma - \vartheta) \leq 0$. Intuitively, the first condition suggests that social networks prevail as hiring channel when non-monetary gains from informal hiring are substantial. Since in developing countries social networks are often very important and informal exchanges widespread, the relative weight of non-monetary benefit versus salary may be substantial. Therefore, our theoretical framework predicts that informal hiring channels should be even more common in developing countries than in industrialized countries. At the same time, since the same non-monetary gain will impact on workers' utility more if their salary is lower, social networks should be more often adopted as hiring channel for less skilled jobs.

Even when networks do not provide a high non-monetary gain, only informal hiring channels are adopted if $\vartheta \geq \gamma$ when $\delta > 0$ and if $\gamma \geq \vartheta$ when $\delta < 0$. If the spread between productivity and cost of effort of a worker is increasing with her skills, our framework predicts that informal hiring channels should be preferred to fill skilled vacancies, when the culture is such that a worker hired through a social network reciprocates the working opportunity by exerting more effort than workers hired through the formal channel ($\delta > 0$). At the same time, in contexts of favoritism ($\delta < 0$) they should be preferred for unskilled jobs, while skilled vacancies should be filled through formal channels.

1.3.3 The wage differential

Figure 1.1 shows that the stronger the willingness to reciprocate a job opportunity obtained through social networks and the tightness of the social network adopted as hiring channel, the higher tends to be the wage of a worker hired through informal channels. The opposite is true the stronger the culture of favoritism and the tighter the social network adopted as hiring channel. The wage of a worker who found her job through a social network increases when

her bargaining power is strong (*i.e.*, $w_{i,j}^N$ close to $\overline{w}_{i,j}^N$) and decreases when it is weak (*i.e.*, $w_{i,j}^N$ close to $\underline{w}_{i,j}^N$). Moreover, when the bargaining power is limited, the salary earned by workers hired through the informal channel decreases with the non-monetary gain workers enjoy, while, if networked employees have strong bargaining power, the effect is weaker and the more so the larger the non-monetary gains.

We now formally assess when workers hired through the informal channel get a wage premium or a wage penalty with respect to employees hired through the formal channel.

Proposition 3 (wage differential)**.** *When $\delta > 0$,*

1. *both wage premium and penalty are possible, depending on the bargaining power, if $\zeta_{i,j} > \gamma\delta\varphi_{i,j}$;*
2. *only wage premium to workers hired through social networks is possible if $\zeta_{i,j} < \gamma\delta\varphi_{i,j}$.*

When $\delta < 0$,

1. *both wage premium and penalty are possible, depending on the bargaining power.*

Proposition 3 suggests that depending on the parameter values, informal hiring channels may have either positive or negative consequences on salaries, as hinted by the empirical literature discussed in section 1.1. In particular, wage penalties should be more likely in contexts of favoritism and wage premia in the opposite case.[23] Even in case of low bargaining power, workers hired through social networks earn for sure wage premia when they reciprocate the working opportunity by exerting more effort than workers hired through formal channels if non-monetary gain don't exist. In such a culture, the value of wage premia are *ceteris paribus* positively affected by network tightness and

[23]Interestingly enough, Pellizzari [2009] finds wage penalties in Italy and wage premia in countries like Belgium and the Netherlands.

the intensity of reciprocity. On the other hand, in contexts of favoritism, workers hired through informal hiring channels can get wage premia only if the bargaining power is particularly strong.

1.4 Econometric analysis of hiring channel choice and wage differentials

We exploit the Senegalese data to investigate the determinants of hiring channel choice and wage differentials imputable to the hiring channel.[24] A fundamental concern undermines the analysis: is the hiring channel choice exogenous to unobservable determinants of wage? If hiring channel and salary share some unobservable determinants, sample selection[25] biases the estimation of coefficients. If for instance less able individuals are more likely to be hired through social networks than through formal channels and therefore receive lower wages *ceteris paribus*, then failing to control for this correlation would yield biased estimates of the impact of hiring channel on wages.

Besides the potential sample selection bias, a further concern is that the hiring channel may have an indirect impact on the salary through the standard wage determinants. For example, the role played by a worker's education on her wage may be weaker for an applicant hired through social networks than for one hired on the formal labor market. The econometric framework addressing at the same time the endogenous sample selection and the switching impact that wage determinants may have for workers hired through different channels is the endogenous switching model (see Heckman [1979]). Roughly speaking, it is a treatment effect model that allows for a full set of interaction terms between the hiring channel and the standard determinants of wage. Some

[24] It would be very interesting to test our theoretical insights concerning the role played by informal hiring channels in different institutional contexts, but a systematic cross-country comparison is beyond the purposes of this paper.

[25] Sample selection is an issue because we observe wages of workers hired through a social network only when they were hired through that channel (and never if they were hired through formal channels).

details on the endogenous switching econometric model are given in appendix.

1.4.1 Specification of estimation

To take advantage of the richness of the available data, we take into account not only variables at the individual level as in the standard endogenous switching model, but also firms' characteristics.[26] Therefore, the system of equations of interest is as follows:

$$ln\ w_{i,j}^{F} = \beta_{worker}^{F} X_i + \beta_{firm}^{F} \Xi_j + \epsilon_{i,j}^{F} \tag{1.10}$$

$$ln\ w_{i,j}^{N} = \beta_{worker}^{N} X_i + \beta_{firm}^{N} \Xi_j + \epsilon_{i,j}^{N} \tag{1.11}$$

$$H_{i,j}^{*} = \gamma Z_{i,j} + u_{i,j} \tag{1.12}$$

where the dependent variable of the wage regressions is the natural logarithm of the real monthly wage, X_i are the regressors at worker i level, Ξ_j the characteristics of firm j, and $Z_{i,j}$ includes X_i, Ξ_j and variables that allow identification. In particular, the vector X_i is represented by worker i's years of education and experience before the current job, gender, marital status, place of origin, number of hours worked per week,[27] type of vacancy filled when hired, whether worker i is a relative of firm's manager or owner, or does not, but belongs to her ethnic group. The vector Ξ_j includes firm j's size, sector, and three dummy variables taking unit value respectively if firm j is located in Dakar, if a large share of its capital belongs to the State, and if its owner personally

[26] Since our focus is on the choice of the hiring channel, variables should refer to the hiring time of each worker. Even though some variables explicitly refer to that time (hiring channel, type of job, salary and previous experience), the large majority of them concerns the year of the survey. However, some information obtained in 2003 may well approximate several variables at the hiring time. For instance, the years of education declared at the time of the survey are likely to correspond to the years of education at hiring time. Therefore, we assume that some variables at the firm (size, sector, location, public capital, and whether the director is also the owner) and the worker (years of education, hours of work and marital status) level are good proxies for their value at the time hiring occurred.

[27] We run the same estimation using the hours of work per week to obtain the wage rates from the monthly salaries. The results are very similar. However, we present the results obtained for monthly wages in order to avoid any concern of propagation of potential measurement errors from hours of work to the dependent variable.

runs the firm.

While the available data allow controlling for a great variety of observable characteristics both at worker and firm level, it may still be the case that some unobserved characteristics differ between individuals hired through different hiring channels. The best available exclusion restriction is a dummy taking unit value when a worker was over 40 years old when hired. The identifying assumption is that this variable is legitimately excluded from wage regressions (1.10) and (1.11), but significant in the selection equation (1.12). While by definition this hypothesis is not testable, economic reasoning supports our choice of this exclusion restriction. Indeed, it is standard to posit that age should not be relevant in a wage determination once experience and education are accounted for.[28] The hypothesis that that relatively old people looking for a job are more likely to be hired through informal rather than formal channels is supported by evidence in Delattre and Sabatier [2007] and it is consistent with our theoretical framework in contexts of favoritism.[29]

Finally, the observed dichotomous realization of the latent variable $H^*_{i,j}$ is whether each sampled worker was hired through social networks ($H_{i,j} = 1$) or not ($H_{i,j} = 0$):

$$H_{i,j} = \begin{cases} 1 & if\ H^*_{i,j} > 0 \\ 0 & otherwise \end{cases}$$

1.4.2 Econometric results

Table 1.3 shows the results for the simultaneous estimation of equations (1.10), (1.11), and (1.12). The first part of the table reports the coefficients of the determinants of the hiring channel, which correspond to the vector of parameters γ in equation (1.12). The determinants of salary for workers hired through

[28] Hayashi [2000] precisely cites age as example of a good instrument for wage regressions that include education and experience in the section dedicated to endogeneity bias of his textbook on Econometrics (pages 199-200).

[29] Indeed, the burden of reconversion tends to decrease the spread between their productivity and their cost of effort with respect to younger applicants. Moreover, it is also possible that people over 40 have tight social networks available, so that $\gamma \geq \vartheta + \zeta_{i,j}/\delta\varphi_{i,j}$ is likely to more strongly hold than for younger workers.

social networks, corresponding to β^Ns in equation (1.11), are reported in the second part of the table in the first column. Those for employees hired through formal channels, corresponding to β^Fs in equation (1.10), are presented in the second column.

Table 1.3 clearly indicates that the use of social networks as hiring channel greatly varies with the type of vacancy to be filled, a stylized fact described in section 1.1. Unskilled workers have a significantly higher probability of being hired through social networks than skilled blue collars (the category of reference), while the opposite is true for skilled white collars. Such result verifies the theoretical implications of the model that are developed in section 1.3.2. If the spread between productivity and cost of effort of workers is decreasing with their skills, and the potential non-monetary gains quite large with respect to unskilled workers' monetary wage, networks are likely to be adopted as hiring channel despite favoritism, while the opposite is true for skilled white collar workers. Managers are not significantly more likely to be hired through formal rather than informal channels, probably because the two countervailing effects, namely large non-monetary benefits and high productivity combined with very costly monitoring, compensate each other.

The coefficients of the wage regressions show that a worker earns significantly more if hired as manager or a skilled white collar and less if hired as unskilled worker than if she is hired as skilled blue collar, consistently with what intuition suggests, whatever the hiring channel. However, the magnitude of the coefficients differs between hiring channels, a point that we will further investigate later on in this section.

One peculiar determinant of the salary is the type of social network whereby a worker was hired. A relative of the owner or manager of the firm *ceteris paribus* has significantly greater chances of being hired through informal hiring channels. At the same time, relatives suffer a substantial wage penalty.[30]

[30]Since we do not separately observe the hiring choices of firms and applicants, but only the outcome of their joint decisions (*i.e.*, that someone is working for a firm), some caution

Table 1.3: Endogenous switching model: determinants of the choice of hiring channel and of the wage for workers hired through formal and informal hiring channels.

Choice of informal hiring channel				
job: manager	-0.458	(0.287)		
skilled white collar	-0.336**	(0.145)		
unskilled	0.252**	(0.112)		
same family as firm's head	0.476***	(0.151)		
only same ethnicity as firm's head	0.081	(0.154)		
education (years)	-0.030**	(0.012)		
previous experience (years)	-0.063***	(0.019)		
previous experience sq. (years)	0.002***	(0.001)		
age over 40 at hiring	0.304**	(0.141)		
origin: Dakar	-0.054	(0.265)		
other in Senegal	-0.215	(0.266)		
married	0.108	(0.092)		
gender: male	-0.042	(0.114)		
hours worked	0.005	(0.005)		
firm located in Dakar	-0.397*	(0.211)		
ln of n.employees	-0.110***	(0.039)		
owner and director	0.110	(0.110)		
TFP at hiring	0.015	(0.156)		
public firm	0.051	(0.253)		
intercept	1.260***	(0.469)		
sector dummies	yes			
Wage regression				
for workers hired through:	social networks		formal channel	
job: manager	0.629*	(0.335)	0.486***	(0.107)
skilled white collar	0.436***	(0.138)	0.197**	(0.101)
unskilled	-0.434***	(0.075)	-0.192**	(0.087)
same family as firm's head	-0.297**	(0.133)	-0.216*	(0.115)
only same ethnicity as firm's head	0.025	(0.089)	0.178	(0.113)
education (years)	0.040***	(0.010)	0.057***	(0.009)
previous experience (years)	0.043***	(0.017)	0.025*	(0.015)
previous experience sq. (years)	-0.002**	(0.001)	-0.001	(0.001)
origin: Dakar	0.134	(0.217)	0.040	(0.259)
other in Senegal	0.100	(0.074)	0.044	(0.257)
married	0.100	(0.074)	0.162***	(0.066)
gender: male	-0.019	(0.083)	0.064	(0.087)
hours worked	0.000	(0.003)	0.003	(0.004)
firm located in Dakar	0.654***	(0.215)	0.721***	(0.190)
ln of n.employees	0.132***	(0.032)	0.058**	(0.029)
owner and director	-0.126*	(0.073)	-0.052	(0.073)
TFP at hiring	0.360***	(0.120)	0.477***	(0.126)
public firm	-0.037	(0.230)	-0.010	(0.131)
intercept	9.675***	(0.328)	9.000***	(0.398)
sector dummies	yes		yes	
ρ_N	-0.747***	(0.256)		
ρ_F	-0.142	(0.270)		
Log-likelihood	-1844.84			
Wald χ^2_{26}	128.49			
N	1139			

Note: Robust Standard Errors in brackets, clustered by firm.
Significance levels: *: 10% **: 5% ***: 1%.

The role played by kinship, possibly the tightest existing network, reflects the theoretical prediction of our framework that the tighter the social network that serves as hiring channel, the larger the potential wage penalties suffered by networked workers, in contexts where favoritism is widespread.

Longer education is associated with a lower probability of being hired through social networks and the use of informal hiring channels is a decreasing and convex function of experience prior hiring.[31] This feature is consistent with the prediction of our theoretical framework that larger productivity increases the incidence of formal channels. Education and experience, the classical Mincerian wage determinants, as expected significantly increase wages, whatever the hiring channel whereby a worker was hired.

An interesting result is that, even controlling for workers' experience, people over 40 years old are significantly more likely to have found their job through informal rather than formal channels. Our theoretical framework helps to intuitively understand the widely recognized phenomenon that elder people seldom get a job on the formal labor market. In fact, the burden of reconversion of their competences, which is required by a new working environment, tends to increase their cost of effort with respect to younger workers, so that formal hiring channels are hardly used despite favoritism, while peer pressure consequent to the adoption of informal hiring channels may compensate it.

We control for marital status, which is not a significant determinant of the hiring channel and does not affect wages of workers hired through social networks. However, workers hired on the formal labor market enjoy significantly higher wages if they are married.[32] Workers' gender, place of origin, and hours worked per week are maintained as control variables at the individual level, but they are never significant.

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is needed in interpreting these results. However, the magnitude of coefficients undoubtedly points to their consistency with a context of favoritism.

[31] The same result is found for example by Pistaferri [1999].

[32] An intriguing interpretation is that the network that has served as hiring channel constitutes a guarantee of trustworthiness, substituting marital status in the formal labor market.

Table 1.3 also shows that there are a number of firms' characteristics affecting the choice of the hiring channel and the wage. The location of a firm in Dakar rather than in other towns decreases the likelihood of hiring somebody through informal hiring channels.[33] At the same time, employees working in a firm in Dakar gain significantly higher wages.[34]

The size of the firm, in terms of total number of employees, has a significantly negative impact on the probability of being hired through informal channels and a positive one on wages.[35] This is consistent with our theoretical predictions, since in small firms the recruiter and the employees tend to work closely, while in large firms peer pressure is less effective.

Workers employed by a firm run by its owner are not significantly more likely to be hired through social networks, but they earn less *ceteris paribus*. Indeed, a manager may get positive utility out of hiring people belonging to her social networks, even in cases when the choice of informal hiring channels does not maximize the firm's expected profit, and may hire too often workers through their social networks. Instead, the utility of a director who is also the owner directly depends also on firm profit and principal-agent distortions are avoided: she uses her social networks as hiring channel only when convenient and she pays her networked employees what is needed to induce their effort and not more than that.

To account for time effects due to the fact that surveyed workers were hired in different years, we control for the total factor productivity change, which is as expected positively strongly correlated with salaries. Finally, we control for firms' public capital and sector.

[33]This finding is coherent with the view that big cities entail weaker social networks, an idea that dates back to the nineteenth century (see Tönnies [1887] and Simmel [1903]) and was developed by the social disorganization theory (see Wirth [1938], Redfield [1947] and Alexander [1973]) and the overload theory (see Milgram [1970]). For a short and enlightening discussion on the topic in sociology, see Amato [1993].

[34]While the qualitative result is intuitive, the magnitude of the coefficients needs to be taken *cum grano salis*, since 96% of sampled employees work in Dakar.

[35]Pistaferri [1999] also finds that large firm are less likely to hire through informal channels and pay higher wages. More in general, the fact that larger firms tend to pay higher wages is a well-established finding (see for instance Oi and Idson [1999]).

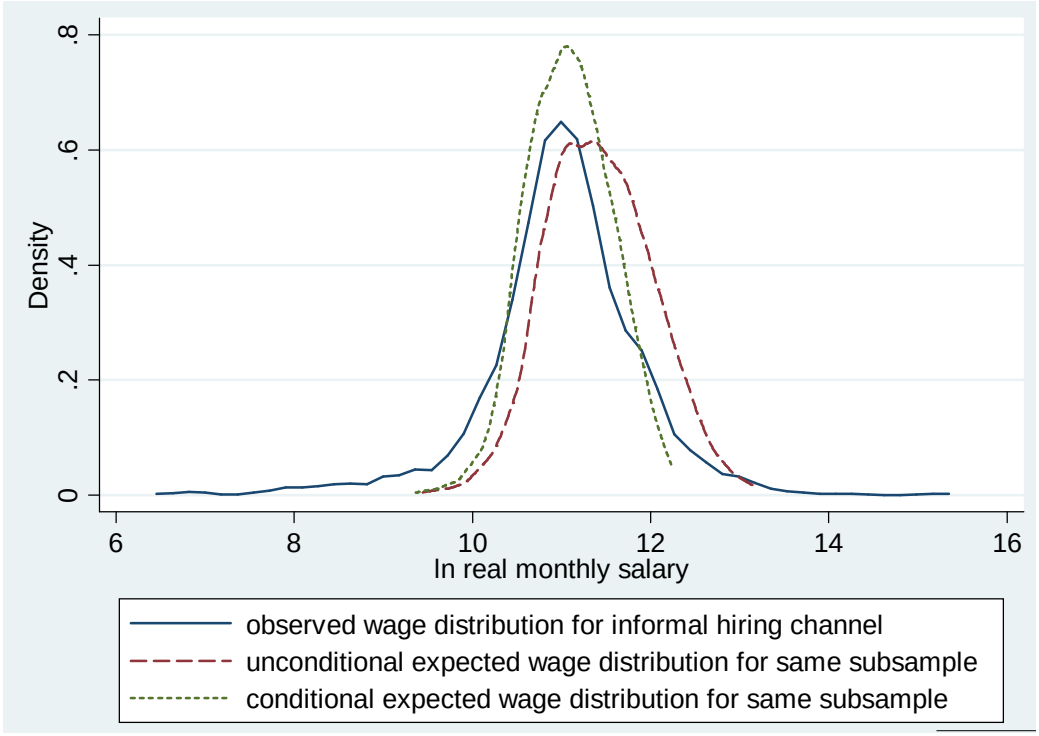

Figure 1.2: True distribution of wages for workers hired through informal hiring channels and distribution of unconditional and conditional expected wages for the same subsample of workers.

At the bottom of Table 1.3 are reported the estimated correlation coefficients between residuals of the regression for the choice of the hiring channel and for wages. The correlation between the residuals of the selection equation (1.12) and the wage regression for workers hired through formal channels (1.10), ρ_F, is not significantly different from zero. However, the correlation between the residuals of the selection equation and the wage regression for workers hired through informal channels (1.11), ρ_N, is significantly negative. Therefore, selection is endogenous and, in particular, workers hired through social networks *ceteris paribus* suffer a significant wage penalty due to unobservable determinants.

A visual way to see the wage penalty due to unobservable factors that is suffered by workers who got their job through social networks is to compare the true distribution of wage earned by workers hired through informal channels with the unconditional expected wage for the same subsample, *i.e.*, $\mathbb{E}\ (ln\ w_{i,j}^N) = \widehat{\beta}_{worker}^N X_i + \widehat{\beta^N}_{firm} \Xi_j$. Figure 1.2 shows that the true distri-

Table 1.4: Switching impact of the hiring channel on wages: difference between estimated coefficients of wage determinants for workers hired through informal and formal channels.

$\widehat{\beta}^N - \widehat{\beta}^F$		
job: manager	0.143	(0.428)
skilled white collar	0.239	(0.210)
unskilled	-0.242**	(0.113)
same family as firm's head	-0.082	(0.254)
only same ethnicity as firm's head	-0.153	(0.175)
education (years)	-0.017	(0.056)
previous experience (years)	0.018	(0.040)
previous experience sq. (years)	-0.001	(0.002)
origin: Dakar	0.094	(0.328)
Senegal	0.056	(0.425)
married	-0.062	(0.119)
gender: male	-0.083	(0.134)
hours worked	-0.004	(0.028)
firm located in Dakar	-0.067	(0.335)
ln of n.employees	0.074	(0.078)
owner and director	0.074	(0.110)
TFP at hiring	-0.117	(0.170)
public firm	-0.027	(0.239)
intercept	0.675	(2.538)

Note: Bootstrap Standard Errors in brackets.
Significance levels: *: 10% **: 5% ***: 1%.

bution of wages of the subsample of workers hired through informal channels is shifted towards lower wages with respect to the unconditional wage distribution predicted for the same workers. However, the distribution of expected wages for the subsample of workers hired through social networks conditional on the dependent variable being observed, *i.e.*, $\mathbb{E}\ (ln\ w^N_{i,j}|H_{i,j} = N) = \widehat{\beta}^N_{worker}X_i + \widehat{\beta}^N_{firm}\Xi_j + \widehat{\sigma}_N\widehat{\rho}_N f(\widehat{\gamma}Z_{i,j})/F(\widehat{\gamma}Z_{i,j})$, fits quite well the true distribution of wages for the same subsample. The difference between the unconditional and the conditional expected wage distribution is precisely the negative selection effect of informal hiring channels.

In order to reach a conclusion about whether overall informal hiring channels imply on average wage penalties in the Senegalese manufacturing sector, the switching impact of observable wage determinants has to be taken into account, too. We therefore compare the estimated parameters $\widehat{\beta}^N$ and $\widehat{\beta}^F$ of Table 1.3 to asses whether the differences are statistically significant. Table 1.4 shows that informal hiring channels also entail a wage penalty due to

observable determinants, but only through the switching impact of unskilled jobs.

Jointly considering our results concerning the unobservable and observable wage determinants for workers hired through social networks and formal channels, we can conclude that the former ones suffer a significant wage penalty.

1.5 Conclusions

This paper sheds light on the role played by social networks as hiring channel and on wage differentials between employees hired through formal and informal hiring channels. It contributes to the theoretical literature on informal hiring channels and to the empirical literature on social networks as hiring channels in developing countries.

From a theoretical point of view, we focus on the role played by moral hazard and allow for heterogeneity of networks' tightness. Our framework helps to interpret the fact that firms and workers rely sometimes on formal hiring channels and sometimes on informal ones and the rather mixed findings of the empirical literature on the impact that the hiring channel has on wages. In particular, the choice of the hiring channel varies with country's development and culture, with the characteristics of networks available as hiring channel and with the type of vacancy to be filled. In contexts of favoritism social networks are predicted to be mainly adopted as hiring channel to fill unskilled vacancies; moreover, such jobs may be associated with wage penalties and the more so the tighter the network that served as hiring channel. However, when skilled workers are hired through informal hiring channel, they are likely to get wage premia, and the more so the tighter the network. The opposite is predicted to happen in a culture where reciprocity prevails.

We empirically verify the implications of the model in the particularly interesting case of the Senegalese formal manufacturing sector. While the analysis of a single country does not allow to study the relationship between the de-

velopment of formal institutions and the use of informal hiring channels, this paper could be the first step in further research on the cross-country analysis, since similar surveys exist for many countries. Our econometric results support the theoretical predictions that, conditional on being employed, when favoritism is widespread social networks are often exploited as hiring channel for unskilled jobs and when non-monetary gains are likely to be large, like in the case of relatives of the firm's head or in small firms. Formal hiring channels are instead adopted for filling skilled vacancies and when the required competences are higher. Finally, we find that workers hired through whatever informal channel suffer a wage penalty. Wage determinants are the standard ones (worker's education, experience and type of job, and firm's location and size), but belonging to a very tight network decreases wages, which of course may be at least partly compensated by larger non-monetary gains.

From a policy perspective, it is therefore important not only to investigate whether workers hired through social networks have wage penalties or premia imputable to their hiring channel, but also to understand the extent of non-monetary benefits that they may enjoy. Moreover, wage differentials crucially depend on the bargaining power of workers and firms, so that the latter could represent a lever for policy intervention. In conclusion, informal hiring channels may be beneficial for everyone, but it is necessary to make sure that employment is accessible through formal channels as well.

Further research could take into account some peculiar features implied by the use of the extended family as a hiring channel. For instance, family ties not only are very tight, but also provide almost full commitment among its members. If the chief of a firm guarantees employment to her relatives, the pooling of business risk[36] within the family should be considered, too. A fundamental step would be taking into account the multi-dimensionality of concerns arising from incompleteness of information in the labor market

[36]Several empirical studies find evidence of risk pooling within highly clustered networks in African countries (see for example Barr and Genicot [2008]).

and developing a theoretical framework that takes simultaneously into account moral hazard and selection problems. The predictions of a such model could then be empirically tested in order to disentangle the relative weight of the two.

Theoretical Appendix

Proof of lemma 1. Worker i chooses whether to shirk (*i.e.*, $e_i^k = 0$) or not (*i.e.*, $e_i^F = e$ or $e_i^N = e + \delta\varphi_{i,j}$) by maximizing her utility.

If she was hired through formal channels, she does not shirk if $w^F - \gamma e \leq \left(1 - \mu^F\right) w^F$. Therefore, the no-shirking condition for workers hired on the formal labor market is (1.2).

If she was hired through a social network, she does not shirk if $w_{i,j}^N + \zeta_{i,j} - \gamma(e + \delta\varphi_{i,j}) \leq \left(1 - \mu_{i,j}^N\right)(w_{i,j}^N + \zeta_{i,j}) - \mu_{i,j}^N \varphi_{i,j}$, *i.e.*, if condition (1.3) is satisfied. □

Proof of proposition 1. For informal hiring channel to arise, both the firm and the worker should prefer it:

1. the firm prefers hiring worker i through social networks, if per worker profits when hiring through informal channels (1.5) are greater than or equal to per worker profits when hiring through formal ones (1.4):

$$\vartheta(e + \delta\varphi_{i,j}) - w_{i,j}^N - \xi_j \frac{\gamma(e + \delta\varphi_{i,j})}{w_{i,j}^N + \zeta_{i,j} + \varphi_{i,j}} \geq \vartheta e - w^F - \xi_j \frac{\gamma e}{w^F}$$

   Therefore,

$$-\vartheta\delta\varphi_{i,j} + w_{i,j}^N + \xi_j \frac{\gamma(e + \delta\varphi_{i,j})}{w_{i,j}^N + \zeta_{i,j} + \varphi i, j} \leq w^F + \xi_j \frac{\gamma e}{w^F}$$

   and $\overline{w}_{i,j}^N$ is the maximum of $w_{i,j}^N$ fulfilling this condition.

2. the worker will accept a job from the informal channel if her utility (1.7)

is greater than or equal to what she could get if she was hired through the formal channel (1.6):

$$w_{i,j}^{N} + \zeta_{i,j} - \gamma(e + \delta\varphi) \geq w^{F} - \gamma e$$

Therefore:

$$w_{i,j}^{N} \geq \underline{w}_{i,j}^{N} = w^{F} - \zeta_{i,j} + \gamma\delta\varphi_{i,j}$$

□

Table 1.5: Description of variables used in the theoretical framework (section 1.3).

	Variable	Support	Index
k	Hiring channel	$k \in \{F, N\}$	
η_i	Worker's bargaining power	$0 \leq \eta_i \leq 1$	$i = 1, ..., n$
γ	Worker's cost of effort	$\gamma > 0$	
e_i^k	Worker's effort	$e_i^F \in \{0, e\}$, $e_i^N \in \{0, e + \delta\varphi_{i,j}\}$	$k \in \{F, N\}$ and $i = 1, ..., n$
ϑ	Productivity of effort	$\vartheta > 0$	
$\zeta_{i,j}$	Non-monetary benefit	$\zeta_{i,j} \geq 0$	$i = 1, ..., n$ and $j = 1, ..., m$
$\varphi_{i,j}$	Network tightness	$0 < \varphi_{i,j} \leq 1$	$i = 1, ..., n$ and $j = 1, ..., m$
δ	Cultural factor	$\delta \in (-\infty, +\infty)$	
$\mu_{i,j}^k$	Probability of monitoring	$0 \leq \mu_{i,j}^k \leq 1$	$k \in \{F, N\}$, $i = 1, ..., n$ and $j = 1, ..., m$
ξ_j	Unit cost of monitoring	$\xi_j > 0$	$j = 1, ..., m$
$q_{i,j}^k$	Probability of firing	$0 \leq q_{i,j}^k \leq 1$	$k \in \{F, N\}$, $i = 1, ..., n$ and $j = 1, ..., m$
$w_{i,j}^k$	Worker's salary	$w_{i,j}^k > 0$	$k \in \{F, N\}$, $i = 1, ..., n$ and $j = 1, ..., m$

Empirical Appendix

Endogenous switching models can be estimated one equation at a time either by two-step least square or maximum likelihood estimation. However, both of these estimation methods are inefficient. An efficient alternative is the full information maximum likelihood method (FIML) that simultaneously estimates binary and continuous parts of the model.[37] Endogenous switching models de-

[37]FIML involves forming the joint distribution of the random variables characterizing the equations of the model and then maximizing the full log-likelihood function. In this paper

scribe the behavior of an agent with two regression equations, and a criterion function that determines which regime of wages the agent faces:

$$ln\ w_i^F = \beta^F X_i + \epsilon_i^F \tag{1.13}$$

$$ln\ w_i^N = \beta^N X_i + \epsilon_i^N \tag{1.14}$$

$$H_i^* = \gamma Z_i + u_i \tag{1.15}$$

where w_i^F is the wage of individual i who was hired through a formal channel, while w_i^N is the wage of individual i who was hired through some social network. H_i^* is the latent variable that determines the hiring channel of individual i. X_i is a vector of individual characteristics that is thought to influence the individual wage, while Z_i is a vector of characteristics that influences the decision regarding the hiring channel. The parameter vectors are β^N, β^F, and γ. Finally, ϵ_i^F, ϵ_i^N, and u_i are the disturbance terms. Notice that the impact of the hiring channel does not show up as a dummy variable in wage regressions, but rather in the fact that the constant term and the β-parameters may differ between the sample of workers hired through formal channels and the sample of workers hired through social networks (*i.e.*, $\beta^N \neq \beta^F$). The difference in the constants yields the difference in average wages if a networked and a formally hired worker had $X_i = 0$. The difference in the β-parameters represents how the returns to different observable wage determinants vary depending on the hiring channel. The observed dichotomous realization (H_i) of the latent variable H_i^* determining the hiring channel of individual i has the following form:

$$H_i = \begin{cases} 1 & if\ H_i^* > 0 \\ 0 & otherwise \end{cases} \tag{1.16}$$

As in any model entailing latent variables, it is necessary to take care of

the estimation of the switching regression model and the counterfactuals are based on the FIML algorithm implemented as a Stata program (movestay) by Lokshin and Sajaia [2004].

identification. Endogenous switching models are identified by construction through non-linearities introduced by the selection equation (1.15). However, the goodness of estimations completely relies on the parametric assumptions about the distribution of error terms. Therefore, it is often preferred to add one or more exclusion restrictions. They are imposed by the researcher, based on economic intuition. By their very nature, exclusion restrictions are not testable, but indirectly. Therefore, Z_i may include some or all variables in X_i, plus at least one additional variable that is legitimately excluded in wage regressions (1.13) and (1.14).

The main assumption of FIML is that ϵ_i^F, ϵ_i^N, and u_i have a trivariate normal distribution, with mean vector zero and covariance matrix Ω as follows:

$$\Omega = \begin{bmatrix} \sigma_u^2 & . & . \\ \sigma_{uF} & \sigma_F^2 & . \\ \sigma_{uN} & . & \sigma_N^2 \end{bmatrix}$$

where σ_u^2 is the variance of the error term in the selection equation (1.15), and σ_F^2 and σ_N^2 are the variances of the error terms in the regression equations (1.13) and (1.14,) respectively. σ_{uF} is the covariance of u_i and ϵ_i^F, and σ_{uF} is the covariance of u_i and ϵ_i^N. The covariance between ϵ_i^F and ϵ_i^N is not defined, as w_i^F and w_i^N are never observed for the same worker.

To see whether sample selection is endogenous or exogenous, the correlation coefficients between residuals in each of the wage regressions and the hiring channel choice are estimated. The correlation between residuals in equation (1.13) and (1.15) is designated by ρ_F:

$$\rho_F = \frac{\sigma_{uF}}{\sigma_u \sigma_F} \tag{1.17}$$

and the correlation between residuals in equation (1.14) and (1.15) by ρ_N:

$$\rho_N = \frac{\sigma_{uN}}{\sigma_u \sigma_N} \tag{1.18}$$

If the unobserved factors determining the hiring choice are not correlated with unobserved determinants of wage, the selection is exogenous. In this case, the sorting into workers hired through formal and informal channel is random and there is no risk of a sample selection bias. The adoption of an endogenous switching model provides also crucial information concerning the indirect impact of the hiring channel on wages. Indeed, the switching model estimates a full set of interaction terms between the hiring channel of each worker and the impact of education, experience, and the other regressors in the wage equations. Therefore, for each wage determinant it is possible to assess whether its impact is dependent or independent of the channel whereby workers were hired. The combination of the switching impact of observable determinants of wage and the unobserved factors allows to draw a conclusion concerning the existence of a wage penalty or premium to workers hired through social networks.

Table 1.6: Description of variables used in the empirical analysis (sections 1.2 and 1.4).

Variables	Description
Firms:	
Sector	Categorical variable indicating the manufacturing sector to which a firm belongs
Location	Dummy variable indicating whether a firm is located in Dakar or elsewhere
Public firms	Dummy variable categorizing a firm as public if more than 45% of its capital belongs to State
Owner and director	Dummy variable indicating whether the owner of a firm is also its director or manager
Mainly informal hiring channels	Number of firms that declared to mainly hire through informal channels
Number of employees	Number of employees working in a firm
Workers:	
Education	Number of years of education
Previous experience	Number of year of experience before being hired in current firm
Age	Worker's age at hiring time
Gender	Dummy variable indicating worker's gender
Origin	Categorical variable indicating worker's place of origin
Marital status	Dummy variable indicating whether a worker is married
Same ethnicity as firm's head	Dummy variable indicating whether a worker belongs to the same ethnic group as the owner or the manager running the firm
Same family as firm's head	Dummy variable indicating whether a worker belongs to the extended family of the owner or the manager running the firm
Job	Categorical variable indicating the type of job for which a worker was hired
Hours worked	Number of hours worked per week
Ln real monthly salary	Natural logarithm of worker's monthly salary when she was hired, adjusted for HCPI
Hiring channel	Dummy variable stating whether a worker was hired through social network

Chapter 2

Professional Network and Career Coevolution [1]

2.1 Introduction

Wages and professional progression are determined by individual observable characteristics and ability, but crucially depend on career paths as well. While many elements contribute to the emergence of professional opportunities and individual decisions, this paper sheds light on the coevolution of career and professional networks. Particular attention is devoted to understanding the factors determining the decisions at the turning points of one's career.

Careers are shaped by a succession of professional opportunities and mobility decisions. Career developments are often relatively smooth, entailing gradual promotions or changes of responsibilities and duties within the current firm. However, at several points in time opportunities may arise that would modify the *ex ante* direction, as if turning points in a road network. These represent discontinuous jumps in the career trajectory and each decision of changing job affects a worker's future offers.

What characterizes career progression is its dynamic dimension: choices at each switching point affect subsequent decisions. What's more, each choice

[1] Coauthored with Paul Seabright.

influences the opportunities that will arise in the future both directly and indirectly. Indeed, not only the type of offers potentially available at each point in time depends on one's current and past jobs, but crucially the probability of receiving an offer may be also affected by one's professional previous history through the characteristics of the network that each worker builds in her professional environment. In turn, when a worker decides to change job, her network is affected, so that professional network and career actually coevolve.

Understanding the relationship between networks and career evolution is a crucial step to embed economic decisions in their social context. The necessity to take into account the embeddedness of the economic agent in her social relationships has long been recognized (see Granovetter [1973]). In particular, professional networks are believed to crucially determine labor outcomes.[2] However, relatively little progress has been achieved in empirically identifying the role of social networks in labor markets.[3] The main reason limiting progress in the integration of social and economic phenomena is the extraordinary complexity of their interactions, coupled with scarcity of suitable data. The relationship between network and labor outcomes is no exception and it is characterized by multiple mechanisms and dynamic coevolution.

The most obvious mechanism whereby the characteristics of professional networks affect the career is that they are privileged channels of information diffusion.[4] They facilitate the spreading of awareness of new vacancies and they also reduce the imperfect information affecting labor markets.

There is at least a second way whereby professional networks influence labor outcomes and in particular the decision to change job. In fact a worker's

[2]"Headhunters, who select most of those who fill the positions in FTSE boardrooms, are increasingly using a service called BoardEx to judge candidates. (...) it profiles 380,000 businessmen and analyses their personal contacts", The Times, 11^{th} March 2010.

[3]Many wish further empirical study of the role of social networks in the functioning of labor markets (see for instance Fafchamps et al. [2010]). In the words of Calvó-Armengol [2006]: "micro details of network characteristics and structure are predicted to matter in shaping outcomes, but there are virtually no empirical studies that take them into account".

[4]In the words of Jackson [2006]: "The most obvious and perhaps pervasive role of network is as a conduit of information, and one of the most extensively documented role for social networks in economics is that of contacts in labor markets."

network is likely to represent a valuable asset in the eyes of an employer.[5] A potential employer may indeed take into account the characteristics of professional contacts of a worker who could join the firm. In particular, valuable links from the point of view of the potential employer are especially the connections with previous colleagues that represent contacts outside the firm.

From a theoretical point of view we therefore take into account that professional networks are likely to affect labor outcomes through multiple channels. At the same time a worker's network is substantially shaped by career choices, so that labor outcomes and networks coevolve and it is necessary to treat the decisions along the career path dynamically. Thus, in our theoretical framework, career choices and in particular the decision to change job result from a recursive optimization.

From an empirical point of view, the analysis is based on an original unbalanced panel dataset describing the career history of more than 90 thousand Executives and Board Members working in almost 4 thousand firms in 4 counties (US, UK, France, and Germany) between 1997 and 2009.[6] The richness of the dataset allows to account for the dynamic aspects of the relationship between professional networks and career progression, exploiting the panel dimension of the dataset.

Our econometric analysis focuses on the effects of the professional network on salary. Based on the benchmark specification suggested by our theoretical framework, we find that professional networks are relevant both because they are valuable for the employer and because they facilitate job mobility. These findings are robust to alternative definitions of career value and specifications accounting for mobility and link endogeneity. We also find that contemporaneous colleagues are not useful channels of information transmission about job opportunities, nor valuable for the employer. Moreover, networks character-

[5]Glaeser et al. [2002] define "individual social capital as a person's social characteristics - including social skills, charisma, and the size of his Rolodex - which enables him to reap market and non-market returns from interactions with others".

[6]The dataset is based on information provided by BoardEx Ltd.

ized on average by ties between nodes that have been colleagues for a long time have a lower direct and indirect effect on labor outcomes. Finally, networks where many links are represented by workers that have been colleagues a long time before are less valuable to the employer.

This paper contributes to several strands of research. First, it enriches from a theoretical and empirical point of view the literature looking at the role of social networks in labor outcomes. Doing so, the paper contributes to the personnel economics literature on career dynamics. Moreover, it also concurs to the literature on social capital in the sense of Coleman [1988].[7] Finally, the paper contributes to the theoretical and empirical literature on Top Management and Board Members remuneration and mobility.

2.2 Literature review

The network literature is growing literally exponentially. The boom in network research has been seen as part of a general shift, beginning in the second half of the 20^{th} century, away from individualist, essentialist and atomistic explanations toward more relational, contextual and systemic understandings.

Labor outcomes are one of the most cited examples of the importance of networks in economics. Granovetter [1973] pioneering work on the strength of weak ties drew attention to the significance of networks for employment. Indeed, networks represent crucial conduits spreading the awareness of new vacancies. Moreover, they further increase the probability of getting a job by reducing the imperfect information affecting labor markets. In particular, a well-established literature argues that they reduce selection concerns and improve the quality of matching on unobservable characteristics (see Montgomery [1991], Saloner [1985] and Simon and Warner [1992]). 1 shows that they also reduce moral hazard, since a social network may monitor and exert pressure

[7] Indeed he states that "An important form of social capital is the potential for information that inheres in social relations".

on a worker that was hired through it. Indeed, empirical evidence shows that the use of social networks as hiring channel is widespread. Granovetter [1973], Rees [1966] and Corcoran [1980] find that about half of the jobs in the United States are filled through personal contacts and Ioannides and Loury [2004] notice that the role played by networks increased over time.

Beyond employment, people access career opportunities, like job promotions, through friends, colleagues, and other contacts (see Burt [1992]). In the words of Burt [1992]: "Criteria other than financial and human capital are used to narrow the pool down to the individual who gets the opportunity. Those other criteria are social capital. New life is given to the proverb of success being determined less by what you know than by who you know".

Networks do not only affect the probability of getting a (better) job, but they are as well likely to have an impact on wages. However, there is no consensus on its sign. Montgomery [1991], Simon and Warner [1992], Kugler [2003], and Ioannides and Soetevent [2006] among others find higher wage rates on average, while for instance Pistaferri [1999] and Bentolila et al. [2010] lower wages when the position is filled through social networks. 1 develops a theoretical model rationalizing positive or negative wage differentials, depending on the circumstances in terms of network tightness, cultural context, non-monetary gains, bargaining power and occupation.

The characteristics of individual networks are crucial in determining the effects on labor outcomes. Network size is the primary measure. Munshi [2003] shows that social interactions improve labor market outcomes among migrants and, in particular, that a larger network at the destination substantially increases the probability that the individual will be employed. Similarly, Beaman [2011], Conley and Topa [2002], and Bayer et al. [2008] find that a larger network helps in job search. Patacchini and Zenou [2008], based on the dynamic model of Calvó-Armengol and Jackson [2004], stress that the individual probability of finding a job is increasing in the number of ties. Using

a panel of local authority-level data in England between 1993 and 2003, they find that the higher the percentage of a given ethnic group living nearby, the higher the employment rate of this ethnic group. Podolny and Baron [1997] find that mobility is enhanced by having large networks for those informal ties oriented toward acquiring information and resources. Finally, Burt [1992] argues that size is a mixed blessing. More contacts can mean more exposure to valuable information, more likely early exposure, and more referrals. However, increasing network size without considering diversity can cripple the network in significant ways.

The relation between network and wage has been found to be positive on average (see Arrow and Borzekowski [2004], Montgomery [1991], and Boxman et al. [1991]). Ioannides and Soetevent [2006] find that the wage rates of the most well connected are 15% to 25% higher than those of workers without connections.

Munshi [2003] also shows that an older network at the destination substantially increases the probability that a migrant will be employed. Podolny and Baron [1997] instead stress that the effects of tie duration on mobility vary across types of networks. In particular, they distinguish between ties that are position-based or induced by organizational structure and those that are person-based or discretionary. The mobility benefit of networks that are primarily position-based should be shorter-lived than the value of person-based ties; the former will tend to obsolesce with time, especially after an individual changes formal positions, whereas the latter, being based on trust and familiarity, should appreciate with time.[8]

The strength of weak ties argument affirmed by Granovetter [1973] stresses the prominent role of weak ties as far as labor outcomes are concerned. Re-

[8]Podolny and Baron [1997] reckon that in the organizational context many ties function primarily as conduits for some resource, particularly access and information. However, they stress that ties in a cohesive social group are important sources of identity and social support, which may be as well crucial in a professional context, for instance allowing to internalize clear expectations for one's role.

cent contributions by 1 and Patacchini and Zenou [2008] show that the role played by tightness may vary with circumstances. A complementary approach initiated by Burt [1992] reckons that what matters the most is not tightness, but the number of non redundant contacts.[9] People bridging structural holes[10] should know about more rewarding opportunities and obtain higher rates of return.

This paper bridges between the network literature and the rather vast literature on Executive Board Members' compensation and mobility. Drawing closer these two fields is key, since the role of professional networks is especially important in the context of Executives and Directors of Boards. Indeed, they constitute "a tiny group of about a dozen individuals holding unusual power in overseeing a company's future and corporations make all effort to recruit well-connected and experienced directors. (...) This interlocked network of board members plays a crucial role in spreading corporate practices and maintaining the political and economic clout of big corporations" (Barabási [2002]).

At the same time, "the managerial labor market offers a unique and data-rich environment to analyze promotions, separations, and careers. Even when results for Executives cannot be easily extrapolated to other labor groups, the results are important in their own right: Top Managers are critical and highly visible inputs into the corporate production function, and understanding better their role can enrich our understanding of both incentives and organizations" (Murphy [1999]).

Finally, executive compensation has attracted a lot of attention since the 90s, particularly due to growing disparities between CEO pay and average worker pay.[11] Even though salaries comprise a declining percentage of total

[9]Burt [1992] argues that, while weak ties and structural holes seem to describe the same phenomenon, the causal agent in the phenomenon is not the weakness of a tie but the structural hole it spans and the weak-tie argument obscures the control benefits of structural holes.

[10]Burt [1992] defines a structural hole as a relationship of non redundancy between two contacts. Thus, non redundant contacts are connected by a structural hole.

[11]The rapid growth in Executives' pay started in the mid-1970s and has been observed to decline only after 2000 (Frydman and Jenter [2010]).

compensation,[12] Executives devote substantial attention to the salary.[13] While salary has been shown to depend on country, industry, and firm size, the role played by professional networks has not been studied to our knowledge in the context of Executives and Board Members. The same observation is true for Executives' turnover.

2.3 Dataset and stylized facts

The empirical analysis is based on individual and firm level information provided by BoardEx Ltd, a UK supplier of data to headhunting companies.[14] Overall it consists of an unbalanced panel dataset describing the career history of more than 90 thousand Executives and Board Members[15] working in almost 4 thousand firms whose headquarters are based in US, UK, France, and Germany[16] between 1997 and 2009.

Our analysis discards individuals that hold a board position with no executive responsibilities (about half of the overall original dataset). This choice is motivated by the fact that non-Executives have very different compensation schemes from Executives, often composed of a null or symbolic salary component, and usually hold a position in many boards at the same time.[17]

[12]The increase over time of executive pay is mainly attributable to increase in the grant-date value of stock option grants, but the growth in stock option use did not occur at the expense of other components of pay (see Murphy [1999] and Frydman and Jenter [2010]).

[13]Murphy [1999] motivates the importance that executives devote to base salary with the fact that it is key in the contract, risk free, and most components of compensation are measured relative to base salary levels.

[14]Individuals on BoardEx are not responsible for keeping their profile up to date as is the case with social networking sites. All data is researched, verified through a 3 stage Quality Assurance system and updated by BoardEx research analysts. Information is 100% fact based on about 30 different information sources, such as Annual Reports, London Stock Exchange, SEC filing, Factiva, RNS, Corporate websites, International Newswire, etc.

[15]For each firm they represent all Executive Board Members or, in the case of firms with less than five Executive Board Members, the five individuals with highest reported salary.

[16]BoardEx cut-off criterion is a market capitalization above 1 million USD and they collect information in many countries. For UK and US BoardEx has a complete coverage on companies listed on major indices. Our dataset is composed of individuals working for firms randomly drawn from BoardEx coverage. We end up with 2100 firms based in the US, 1613 in the UK, and the full BoardEx coverage of France (220) and Germany (80).

[17]The most frequent categories of executive jobs are CEOs. The main functions held are general management, followed by finance. Notice that Executives may also seat in a board. Our analysis focuses however on their main executive position.

Moreover, since the transition between executive and non-executive positions[18] entails specific salary dynamics, we focus on workers that keep executive positions over time.[19] We also exclude individuals with null salary, since this is highly unlikely to result from a proper executive occupation. Finally, since the main focus of this paper is on job mobility and less than 2% of Executives change job each year, our main analysis (section 2.5) relies on a cumulation of job changes over 4 year and on a cross-section enriched with lagged values referring to 4 years before. Finally, we put aside the first years of data due to relatively low coverage and the crisis period. The benchmark analysis of this paper is based on data referring to the years 2006 and lagged values of 2002.[20] Table 2.1 and 2.2 show some descriptive statistics at the individual and firm level respectively for the year 2006.

Table 2.1: Descriptive statistics at the individual level for Executives in 2006.

Variable	**Mean**	**(SD)**	**Min.**	**Max.**	**N**
Potential network size	146	(193.507)	4	1669	6895
Mean link duration (years)	5.046	(2.137)	1.629	16.667	6895
Mean link age (years)	5.866	(4.734)	0	38.465	6895
Colleagues in network	18.66	(7.783)	1	58	6921
Salary (thousand USD)	389.97	(285)	0.854	6918.75	6921
Liquid wealth (thousand USD)	31483	(646945)	0	42684792	6665
Total wealth (thousand USD)	38776	(657062)	0	42684792	5362
Changed firm or fired (prop)	0.018	(0.131)	0	1	5456
Gender: female (prop)	0.052	(0.223)	0	1	6921
Age	53.5	(7.6)	28	97	6896
Achieved degree: BA (prop)	0.216	(0.411)	0	1	6921
Achieved degree: MA (prop)	0.279	(0.449)	0	1	6921
Achieved degree: PhD (prop)	0.163	(0.369)	0	1	6921
Degree major: Business (prop)	0.237	(0.425)	0	1	6921
Degree major: Finance (prop)	0.069	(0.253)	0	1	6921
Degree major: Science (prop)	0.015	(0.122)	0	1	6921
Degree major: Social Sc. (prop)	0.077	(0.266)	0	1	6921

[18] Vancil (1987) estimates that 80% of exiting (non-deceased) CEOs remain on their firms' boards of directors; and 36% continue serving on the board as chairman.

[19] Among workers holding an executive position in 2006 less than 4% were not holding an executive position in 2002. This may imply a small bias in our selected sample.

[20] The time period 2002-2006 has the highest number of observations and is obviously not affected by the crisis. The main results are robust to the choice of different time periods and are available upon request.

Table 2.2: Descriptive statistics at the firm level for 2006.

Variable	Mean	(SD)	Min.	Max.	N
Firm number of employees	13332	(48035)	1	1800000	3204
Firm country: US (prop)	0.553	(0.497)	0	1	3294
Firm country: UK (prop)	0.386	(0.487)	0	1	3294
Firm country: France (prop)	0.041	(0.199)	0	1	3294
Firm country: Germany (prop)	0.020	(0.14)	0	1	3294
Sector: construction (prop)	0.033	(0.179)	0	1	3294
Sector: defense (prop)	0.009	(0.095)	0	1	3294
Sector: education (prop)	0.002	(0.043)	0	1	3294
Sector: financial (prop)	0.128	(0.334)	0	1	3294
Sector: health (prop)	0.031	(0.172)	0	1	3294
Sector: information (prop)	0.152	(0.359)	0	1	3294
Sector: mining (prop)	0.072	(0.258)	0	1	3294
Sector: real estate (prop)	0.042	(0.2)	0	1	3294
Sector: services (prop)	0.092	(0.289)	0	1	3294
Sector: technical (prop)	0.047	(0.211)	0	1	3294
Sector: trade (prop)	0.062	(0.241)	0	1	3294
Sector: transportation (prop)	0.031	(0.173)	0	1	3294
Sector: utilities (prop)	0.032	(0.176)	0	1	3294

The unique feature of our dataset is the information provided on networks. In general, each individual is simultaneously embedded in very different types of social networks. In the present context we are especially interested in the professional network, that is, the links resulting from one's professional activity. There are many ways of assessing networks. Often people are asked to list their links. This procedure suffers however from concerns related to self-reporting and directionality of the reported ties. Moreover, it is very costly and therefore usually identifies rather small and intimate networks. Here instead, links are factual[21], not revealed. In our dataset a link is created when two persons work together.[22] The average number of professional links is 146, while the median

[21]Links are defined on the basis of relational states and events. That is, social ties are proxied by group co-membership, which is likely to contribute to the formation of ties. While in general it is difficult to infer whether people know each other at work, in the case of Top Executives it seems unlikely that two of them working in the same firm do not know each other one way or another. However, we lack information about the effort invested in each potential link.

[22]While many studies focus on friends, the focus of this paper is on professional links. Indeed, Podolny and Baron [1997] find that friendship is not the relevant network for studying career mobility. Notice that the network of all contact acquired while working would be larger than the professional network of current and previous colleagues defined in this paper.

is 72 in 2006.[23]

Notice that, even if one of the two nodes leaves the workplace, the link is not considered extinct. However, the link with a past colleague may play a different role than an ongoing relationship with a colleague. Therefore, we compute the number of years elapsed since two workers have been colleagues. The mean link 'age' is almost 6 years, while the median is 4 and a half. We also compute the number of contemporaneous colleagues present in the dataset, which is on average about 19. Finally, we calculate the 'duration' of a link as the years of overlapping of two persons in the same workplace. The mean overlapping is about 5 years.

Most executive pay packages contain four components: a base salary, an annual bonus tied to accounting performance, stock options, and long-term incentive plans. In our dataset salary is base annual pay. Liquid wealth is the sum of the value of shares held[24] and the intrinsic value of exercisable options[25]. Finally, total wealth is the sum of equity, estimated value of options, and long term incentive programs held (in thousand of US Dollars). This paper focuses on salary. Indeed, Executives devote substantial attention to the salary-determination process. Although salaries comprise a declining percentage of total compensation, they are key in the contract and risk free. Moreover, most components of compensation are measured relative to base salary levels. Wealth on the other hand is more likely to be reported with measurement error, since it is often difficult to assess it precisely. In a robustness analysis we look at wealth; network effects are qualitatively similar, but stronger.[26]

[23]Extrapolating from the brain sizes and social networks of apes, Dr.Dunbar suggested that the size of the human brain allows stable networks of about 150, which is known as the Dunbar number. Other anthropologists have come up with estimates of almost double the Dunbar number for the upper limit of human groups. Sociologists distinguish between a person's wider network of people known by name, estimate between 200 and 5000, and his social core.

[24]That is, multiplies the number of shares held directly by the individual by the stock price of the organization.

[25]That is, by how much the total number of options held are in the money. This is the gap between the exercise price of the options held and the stock price, multiplied by the number of options held.

[26]See section 2.5.3.

The probability of changing organization between 2005 and 2006 is less than 2% on average.[27] Only 5% of Executives are women and the average age is 53 years. They often hold a master degree in Business. Finally, Table 2.2 shows some characteristics at the firm level, such as size and sector. The majority of firms have their headquarters in the US and the most common sectors in the dataset are finance, information, and services.

A first exploration of the variables that are at the center of this paper (professional links, salary, and mobility decisions)[28] reveals some interesting patterns[29] that are going to form the basis of the theoretical framework of the paper. The Spearman correlation between salary and previous professional links is significant and equal to 0.31. At the same time, the Wilcoxon-Mann-Whitney test[30] indicates that the salary significantly differs between workers that stayed in the same firm and those who decided to change firm in the previous four years. In particular, the former have lower salaries than the latter on average. Moreover, mobility decisions significantly vary with professional potential network size. Indeed, the size of the professional network of workers deciding to stay is smaller than for people changing firm in the subsequent period. Finally, the number of professional links is larger for workers that previously decided to change firm and it is strongly related to the number of links previously held, as expected.

Therefore, the modeling exercise developed in section 2.4 is going to take into account the following observations: 1) salary is significantly related to previous number of professional links and mobility; 2) mobility is related to

[27]The mean time spent in an organization almost 14 years. Among Executives 60% are also Board Members and the average number of years spent in a board is below 2 years. Jensen and Murphy [1990] find in a thirteen-year sample that CEOs hold their jobs an average of over ten years before leaving, and most leave their position only after reaching normal retirement age. 60% of the sample CEOs are between 60 and 66 when they leave their firm; 32% are ages 64 or 65.

[28]As already explained, we look at variables in 2006 and use 2002 as previous period when considering lagged values.

[29]These relations and their significance are robust to a first set of *ceteris paribus* analyses (results available upon request) that includes a number of controls at the individual (previous salary, age, gender, degree level and major) and firm (country, sector, and size) level.

[30]The Wilcoxon-Mann-Whitney test is a non-parametric test for independent samples.

the size of the professional network contemporaneous to the decision; 3) the number of links is related to both the number of previously held links and to previous mobility decisions.

2.4 Theoretical framework

The key idea of our modeling of career is that career choices and professional networks coevolve. We develop a dynamic framework where the utility of a worker is affected by the choices she makes during her career and by the characteristics of her professional network. The idea is that wages may be directly affected by professional networks if their characteristics are valuable for the employer. Indeed, the fact that an employee has personal contacts with workers in another firm may increase the likelihood of new contracts or facilitate the transactions between the two firms. An alternative interpretation, even if contacts did not improve business, is that they may affect the bargaining power of a worker. The individuals' employment network outside the firm represents in this sense a form of social capital that may be useful for the employer and that is thus 'remunerated'. Decisions along the career path shape the development of one's professional network. For instance, when a worker decides to move to a new firm, her professional network is likely to expand, since new links will be created with new colleagues. Thus, mobility choices affect worker's network. At the same time it seems reasonable to argue that professional opportunities don't arise randomly among workers. A well-established stylized fact is that the probability of moving to another firm is likely to be affected by an individual's employment network. In particular, the larger the first degree network of the individual, the higher the probability that she gets exposed to job offers. Indeed, the information diffusion and bargaining is made easier by the existence of professional ties. This is particularly true in the case of Top Managers and Board Members. These positions are usually filled through head hunting and professional acquaintanceship, rather than

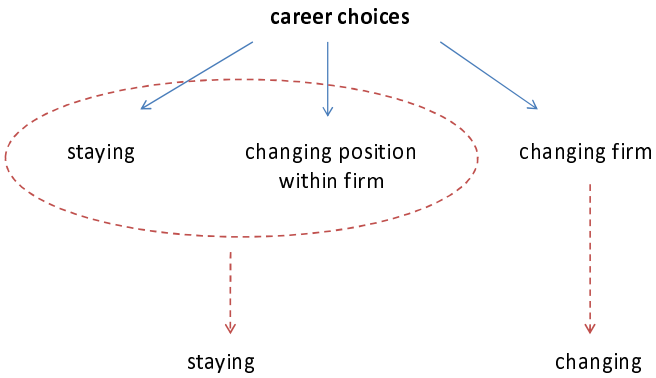

Figure 2.1: Potential career choices.

through formal advertisement of openings. Thus, worker's network affects her career.

2.4.1 Setting

An individual's career is modeled as a sequence of periods from $t = 0, ..., T$. In $t = 0$ the individual starts her career and at the end of $t = T$ she retires. At many points in time during an individual's career, each worker may have a choice to change her job. While professional dynamics may entail continuous progressions within the current firm and even within the current job position, this paper especially focuses on discrete progressions. Indeed, changing firm is usually the kind of professional mobility that most actively involves and affects an individual's professional network.[31] We thus simplify the space of punctual career choices restricting our attention to a worker's decision to accept an offer from another firm, as illustrated in Figure 2.1. Between the beginning and the end of the career, the individual may have several times the opportunity to change firm. That is, at each time $0 \leq t < T$, she may receive news of opportunities in an alternative firm. In this case, she evaluates the best outside option and compare it with the continuation in the current firm. In $t + 1$ she will either still work in current firm or will have changed firm.

The individual maximizes the sum of the discounted utility during her

[31] Another crucial reason why this paper restricts attention to mobility across firms is that from an empirical point of view it is possible to identify with more precision this type of mobility than promotions within a firm.

whole career. The optimal value that can be obtained is:

$$V_1(l_0) = max_{\{a_t\}_{t=0}^{T-1}} \sum_{t=0}^{T-1} \gamma^t \, U_{t+1}(l_t, a_t) \tag{2.1}$$

subject to $a_t \in \{S(l_t), M(l_t)\}$ and $l_{t+1} = \varphi(l_t, a_t) \; \forall t = 0, ..., T-1$, where γ discounts future utility, l_t are the characteristics of the relevant employment network and a_t is the decision of staying (S) or moving (M) in t and affecting the utility in $t+1$. Intuitively, a worker's utility depends on mobility choices and the probability of changing job may depend on a worker's professional network, if the information about new job opportunities spreads through it. Moreover, professional links may directly affect utility if their characteristics are valuable to the employer and are thus remunerated as part of wage.[32] Finally, the decision of staying or moving in t will in turn affect the shape of her professional network in $t+1$.

Bellman's Principle of Optimality suggests that the maximization can be rewritten as:

$$V_1(l_0) = max_{a_0} \; U_1(l_0, a_0) + \gamma \left[max_{\{a_t\}_{t=1}^{T-1}} \sum_{t=1}^{T-1} \gamma^{t-1} \, U_{t+1}(l_t, a_t) \right] \tag{2.2}$$

subject to $a_0 \in \{S(l_0), M(l_0)\}$, $l_1 = \varphi(l_0, a_0)$, and $a_t \in \{S(l_t), M(l_t)\}$, $l_{t+1} = \varphi(l_t, a_t) \; \forall t = 1, ..., T-1$.

The optimal value that can be obtained is therefore:

$$V_1(l_0) = max_{a_0} \; [U_1(l_0, a_0) + \gamma \, V_2(l_1)] \tag{2.3}$$

subject to $a_0 \in \{S(l_0), M(l_0)\}$ and $l_1 = \varphi(l_0, a_0)$, or dropping time subscripts

[32] Notice the value to the employer of an employee's professional network that it is possible to identify does not correspond in a non-neoclassical framework to the total value that a worker represent to her employer. Rather, by 'value to the employer' we mean the value that the employer is induced to bid for an employee at equilibrium.

and plugging the value of the next state:

$$V(l) = max_{a \in \{S(l), M(l)\}} \ [U(l,a) + \gamma \ V(\varphi(l,a))] \tag{2.4}$$

Individuals are risk-neutral and maximize their discounted sum of utilities. The maximization problem is solved backward starting from the last period of career.

We assume that the individual can always choose to stay in the current firm with probability one. In other words, the theoretical framework does not account for firing or firm bankruptcy. The decision taken in t of changing job in $t+1$ arises with the probability $p(l_t)$, which is an increasing function of the number of professional ties in t. Thus, in t the expected value is:

$$\mathbb{E}\, V_{t+1}(l_t) = p(l_t)\, max_{a_t} \left[V_{t+1}(l_t|a_t = S), V_{t+1}(l_t|a_t = M)\right] + [1 - p(l_t)]\, V_{t+1}(l_t|a_t = S) \tag{2.5}$$

We further assume that there always exists a potential offer that gives at least the value provided by staying in the current firm, *i.e.* $V_{t+1}(l_t|a_t = M) \geq V_{t+1}(l_t|a_t = S)$. In this case, $p(l_t)$ represents the probability that a job opportunity better than the current one arises and the expected value simplifies to:

$$\mathbb{E}\ V_{t+1}(l_t) = p(l_t)\, V_{t+1}(l_t|a_t = M) + (1 - p(l_t)) V_{t+1}(l_t|a_t = S) \tag{2.6}$$

where $V_{t+1}(l_t|a_t = S) = U_{t+1}(l_t|a_t = S) + \gamma\, \mathbb{E}\, V_{t+2}(l_{t+1}|a_t = S)$ and $V_{t+1}(l_t|a_t = M) = U_{t+1}(l_t|a_t = M) \ + \ \gamma\ \mathbb{E}\ V_{t+2}(l_{t+1}|a_t = M)$.

The optimal value depends on current utility and expected future value. That is, when a worker is considering an offer to change job, she takes into account on one hand the proposed compensation, which may be directly affected by her professional network if the employer values it. On the other hand, she also takes into account the dynamic effect of moving, through the changes in

her network. Indeed, changing job is likely to increase her professional network, which in turn will increase the probability of receiving interesting offers in the future (and, thus, the expected future value), so that network and career actually coevolve.

2.4.2 The role of professional links

We turn now to a more analytical understanding of the different channels whereby professional links affect career outcomes. From expression (2.6) it is easy to see that the professional network plays a role in several ways. Indeed, the derivative of the value in $t+1$ with respect to professional links in t is:

$$\frac{\partial \mathbb{E}V_{t+1}(l_t)}{\partial l_t} = \frac{\partial p(l_t)}{\partial l_t}\left[V_{t+1}(l_t|a_t = M) - V_{t+1}(l_t|a_t = S)\right] + \\ + p(l_t)\left[\frac{\partial V_{t+1}(l_t|a_t = M)}{\partial l_t} - \frac{\partial V_{t+1}(l_t|a_t = S)}{\partial l_t}\right] + \frac{\partial V_{t+1}(l_t|a_t = S)}{\partial l_t} \quad (2.7)$$

If we assume that the way links affect the value does not depend on mobility decisions,[33] *i.e.* $\frac{\partial V_{t+1}(l_t|a_t=M)}{\partial l_t} \approx \frac{\partial V_{t+1}(l_t|a_t=S)}{\partial l_t}$, then expression (2.7) simplifies to:

$$\frac{\partial \mathbb{E}V_{t+1}(l_t)}{\partial l_t} = \underbrace{\frac{\partial V_{t+1}(l_t|a_t = S)}{\partial l_t}}_{link\ direct\ effect} + \underbrace{\frac{\partial p(l_t)}{\partial l_t}}_{link\ indirect\ effect} \underbrace{\left[V_{t+1}(l_t|a_t = M) - V_{t+1}(l_t|a_t = S)\right]}_{mobility\ effect} \quad (2.8)$$

Expression (2.8) implies that the overall impact of links results from three effects. The first term constitutes the direct effect that professional links have on value beyond mobility, that is, the extent to which they directly affect the career value. It captures the value that a worker's contacts represent to the

[33] If this hypothesis was not true, the same network would have a different effect depending on whether a worker changes firm or not. That is, the link direct effect would be different for stayers and movers. In this case, empirically we would need to allow for potentially different effects on links on the salary for movers and stayers. We should then estimate an endogenous switching model. However, since there are few observations for movers, convergence is not achieved. Therefore, to the extent that it is reasonable to assume that links have the same effect on salary for movers and for stayers, it is possible to interpret the difference in the impact of links on value for movers and stayers as a measure of the probability of moving.

employer. The second addendum captures the role that professional networks play through mobility (*i.e.* second and third effect): the gain from changing job with respect to staying in the current firm and the extent to which links affect the probability of getting the information about a better job opportunity.

2.4.3 From the theoretical framework to the empirical specification

In order to assess the relative role played by the different effects that are identified in the theoretical framework, it is necessary to disentangle the three channels. Indeed, if we simply estimated $Y_{t+1} = \beta_0 + \beta_1 l_t + \beta_2 X_{t+1} + \epsilon_{t+1}$, where Y_{t+1} is the career value (for the moment, it can be useful to think of it as simply the salary) and X_{t+1} the standard determinants, the estimated coefficient $\widetilde{\beta_1}$ would combine the three channels whereby links affect a worker's value. Nor it is sufficient to include explicitly the mobility decisions (*i.e.*, $Y_{t+1} = \beta_0 + \beta_1 l_t + \beta_2 X_{t+1} + \beta_3 A_t + \epsilon_{t+1}$, where A_t is the decision taken in period t, or $Y_{t+1} = \beta_0 + \beta_1 l_t + \beta_2 X_{t+1} + \beta_3 A_t + \beta_4 l_t * A_t + \epsilon_{t+1}$), since A_t may be endogenous with respect to Y_{t+1}. Indeed, beyond professional network, some unobserved individual or firm characteristics may affect both mobility and salary.

Instead, based on the theoretical framework the benchmark empirical specification in this paper takes into account that utility depends directly on links and on mobility decisions. Moreover, it considers that the professional network affects the probability of career mobility and therefore indirectly utility. That is, the benchmark empirical specification consists of two stages. The first stage estimates the probability of being offered a better job opportunity:

$$A_t = \delta_0 + \underbrace{\delta_1}_{link\ indirect\ effect} l_t + \delta_2 Z_t + \zeta_t \tag{2.9}$$

where Z_t includes the controls X_{t+1} and at least a mobility determinant that

is legitimately excluded from the second stage. The second stage is then represented by:

$$Y_{t+1} = \beta_0 + \underbrace{\beta_1}_{link\ direct\ effect} l_t + \beta_2 X_{t+1} + \underbrace{\beta_3}_{mobility\ effect} \widehat{A}_t + \epsilon_{t+1} \qquad (2.10)$$

The three components singled out in the theoretical framework (see expression (2.8) in section 2.4.2) correspond to the estimated coefficient $\widehat{\beta_1}$ (link direct effect), $\widehat{\beta_3}$ (mobility effect), and $\widehat{\delta_1}$ (link indirect effect).

In abstract, the potential endogeneity of professional links with respect to salary is of course a concern. However, the measure of network size exploited in this paper is based on factual contacts and not on reported links. That is, it corresponds to the number of previous and current colleagues of an Executive. Therefore, it does not reflect the success or popularity of a worker, but rather her career mobility. The first stage explicitly takes into account that mobility and potential network size are not independent: links in period t may affect the mobility decision taken in that period and effective in $t+1$. Finally, reverse causality is not an issue because the impact of changing firm on network size will realize in $t+1$.

Notice that in general Y_{t+1} is not simply represented by the salary, but by the continuation value. One way to empirically approximate the continuation value is to take into account not only salary, but also equities, stock options, and long term incentive plans. However, the precision of this global amount is not very high. Therefore, beyond checking alternative measures of the dependent variable, we also run a further complementary test to check the robustness of the benchmark specification. The test is based on the observation that in the last period of a worker's career (T), she has no longer to decide whether changing job and links are then not useful to find a better job in the following period (*i.e.* $p(l_T) = 0$).[34] Therefore, in period $T-1$ the continuation value

[34]This seems reasonable as far as executive positions are concerned, while it may still be the case that the professional network built in an Executive career contributes to getting a

simplifies to the utility and expression (2.8) can be rewritten as:

$$\frac{\partial \mathbb{E}V_T\left(l_{T-1}\right)}{\partial l_{T-1}} = \frac{\partial U_T\left(l_{T-1}|a_{T-1}=S\right)}{\partial l_{T-1}} + \frac{\partial p\left(l_{T-1}\right)}{\partial l_{T-1}}\left[U_T\left(l_{T-1}|a_{T-1}=M\right) - U_T\left(l_{T-1}|a_{T-1}=S\right)\right] \tag{2.11}$$

Thus, we can estimate link effects directly on salary for individuals close to retirement.[35]

2.5 Econometric specification and results

In the theoretical framework developed in section 2.4 at many points in time during a worker's career, she may receive offers and has to decide whether staying in the current firm or changing job. The decision taken at each point is dynamic and takes into account not only the utility in that period, but also the discounted expected utility in the future. In particular, the optimal value depends on professional networks directly through utility to the extent that links are valuable to the employer and indirectly through the effect that they have on mobility decisions.

Based on the benchmark specification suggested by the theoretical framework, we find evidence that professional networks are relevant both because valuable for the employer and because they facilitate job mobility. Moreover, we investigate some characteristics of the relevant network component (section 2.5.2). We find that contemporaneous colleagues are not useful channels of information transmission about job opportunities, nor valuable for the employer. The average length of the overlapping time of workers in the same firm and the average time elapsed since then have a negative impact on the network value to the employer. Moreover we find that professional networks characterized by longer average time spent in the same firm as colleagues are less useful to

better non-executive position in a board. This is however beyond the dynamics analyzed by the present paper.

[35]The results can be generalized to the extent that the way networks affect utility does not change over time.

find a better job. To the extent that overlapping time may proxy ties strength, this result supports Granovetter's theory of the 'strength of weak ties'. Finally, we check the robustness of the main findings with respect to alternative definitions of career value and to specifications accounting for mobility and link endogeneity (section 2.5.3). Table 2.10 summarizes the estimated elasticities of salary with respect to potential network size.

2.5.1 Benchmark

The benchmark econometric specification suggested by the theoretical framework developed in section 2.4 comprises a first stage where the dependent variable is the mobility decision (see expression (2.9)) and a second stage where the dependent variable is the career value (see expression (2.10) in section 2.4.3). Since mobility decisions are endogenous to salary it is necessary that at least one variable included in Z_t in expression (2.9) is legitimately excluded from the X_{t+1} variables in expression (2.10).

In transposing the theoretical framework to empirical estimation we face the practical difficulty that the percentage of workers changing firm between each period t and $t+1$ is extremely low if we consider a one-year interval. Therefore, four years are cumulated.[36] The dependent variable of the first stage (from table 2.4 on) is a dummy variable taking unit value if a worker has changed firm between 2002 (excluded) and 2006 (included). To be consistent with our theoretical framework, where dismissal is ruled out and mobility decisions result from the maximization of the expected value over the career, the econometric analysis does not consider individuals that changed firm and get a lower salary (about 30% of the observed mobility of Executives) as workers that voluntarily decided to work for another firm.[37]

[36]Between 2005 and 2006, for instance, only about 1.8% of Executives changed firm (see table 2.1). Between 2002 and 2006 the percentage rises to about 4.5%.

[37]This resctriction aims at consistency between the theoretical and empirical analyses. Indeed, to be able to interpret the results on the basis of our framework, this sample selection is necessary. It is possible that workers may choose a job for unobservable reasons, but we cannot distinguish empirically between this voluntary choice and fired workers. While this

Before proceeding to the estimation of our benchmark, we rapidly illustrate the simple OLS estimates as element of comparison. The first column of table 2.3 shows the simplest possible OLS estimation. The estimated elasticity of salary with respect to professional links capture the overall impact of potential network size on salary. The estimated network effect implies that a 1% change in potential network size accompanies a 0.163% increase in salary on average. For instance, 50% more links (from the average of 121 to 182) would imply an average annual salary increase of 32 thousand USD (from the average 390 to 422 thousand USD). However, there may be some unobserved factors that affect both the number of professional links and salary. We therefore include as a control past salary (column [II]) in order to control as much as possible for unobserved heterogeneity. Taking into account mean reversion reduces the elasticity with respect to links by two thirds. Including past salary may actually lead to some underestimation of the effect of professional networks on salary by absorbing even too much variance related to individual heterogeneity. Alternative specifications are run in section 2.5.3 and confirm that the network effect as estimated by our benchmark specification is likely to be quite conservative.

The theoretical framework points out that professional links may also affect salary through their impact on mobility. The third and fourth column of table 2.3 take into account the role played by mobility by including a dummy variable that takes unit value when a worker has changed job in the previous 4 years.[38] Column [IV] also controls for unobserved heterogeneity through past salary. However, as explained in section 2.4.3, it is not sufficient to include mobility

could create a bias, the main results do not change. If we considered the sample of all the workers that changed firm independently of the subsequent salary, the only differences are that previous salary looses its significance in the first-stage and that a borderline significant negative mobility effect emerges in the second stage.

[38]Notice that once introduced this variable, the dummy variables for firm location in France and Germany are dropped due to collinearity. Indeed, there are no workers in firms located in France and Germany who changed firm between 2002 and 2006. This is not surprising, since firms in France and Germany represent respectively only 4% and 2% of sampled firms.

Table 2.3: Network effects on salary (OLS estimation).

Ln salary (2006)	[I]	[II]	[III]	[IV]
Ln potential network size (2002)	0.163***	0.053***	0.158***	0.048***
	(0.01)	(0.01)	(0.01)	(0.01)
Age (2006)	0.130***	0.010	0.148***	0.016
	(0.02)	(0.01)	(0.02)	(0.01)
Age sq. (2006)	-0.001***	-0.000	-0.001***	-0.000*
	(0.00)	(0.00)	(0.00)	(0.00)
Gender: female	-0.200***	-0.042	-0.227***	-0.053*
	(0.05)	(0.03)	(0.05)	(0.03)
Achieved degree: BA	0.178***	0.063***	0.167***	0.056***
	(0.03)	(0.02)	(0.03)	(0.02)
Achieved degree: MA	0.183***	0.081***	0.177***	0.079***
	(0.03)	(0.02)	(0.03)	(0.02)
Achieved degree: PhD	0.148***	0.030	0.147***	0.015
	(0.04)	(0.03)	(0.04)	(0.03)
Degree major: Business	0.065**	0.018	0.085***	0.016
	(0.03)	(0.02)	(0.03)	(0.02)
Degree major: Finance	-0.026	0.025	-0.004	0.032
	(0.04)	(0.03)	(0.04)	(0.03)
Degree major: Science	-0.210***	-0.097**	-0.090	-0.021
	(0.08)	(0.05)	(0.09)	(0.06)
Degree major: Social Sciences	-0.043	0.054	-0.063	0.055
	(0.05)	(0.04)	(0.06)	(0.04)
Firm country (2006): UK	0.169***	0.249***	0.201***	0.258***
	(0.03)	(0.02)	(0.03)	(0.02)
Firm country (2006): Germany	-0.135	-0.214		
	(0.09)	(0.27)		
Firm country (2006): France	-0.474***	-0.001		
	(0.12)	(0.13)		
Ln salary (2002)		0.723***		0.724***
		(0.02)		(0.02)
Changed firm (2002-06)			0.109*	0.283***
			(0.06)	(0.07)
Intercept	1.382***	1.280***	1.106**	1.185***
	(0.51)	(0.28)	(0.52)	(0.29)
N	6825	6768	5431	5431
R^2	0.111	0.617	0.114	0.632

Note: Robust Standard Errors in brackets, clustered by firm.

Significance levels: *: 10% **: 5% ***: 1%.

as it may be endogenous. Therefore, we now turn to the estimation of our benchmark specification.

The benchmark specification results from our theoretical framework. The latter identified three effects of professional networks on the career value (see section 2.4.2): a link direct effect (beyond mobility), a mobility effect (the gain from changing firm), and a link indirect effect (through the probability of changing firm). The link direct and indirect effects correspond to the estimated coefficients of potential network size respectively in the second and first stage (β_1 in expression (2.10) and δ_1 in expression (2.9) in section 2.4.3). The mobility effect is represented by the estimated coefficient of the dummy variable for having changed firm (β_3 in expression (2.10) in section 2.4.3).

In order to be able to estimate the two-stage model, we need to single out factors that affect voluntary choices of changing job, but are not salary determinants otherwise. A natural candidate are external conditions that may affect mobility choices. For instance, to the extent that Executives are able to work for firms in different sectors, they could be more inclined to change job when their sector suffers from an economic slowdown. We thus exploit the evolution of sectoral stock index, namely the MSCI sectoral weighted market capitalization index[39], to take into account the fact that a worker's choice to change job can result from poor performance of the industry she is working in. The growth rate of sectoral weighted market capitalization index between 2006 and 2002 corresponding to the firm where the worker was in 2002[40] captures the evolution of the market capitalization index for the 'incumbent' sector. It is expected to have a negative impact on the probability of moving. For this sectoral performance variable to be a valid instrument, it is also necessary that it does not affect salary beyond its impact through mobility decisions.

[39]We exploit the MSCI sectoral weighted market capitalization index relative to the US and Europe (for firms in UK, Germany, and France). The index is a market capitalization weighted index that is designed to measure the equity market performance of the developed markets.

[40]This firm variable has a mean of 0.62 and a standard deviation of 0.22. The minimum value is -0.06 and the maximum 1.24.

The determinants of salary are many and complex and it would seem reasonable that sectoral performance correlates with compensation. However, performance would more likely influence other components that are more variable than salary. Moreover, many studies looking for performance effects in Executive compensation don't find any relation.[41]

We also impose an additional exclusion restriction relying on a different source of external variation. The fact that a firm changed the country of its headquarters is likely to affect mobility choices of its workers, while not directly the salary component of their overall compensation.[42] To the extent that the exclusion restrictions hold, the estimated coefficients of the benchmark specification reported in table 2.4 allow to assess the multiple effect that professional networks have on workers' career. The main object of interest in the first stage estimation is the relation between network size and mobility. Indeed, the estimated network coefficient relates to the indirect effect of link on salary through the probability of changing firm. The theoretical framework described in section 2.4 assumes that mobility decisions depend on workers' professional network. In particular, we expect that the probability of receiving an interesting job offer is increasing in the number of direct links of an individual. As expected, in the first stage the number of professional links held before the mobility decision takes place significantly increases the probability of changing firm. The estimated marginal effect is 0.011, suggesting that if the network increases by 50% (from the average 121 links to 182), the probability of choosing to change firm increases by 15% (from the average 3% to 3.45%).

The estimated coefficients reported in the first column of table 2.4 also suggest that the higher previous salary the lower the probability of changing job.[43] This is consistent with the observation that the utility of staying in

[41] Jensen and Murphy [1990] for instance find that for CEOs that their compensation is unrelated to market and industry performance. Friebel and Matros [2005] provide a theoretical framework explaining how CEOs in bad firms may nonetheless receive larger wages.

[42] This is a rare event, taking place for only 1.2% of firms.

[43] Abowd et al. [2006] consistently find that firms that pay high wages have low turnover

Table 2.4: Network effects on salary (2SLS estimation: benchmark).

	[I stage]		[II stage]	
	Changed firm (2002-06)		Ln salary (2006)	
Ln potential network size (2002)	0.018***	(0.00)	0.067***	(0.01)
Ln salary (2002)	-0.013***	(0.00)	0.712***	(0.02)
Age (2006)	-0.000	(0.00)	0.016	(0.01)
Age sq. (2006)	-0.000	(0.00)	-0.000*	(0.00)
Gender: female	-0.012	(0.01)	-0.062**	(0.03)
Achieved degree: BA	0.015***	(0.01)	0.073***	(0.02)
Achieved degree: MA	0.017**	(0.01)	0.097***	(0.02)
Achieved degree: PhD	0.012	(0.01)	0.031	(0.03)
Degree major: Business	0.018**	(0.01)	0.034	(0.02)
Degree major: Finance	0.011	(0.01)	0.042	(0.03)
Degree major: Science	-0.011	(0.01)	-0.033	(0.06)
Degree major: Social Sciences	0.006	(0.01)	0.059	(0.04)
Firm country (2006): UK	0.030***	(0.01)	0.288***	(0.02)
Sectoral growth for 2002-firm (2006-02)	-0.027**	(0.01)		
Headquarters country changed (2006-02)	0.562***	(0.13)		
Changed firm (2002-06)			-0.754	(0.49)
Intercept	0.056	(0.07)	1.215***	(0.32)
N	5431		5431	
Pseudo R^2 / R^2	0.056		0.581	
F statistic cluster-robust			11.90	
Hansen J statistic			2.145	
Hansen J χ^2 p-value			0.143	

Note: Robust Standard Errors in brackets, clustered by firm.

Significance levels: *: 10% **: 5% ***: 1%.

the current firm is likely to be a smoother evolution of the utility of previous period, while moving is more likely to be accompanied by utility jumps.

The second stage regression shows that professional network significantly affects in a direct way salary even beyond mobility. The estimated coefficient of potential network size suggests that a 50% increase in the number of links accompanies a 3.25% increase of salary with respect to the average. In other words, if a worker has 50% more links than the average (from 121 to 182 links), her annual salary would increase by 13 thousand USD (from an average of 390 to 403 thousand USD).

The second stage estimates also show that once the endogeneity of mobility is taken into account, we cannot reject the hypothesis that changing firm has

rate.

no impact on salary, so that mobility *per se* does not significantly affect salary. In other terms, out of the three potential effects identified by the theoretical model (section 2.4.2) the indirect and direct effects of links are positive and significant, while the mobility effect is not significantly different from zero once considering endogeneity.

Mincerian determinants are, as expected, significant[44] and women suffer a wage penalty on average[45]. Workers that earned a degree[46] with a major in Business have on average higher salary and a higher probability of changing job than those with another major. The location of the firm is also important.[47]

The robustness of the results obtained with the benchmark specification is assessed with respect to a number of dimensions. In particular, section 2.5.3 runs the same specification, but where the dependent variable of the second stage is the sum of salary and total wealth, as defined in section 2.3. Moreover, we check the extent to which the role of links changes when the continuation value simplifies to the salary, as it is the case toward the end of the career. Finally, section 2.5.3 and 2.5.3 assess robustness with respect to alternative specifications accounting for the effect of mobility and network size respectively on salary.

2.5.2 Characteristics of relevant network components

This section explores the relevant network components as far as direct and indirect salary effects of links are concerned. In particular, with respect to the rest of a worker's professional network, are colleagues in the contemporaneous

[44]Murphy [1999] notices that Mincerian determinants may be less significant for Top Executive remuneration than for other jobs. Indeed executive remuneration is often based on surveys that do not contain criteria like age, experience, education. Llense (2008) for instance finds that CEO compensation is not sensitive to attributes such as age or formal qualification.

[45]See Lalanne and Seabright [2011] for more details on the gender dimension.

[46]The reference degree achieved is a residual category.

[47]Firms based in the US pay lower salaries. This result may be reconciled with the literature on executive compensation, since Murphy [1999] says that in US CEOs, and not Executives in general, are paid more than elsewhere. Moreover, Executives working in the US have a larger fraction of their compensation in stock options. Notice also that the dummies indicating firms located in Germany and France are dropped due to collinearity.

firm useful? Moreover, it investigates how the characteristics of links (and in particular duration and age) affect both network direct and indirect relations with salary. That is, are long-lasting or old links more or less useful than short and recent ties?

We consider the role played by contemporaneous colleagues and find evidence confirming the intuition that it is people you know outside your current firm that are more likely to be useful and valuable.[48] Indeed, colleagues are not very likely to know much more than the worker herself about other job possibilities, so that, as far as information diffusion is concerned, the relevant employment network does not include worker's colleagues contemporaneous to her mobility decision. Moreover, as far as the direct effect of links on salary is concerned, the most valuable links to the employer are those beyond current and former workers of the firm.[49] Indeed, the latter ones represent quite useless ties for the employer in $t+1$, since they are redundant contacts among workers in the firm.

An interesting issue is how the characteristics of a worker's network influence its direct and indirect effects on the career. The first question is whether the time spent as colleagues plays a role on the usefulness of the tie. In order to answer this question we include in the benchmark specification the average overlap of links in each worker's professional network. This variable somehow proxies the average minimum duration of the potentially active link. Indeed, it is very likely that two persons have opportunities of contact when they work as

[48] Results available upon request.

[49] Notice that the wage effect of the component of the employment network that is useful because it spreads information and the one that is valuable to the employer tend to empirically coincide for people with low mobility. The reason is that empirically we proxy current and former workers of the firm with the current ones. However, in theory the two components are different. Indeed, former colleagues that left the firm where the individual still works are potentially very useful for spreading original information, while they are not valuable for the employer, since those are redundant links being shared by many employees. From an empirical point of view, it is not easy to assess the number of former colleagues that moved. For instance the number of colleagues may have not changed between t and $t+1$, but just because newcomers compensate workers that left. In a more sophisticated analysis where each node in the network is characterized by its full employment history this distinction is empirically relevant.

Top Executives in the same firm, while we cannot be sure whether nodes keep in touch when they do not work together anymore. The average overlap period of network links represent the closest proxy that is available to tie strength in our dataset. The first two columns of table 2.5 show that networks characterized by longer overlaps are less useful. First, they are not the best channel to spread information about better opportunities. This result is in line with Granovetter's classical 'strength of weak ties' argument. Second, they have a lower direct effect on salary. In a sense, it is really the size of the Rolodex that matters.

Another interesting question is whether the recentness of links impacts their direct and indirect effect on salary. Indeed, it is not straightforward whether more recent links should be more or less useful to get information about job opportunities or more or less valuable for an employer. In order to answer this question we run a variation of the benchmark specification where we include a variable accounting for the average age of workers' links. The estimated coefficient of the network average age in the first stage estimation (third column of table 2.5) suggests that the time elapsed since nodes were colleagues does not significantly affect their value as information channels. A different conclusion is suggested by the second stage estimation (last column of table 2.5). Indeed, networks characterized by on average old links are less valuable as far as their direct effect on salary is concerned.

It would be very interesting to assess the role played by a more precise measure of link tightness. The information available unfortunately does not indicate the intensity of relationships. However, notice that the strength of a link is somehow a subjective matter and two persons in a relationship may have a different view on the intensity of their relationship, while we exploit objective characteristics of links. Our measures of link overlap and age avoid the inconsistencies that arise in studies based on subjective reporting on tightness depending on whether the network is considered undirected (*i.e.* links are

Table 2.5: The role of link overlap and age (2SLS estimation).

	Link Overlap		Link Age	
	[I stage] Changed	[II stage] Ln salary	[I stage] Changed	[II stage] Ln salary
Ln potential network size (2002)	0.017***	0.062***	0.018***	0.093***
	(0.00)	(0.01)	(0.00)	(0.01)
Mean overlap of network links (2002)	-0.003***	-0.011***		
	(0.00)	(0.00)		
Mean age of network links (2002)			-0.000	-0.011***
			(0.00)	(0.00)
Ln salary (2002)	-0.012***	0.714***	-0.013***	0.711***
	(0.00)	(0.02)	(0.00)	(0.02)
Age (2006)	-0.000	0.016	-0.000	0.017
	(0.00)	(0.01)	(0.00)	(0.01)
Age sq. (2006)	-0.000	-0.000*	-0.000	-0.000*
	(0.00)	(0.00)	(0.00)	(0.00)
Gender: female	-0.011	-0.060**	-0.012	-0.065**
	(0.01)	(0.03)	(0.01)	(0.03)
Achieved degree: BA	0.014**	0.072***	0.015***	0.075***
	(0.01)	(0.02)	(0.01)	(0.02)
Achieved degree: MA	0.015**	0.094***	0.017**	0.097***
	(0.01)	(0.02)	(0.01)	(0.02)
Achieved degree: PhD	0.011	0.029	0.012	0.037
	(0.01)	(0.03)	(0.01)	(0.03)
Degree major: Business	0.018**	0.034	0.018**	0.033
	(0.01)	(0.02)	(0.01)	(0.02)
Degree major: Finance	0.010	0.039	0.011	0.057*
	(0.01)	(0.03)	(0.01)	(0.03)
Degree major: Science	-0.012	-0.037	-0.011	-0.037
	(0.01)	(0.06)	(0.01)	(0.06)
Degree major: Social Sciences	0.006	0.057	0.006	0.044
	(0.01)	(0.04)	(0.01)	(0.04)
Firm country (2006): UK	0.027***	0.276***	0.031***	0.306***
	(0.01)	(0.02)	(0.01)	(0.03)
Sectoral growth for 2002-firm (2006-02)	-0.026**		-0.027**	
	(0.01)		(0.01)	
Headquarters country changed (2006-02)	0.560***		0.562***	
	(0.13)		(0.13)	
Changed firm (2002-06)		-0.775		-0.786
		(0.50)		(0.50)
Intercept	0.068	1.264***	0.053	1.103***
	(0.07)	(0.32)	(0.07)	(0.32)
N	5431	5431	5431	5431
F statistic cluster-robust		11.66		11.92
Pseudo R^2 / R^2	0.058	0.580	0.056	0.580
Hansen J statistic		1.861		1.740
Hansen J χ^2 p-value		0.172		0.187

Note: Robust Standard Errors in brackets, clustered by firm. Significance levels: *: 10% **: 5% ***: 1%.

bilateral) or directed (*i.e.* at least a pair of connected nodes is asymmetric in the sense that one directed link is not symmetrically reciprocated).

2.5.3 Robustness checks

Alternative specifications for continuation value

While Executives in practice devote substantial attention to salary (see section 2.3), the crucial variable of interest in the dynamic maximization sketched in the theoretical framework is the expected value over the career. The richness of the information available allows us to test the robustness of our results with respect to a different measure of value.

The first two columns of table 2.6 report the first and second stage estimates of a variation of the benchmark specification where the dependent variable salary is replaced by the sum of salary and total wealth.[50] The idea is that the sum of salary, shares, stock options, and long term incentive programs held approximates better than salary alone the expected value over the career.

The indirect effect of network size on career value through mobility is of course identical to the indirect effect on salary. However, the second stage estimated elasticity of career value with respect to links is more than three times the one of salary. Therefore, the direct effect of professional links on salary is a very conservative estimates of the value attributed by employers to social capital, especially in the case of the Top Management of firms, that are the most likely to earn conspicuous total wealth.[51]

A further test to the robustness of our results consists in verifying the extent to which the role of links changes when the continuation value simplifies to the salary, as it is the case toward the end of the career. For people over 60 years

[50] To be precise we sum salary and pseudo total wealth. Indeed, in order to avoid reducing the sample size, we substitute missing values of total wealth with its sample mean.

[51] Notice that this is the only specification where the mobility effect in the second stage in significantly negative. A natural interpretation is that, when an Executive changes firm, she usually looses a major part of her total wealth. Indeed, the stock options granted by the previous firm are not exercisable any longer.

Table 2.6: Robustness of network effects to alternative specifications for continuation value (2SLS estimation).

	[I stage] Changed	[II stage] Ln wealth	[I stage] Changed	[II stage] Ln salary
Ln potential network size (2002)	0.018***	0.225***	0.018***	0.069***
	(0.00)	(0.03)	(0.00)	(0.01)
Ln salary (2002)	-0.013***	0.877***	-0.013***	0.710***
	(0.00)	(0.04)	(0.00)	(0.02)
Age (2006)	-0.000	-0.106***	-0.000	-0.003
	(0.00)	(0.03)	(0.00)	(0.01)
Age sq. (2006)	-0.000	0.001***	-0.000	-0.000
	(0.00)	(0.00)	(0.00)	(0.00)
Gender: female	-0.012	-0.213***	-0.012	-0.062**
	(0.01)	(0.08)	(0.01)	(0.03)
Achieved degree: BA	0.015***	0.181***	0.015***	0.076***
	(0.01)	(0.06)	(0.01)	(0.02)
Achieved degree: MA	0.017**	0.209***	0.017**	0.096***
	(0.01)	(0.06)	(0.01)	(0.02)
Achieved degree: PhD	0.012	0.004	0.012	0.030
	(0.01)	(0.07)	(0.01)	(0.03)
Degree major: Business	0.018**	0.091	0.018**	0.035
	(0.01)	(0.06)	(0.01)	(0.02)
Degree major: Finance	0.011	-0.165**	0.011	0.043
	(0.01)	(0.07)	(0.01)	(0.03)
Degree major: Science	-0.011	0.010	-0.011	-0.032
	(0.01)	(0.16)	(0.01)	(0.06)
Degree major: Social Sciences	0.006	0.210**	0.006	0.061
	(0.01)	(0.09)	(0.01)	(0.04)
Firm country (2006): UK	0.030***	-0.454***	0.030***	0.288***
	(0.01)	(0.06)	(0.01)	(0.02)
Sectoral growth for 2002-firm (2006-02)	-0.027**		-0.027**	
	(0.01)		(0.01)	
Headquarters country changed (2006-02)	0.562***		0.562***	
	(0.13)		(0.13)	
Changed firm (2002-06)		-1.380*		-0.756
		(0.77)		(0.49)
Age over 60 (2002)			0.055**	0.014
			(0.02)	(0.19)
Interaction age over 60 & ln potential network size (2002)			-0.014***	-0.044
			(0.01)	(0.04)
Intercept	0.056	5.569***	0.056	1.666***
	(0.07)	(0.84)	(0.08)	(0.38)
N	5431	5431	5431	5431
F statistic cluster-robust		11.90		11.81
Pseudo R^2 / R^2	0.056	0.311	0.057	0.582
Hansen J statistic		0.355		2.279
Hansen J χ^2 p-value		0.551		0.131

Note: Robust Standard Errors in brackets, clustered by firm. Significance levels: *: 10% **: 5% ***: 1%.

old the future expected value has a limited role in the optimal value, since the time horizon is short. Therefore, looking at the interaction between the role of links and the fact of being toward the end of the career allows to disentangle the direct and indirect effect of employment networks on utility (see expression 2.11 in the theoretical section).

The estimated coefficient of the interaction between network size and the fact of being over 60 is negative and significantly different from zero in the first stage (third column of table 2.6). In other words, toward the end of one's career the role of links as channels of diffusion of job opportunities is fading away.

At the same time, the results of the second stage estimation reported in the last column of table 2.6 show that the direct effect of links on salary is not significantly different for people over 60.

Alternative econometric specification for mobility endogeneity

An empirical difficulty in the analysis is the endogeneity of mobility decisions with respect to salary. Indeed, there may exist unobservable variables that affect workers' decision to change job and also their wages. The problem is that if an individual decides to stay we only observe her salary in her current firm, while if the worker decides to move we only observe the best salary she was offered in another firm. Since we never observe the counterfactual wage, we need to take into account potential endogenous selection. In this case the two groups of individuals, those who stay longer in one firm and those who change firm, are not randomly selected. The benchmark specification of this paper relies on instrumental variable estimation. An alternative specification is running a Heckman model (see Heckman [1979]), a sample correction model where selection is determined by a probit model. The model consists then of two equations: a wage regression and a selection equation.

In our framework, the Heckman specification would be:

$$Y_{t+1} = \beta_0 + \beta_1 l_t + \beta_2 X_{t+1} + \epsilon_{t+1} \tag{2.12}$$

$$M_t^* = \delta_0 + \delta_1 l_t + \delta_2 Z_t + \zeta_t \tag{2.13}$$

The last equation estimates the probability of changing firm and the regressors Z_t include all X_{t+1}, plus some instruments.[52] The observed dichotomous realization of the latent variable M_t^* is whether each sampled worker changed job ($M_t = 1$) or not ($M_t = 0$):

$$M_t = \begin{cases} 1 & if\ M_t^* > 0 \\ 0 & otherwise \end{cases} \tag{2.14}$$

The main assumption in this case is that ϵ_i and u_i have a bivariate normal distribution.The estimated parameter ρ is the correlation between unobserved determinants of wage and of changing job.

We report the estimation results of a simplified Heckman model with a wage regression and a selection equation.[53] The first part of table 2.7 reports the estimated selection equation, while the second part the estimated wage regression.[54] The correlation between the residual of the selection and of the wage equation is not significant, suggesting that selection is not endogenous.[55] In other words, mobility does not significantly affect salary beyond the channels

[52]The Heckman model is identified non-parametrically through non-linearities introduced by the selection equation and parametrically through the exclusion restrictions imposed by the researcher.

[53]Estimates of the three equations corresponding to the endogenous switching model are available upon request. We also run a censored regression with varying censoring values. Indeed, if we assume that workers change job only if the offered wage is higher than what they could expect in their current firm and otherwise stay in their firm, then salaries of workers who changed job can be interpreted as left censored. Estimates are available upon request. That is, their salary would have been less than or equal to the one we observe. While this approach does rely on the validity of instruments, the Heckman model is more general, allowing the selection between staying in the current job and changing firm to depend not only on standard wage determinants, but also on unobserved factors.

[54]Results are obtained by FIML simultaneous estimation of the two equations.

[55]Similarly, Abowd et al. [2006] find no clear relation between residuals of mobility and wage equation.

Table 2.7: Robustness of network effects on salary to alternative specification for mobility endogeneity (Heckman estimation).

	Selection		Wage	
	Changed firm		Ln salary	
Ln potential network size (2002)	0.237***	(0.034)	0.135***	(0.038)
Ln salary (2002)	-0.177***	(0.044)	0.272***	(0.097)
Age (2006)	0.070	(0.072)	-0.026	(0.059)
Age sq. (2006)	-0.001	(0.001)	0.001	(0.001)
Gender: female	-0.165	(0.166)	0.233**	(0.091)
Achieved degree: BA	0.376***	(0.127)	0.555***	(0.159)
Achieved degree: MA	0.394***	(0.127)	0.505***	(0.111)
Achieved degree: PhD	0.320**	(0.153)	0.143	(0.151)
Degree major: Business	0.302***	(0.111)	-0.039	(0.130)
Degree major: Finance	0.272*	(0.165)	0.288*	(0.172)
Degree major: Science	-0.192	(0.390)	0.143	(0.242)
Degree major: Social Sciences	0.180	(0.180)	0.321*	(0.194)
Firm country: UK (2006)	0.457***	(0.097)	0.064	(0.119)
Sectoral growth for 2002-firm (2006-02)	-0.389*	(0.200)		
Headquarters country changed (2006-02)	2.155***	(0.363)		
Intercept	-3.467**	(1.709)	3.542**	(1.469)
ρ			-0.017	(0.140)
N			5432	
Log-likelihood			-781.092	

Note: Robust Standard Errors in brackets, clustered by firm.

Significance levels: *: 10% **: 5% ***: 1%.

we control for, as the instrumental variable estimation indicated, too. The indirect impact of links through mobility is highly significant and their direct effect is larger than the instrumental variable estimates. The elasticity of salary with respect to professional links suggested by the estimation of the Heckman model is 0.144%.

Alternative specifications for unobserved heterogeneity

The benchmark specification of this paper controls for unobserved heterogeneity mainly through the inclusion of previous salary as a regressor. Another possible approach is to include more controls, namely to control as much as possible for firm characteristics. Indeed, links may be endogenous with respect to salary because they both depend on some firm characteristics.

The second column of table 2.8 shows that salary indeed depends, beyond

Table 2.8: Robustness of network effects to alternative specifications for unobserved heterogeneity: firm characteristics (2SLS estimation).

	[I stage]		[II stage]	
	Changed firm		Ln salary	
Ln potential network size (2002)	0.016***	(0.00)	0.095***	(0.01)
Age (2006)	-0.003	(0.00)	0.113***	(0.02)
Age sq. (2006)	0.000	(0.00)	-0.001***	(0.00)
Gender: female	-0.011	(0.01)	-0.222***	(0.05)
Achieved degree: BA	0.014**	(0.01)	0.171***	(0.03)
Achieved degree: MA	0.017**	(0.01)	0.190***	(0.03)
Achieved degree: PhD	0.013	(0.01)	0.197***	(0.04)
Degree major: Business	0.018**	(0.01)	0.074**	(0.03)
Degree major: Finance	0.014	(0.01)	0.050	(0.04)
Degree major: Science	-0.009	(0.01)	-0.004	(0.09)
Degree major: Social Sciences	0.007	(0.01)	-0.129**	(0.06)
Firm country (2006): UK	0.033***	(0.01)	0.279***	(0.03)
Sector (2006): construction	0.014	(0.01)	0.032	(0.06)
Sector (2006): defense	-0.022	(0.02)	0.081	(0.06)
Sector (2006): education	-0.049***	(0.02)	-0.250	(0.20)
Sector (2006): financial	-0.004	(0.01)	-0.034	(0.04)
Sector (2006): health	0.011	(0.02)	-0.005	(0.04)
Sector (2006): information	0.001	(0.01)	0.020	(0.04)
Sector (2006): mining	0.022	(0.01)	0.137***	(0.04)
Sector (2006): real estate	0.011	(0.01)	0.240***	(0.07)
Sector (2006): services	0.007	(0.01)	-0.087*	(0.05)
Sector (2006): technical	0.029*	(0.02)	-0.069	(0.05)
Sector (2006): trade	0.032**	(0.01)	-0.046	(0.05)
Sector (2006): transportation	-0.001	(0.01)	-0.173**	(0.07)
Sector (2006): utilities	0.016	(0.02)	0.035	(0.05)
Ln firm number of employees (2006)	-0.001	(0.00)	0.133***	(0.01)
Sectoral growth for 2002-firm (2006-02)	-0.049**	(0.02)		
Headquarters country changed (2006-02)	0.556***	(0.13)		
Changed firm (2002-06)			-0.160	(0.35)
Intercept	0.073	(0.07)	1.316***	(0.49)
N	5371		5371	
F statistic cluster-robust			11.08	
Pseudo R^2 / R^2	0.057		0.190	
Hansen J statistic			14.355	
Hansen J χ^2 p-value			0.001	

Note: Robust Standard Errors in brackets, clustered by firm.

Significance levels: *: 10% **: 5% ***: 1%.

the Mincerian determinants, on some characteristics of the firm. Beyond location,[56] firm sector affects salaries in a few cases, once firm size is controlled for.[57] As expected, we find that salary adjusts for company size.[58] The estimated elasticity of salary with respect to links is higher than when controlling for past salary. Therefore, our benchmark specification may actually absorb even too much of the individual heterogeneity and it represents a conservative estimate of the network effects. The estimated marginal effect of network on the probability of changing firm reported in the first column of table 2.8 is basically the same as in the benchmark specification.

Another approach to take into account the endogeneity of links, beyond controlling for previous salary, is to directly consider network size as endogenous and instrument it (first column of table 2.9).

In order to take into account the potential endogeneity of links and to estimate this first stage, an additional instrument is included, counting how many times the person changed job before 2002.As intuitive, the more differentiated the experience in different jobs, the larger the potential network size. The second column of table 2.9 reports the first stage estimates of the determinants of mobility decisions and the last one the estimated coefficients of the second stage. The elasticity of salary with respect to potential network size is positive and significant, consistently with the benchmark estimate. The magnitude of the elasticity is however more than three times larger, suggesting that an increase in the number of professional links by 40 (from the average 121 to

[56] See section 2.5.1.

[57] Without controlling for size, a few more sectors are significant. The relatively little importance of sector is not too surprising, since surveys adjust for company size and only sometimes for industry (see Murphy [1999]).

[58] As often the case, the adjustment appears to be consistent with a simple log-linear regression of logarithm of salary on logarithm of firm size (see Murphy [1999]). Some standard explanations for the relation between firm size and salaries are that monitoring is more difficult in big firms (Bulow and Summers [1976]) and that large firms better select on unobserved worker characteristics (Weiss and Landau [1984]). See Abowd et al. [1999] for a discussion of the firm-size wage effect. Base salary for CEO is typically determined through competitive benchmarking based primarily on general industry salary surveys. Size adjustment in the survey instruments both formalize and reinforce the observed relation between compensation and company size.

Table 2.9: Robustness of network effects to alternative specifications for unobserved heterogeneity: endogeneity of mobility and network size (2SLS estimation).

	[I stage] Ln pot.netw.size		[I stage] Changed firm		[II stage] Ln salary	
Ln potential network size (2002)					0.202**	(0.09)
Ln salary (2002)	0.239***	(0.02)	-0.008***	(0.00)	0.680***	(0.03)
Age (2006)	-0.007	(0.02)	-0.000	(0.00)	0.017	(0.01)
Age sq. (2006)	0.000	(0.00)	0.000	(0.00)	-0.000*	(0.00)
Gender: female	0.160***	(0.06)	-0.009	(0.01)	-0.085**	(0.03)
Achieved degree: BA	0.369***	(0.04)	0.021***	(0.01)	0.024	(0.04)
Achieved degree: MA	0.523***	(0.04)	0.027***	(0.01)	0.025	(0.05)
Achieved degree: PhD	0.405***	(0.05)	0.019**	(0.01)	-0.025	(0.05)
Degree major: Business	0.183***	(0.04)	0.021***	(0.01)	0.012	(0.03)
Degree major: Finance	0.831***	(0.06)	0.026***	(0.01)	-0.071	(0.08)
Degree major: Science	-0.218*	(0.12)	-0.015	(0.02)	-0.004	(0.07)
Degree major: Social Sc.	-0.056	(0.06)	0.006	(0.01)	0.064	(0.04)
Firm country (2006): UK	-0.278***	(0.04)	0.025***	(0.01)	0.331***	(0.04)
Sectoral growth for 2002-firm (2006-02)	-0.194***	(0.06)	-0.031***	(0.01)		
Headquarters country changed (2006-02)	-0.068	(0.25)	0.564***	(0.04)		
Number of jobs changed (2002)	0.892***	(0.09)	-0.003	(0.02)		
Changed firm (2002-06)					-0.810	(0.50)
Intercept	2.921***	(0.43)	0.108	(0.07)	0.834*	(0.43)
N	5431		5431		5431	
F statistic cluster-robust					48.74	
Pseudo R^2 / R^2	0.159		0.044		0.547	
Hansen J statistic					0.557	
Hansen J χ^2 p-value					0.456	

Note: Robust Standard Errors in brackets, clustered by firm. Significance levels: *: 10% **: 5% ***: 1%.

161 links) accompanies an increase of salary of 39 thousand USD (from the average 390 thousand to 429 thousand USD). Our benchmark estimate of link direct effect appears therefore as a conservative one with respect to the case where also links are considered as endogenous (see table 2.10 for a comparison of estimated elasticities of salary with respect to potential network size).

Table 2.10: Estimated elasticities of salary with respect to potential network size (link direct effect).

elasticity	estimation		
0.163	basic OLS	without mobility and previous salary	(column [I] table 2.3)
0.053	basic OLS	without mobility	(column [II] table 2.3)
0.158	basic OLS	without previous salary	(column [III] table 2.3)
0.048	basic OLS		(column [IV] table 2.3)
0.067	benchmark IV		(column [I] table 2.4)
0.062	network charact. IV	with link overlap	(column [I] table 2.5)
0.093	network charact. IV	with link age	(column [III] table 2.5)
0.225	robustness IV	continuation value (total wealth)	(column [I] table 2.6)
0.069	robustness IV	continuation value (end of career)	(column [III] table 2.6)
0.135	robustness Heckman	mobility endogeneity	(column [I] table 2.7)
0.095	robustness IV	unobs. heterogeneity (firm charact.)	(column [I] table 2.8)
0.202	robustness IV	unobs. heterogeneity (network endog.)	(column [I] table 2.9)

2.6 Conclusions

This paper emphasizes that the relation between network and labor outcomes is characterized by multiple mechanisms and dynamic coevolution. The most obvious mechanism whereby the characteristics of professional networks affect the career is that they are privileged channels of information diffusion. Indeed, careers are shaped by a succession of mobility decisions. At many points in time during an individual's career, a worker may receive offers and has to decide whether staying in the current firm or changing job. The probability of moving to another firm is likely to be affected by some characteristics of her employment network. In particular, the larger the first degree network of the individual, the higher the probability that she gets exposed to job offers. This is particularly true in the case of Top Managers and Board Members. Indeed, these positions are usually filled through head hunting and professional acquaintanceship, rather than through formal advertisement of openings.

The second way whereby professional networks influence labor outcomes is that they represent a valuable asset in the eyes of an employer. In particular, the individuals' employment network outside the firm represents a form of social capital that may be useful for the employer and that is thus 'remunerated'.

While professional links affect labor outcomes, at the same time a worker's network is substantially shaped by career choices. Indeed, decisions along the career path shape the development of one's professional network. Career choices and in particular the decision to change job therefore result from a recursive optimization and it is necessary to look at them in a dynamic way.

Therefore, the paper develops a dynamic framework where the utility of a worker is affected by the choices she makes during her career and by the characteristics of her professional network. In particular, the optimal value depends on professional networks directly through current utility to the extent that links are valuable to the employer and indirectly through the effect that they have on mobility decisions.

The empirical analysis is based on an original dataset describing the career history of more than 90 thousand Executives and Board Members working in almost 4 thousand firms in 4 counties (US, UK, France, and Germany) between 1997 and 2009. For the purpose of this paper, we restrict our attention to a sample of almost 7 thousand Executives working in more than 3 thousand firm between 2002 and 2006. A descriptive analysis of the relations among the variables that are at the center of this paper (salary, professional links, and mobility decisions) provides foundation to the hypotheses of the theoretical framework.

Based on a more rigorous specification suggested by the model, we find evidence that professional networks are relevant both because valuable for the employer and because they facilitate job mobility. For instance, if a worker had 50% more links than the average (that is, had 61 more links more than the average 121), her annual salary would be 13 thousand USD higher (from an average of 390 to 403 thousand USD) and the probability of moving would increase by 15% (from an average of 3% to 3.45%). These findings are robust to alternative definitions of career value and specifications accounting for mobility and link endogeneity.

We also find that current colleagues are not a useful component of a worker's network. Moreover, networks characterized on average by ties between nodes that have been colleagues for a long time have a lower direct and indirect effect on labor outcomes. Finally, networks where many links are represented by workers that have been colleagues a long time before are less valuable to the employer.

Further research could shed light on the relation between other characteristics of professional networks and labor outcomes. In particular, a further step of analysis entails the exploitation of the geometric network structure in order, for instance, to understand the relation between a worker centrality and her labor outcomes.

Chapter 3

Joint Ownership of Production Projects as a Commitment Device against Lobbies[1]

3.1 Introduction

Many projects involve cooperation between partners, often at an international level. Sometimes this cooperation is contractual. Often, though, it takes the form of joint ownership of production projects by two or more firms. This is a puzzle: joint ownership is typically inefficient, because interests often diverge and strategies target different objectives among partners. So why does it happen?

The answer we explore in this paper is that joint ownership may have advantages when it commits the parties to resisting certain kinds of lobbying to expropriate the fruits of investment in the project. Joint ownership of a production project is particularly common in industries that face highly uncertain returns to investments and in which, as a result, investments tend to be spread out over time in order to benefit from the option value of learning

[1] Coauthored with Paul Seabright.

from the success of initial investments about the prospects for later ones[2].

Specifically, in section 3.3 we assume that a number of firms have the opportunity to invest in a project that yields revenue in two stages. The results of the first stage are informative about the likely results of the second stage, due to autocorrelation in productivity shocks: a project that is successful in the first round is more likely to have good outcomes in the second round, too. However, there are lobbies that demand payouts, and their demands are the more vociferous the higher are the revenues from the first round. A successful first round therefore creates a tension: it implies a strong reason to reinvest the revenues, but it also gives rise to intense lobbying to distribute the revenues instead. As we show below, this pressure is stronger when the lobbies' goals are at least partially shared by the decision makers in the firm itself.

In this context joint ownership with one or more other firms helps the firm to resist such lobbying, not completely, but to some extent. In practice it often takes the corporate governance structure of a joint venture (JV).[3] Because in a JV payouts to one partner's lobbies have to be matched by payouts to those of the other partner, giving in to lobbying pressure is more expensive and less likely to occur; in response the lobbies will scale down their efforts at persuasion and waste fewer resources in such activities. Therefore, our model implies that organizations under tough (internal or external) pressure of lobbies should tend to choose joint ownership of a production project. We find support to this prediction based on data from the European Bank of Reconstruction and Development - World Bank Business Environment and Enterprise Performance Surveys (BEEPS), as detailed in section 3.4.

[2]Note that this argument is based on option values and has nothing to do with risk aversion

[3]As far this paper is concerned, JVs are defined as having the following characteristics: *(i)* each party has an ownership interest in a jointly owned business, and *(ii)* the parties share the profits (or losses) of the jointly owned business. This definition is a more general version of Hewitt [2008] definition of equity JV, as opposed to collaborative JV, which only involves agreements by companies to cooperate without affiliation through stock ownership. While many other rationales may lead to the constitution of JVs, this paper focuses on joint ownership as a commitment device.

Notice that interest groups may indeed exist within the firm (some divisions of the firm may have divergent interests from those of the Head Office or Board of Directors)[4], or outside it (there may be political pressures, or pressures from trade-unions or from upstream or downstream trading partners).[5]

Moreover, the structure of joint ownership of a production project as a commitment device against lobbying pressure may be useful whether the decision-making organization is a firm or a government.[6] For instance, in the case of infrastructure projects, especially in developing countries, decision makers are often country governments and they may face internal and external lobbying, too.

Joint ownership of production is common in infrastructure projects.[7] They require considerable and sustained investments that are highly visible, having a cost structure that is typically heavily weighted toward fixed (sunk) costs. Indeed, firms may generate large operating profits while being barely able to cover fixed costs. Profits are also extremely sensitive to the regulatory and political context in which organizations operate. They are often subject to strong political pressures to keep prices low or to other rent-seeking manoeuvres, once investments are sunk. Weak institutions and powerful interesting groups make it even more difficult to resist political pressures to claw back profits resulting from the success of initial tranches of infrastructure investment.

Indeed, if the project succeeds and generates substantial net revenues, major political pressures may emerge to recoup some of the benefits.[8] This may

[4]A wholly owned research project that starts to yield positive profits may risk being treated as a cash cow by jealous divisions in the parent company, at a potential cost to its own long-term investments needs.

[5]It is also possible that internal and external interest groups interact.

[6]For simplicity, in what follows we are going to use in general the term firm, but a similar reasoning applies for other types of organization as well.

[7]We investigated about thirty-five cases of infrastructure projects mainly in sectors like natural resources and renewable energies across the African, American and Asian continent. More than two third of these projects were or still are run by a JV.

[8]Among the thirty-five cases of infrastructure projects that we explored we found some evidence that lobbying pressure is a problem in more than one third of the infrastructure JVs. For instance, the Yacyretá hydro-power project in Paraguay suffered more than ten years of delay due to regional maneuvering and lobbying by the Argentine nuclear and oil industries, besides political instability in Argentina.

occur through repayments of dividends to the public budget, which has many urgent claims on the revenues generated other than reinvestment. Or it may occur through caps on tariffs in the name of allowing the citizens (even if this means mainly rich farmers and industrialists) to share in the prosperity generated by the investments. But it is precisely at the time when the project has succeeded that it is most important to reinvest some of its earnings, both in maintenance expenditures to ensure that the benefits are maintained and in expansion since the project's success is a positive signal that further investments in similar conditions are also likely to be successful. Thus, the influence activity set up by the project's success in the past may stand in the way of its continued success in the future.

In these circumstances joint ownership, particularly with a foreign government or firm, can play an important role in committing the project to reinvest revenues instead of paying them back under the pressures of political lobbying. Let's imagine a hydro-electric plant owned by two bordering countries. First of all, repayment of dividends to the public budget would require proportional payments to be made to the partner; this would make the payouts more expensive from the point of view of the lobbyists because twice as much must be paid out to ensure the same benefits. Alternatively, if the clawing-back of the project's benefits is done not by distributing dividends but by capping tariffs, this will cost the partner, which can be expected to engage in some fierce lobbying of its own. In other words, the partner becomes a formidable source of countervailing pressure against payouts of revenues that would be better reinvested in the project. Joint ownership, so often the source of inefficiencies in management structures (because of divergences in interests and strategies of the partners), becomes here a positive source of strength because it allows the owners of a project to commit to a consistent pattern of investment over time.

Our theoretical model suggests that the corporate governance structure

of JV may contribute to the success of a project by committing the parties to equality of treatment with respect of the profit generated by a project. When revenues are realized and the owners of the project choose whether to distribute them or to reinvest them back into the project, the distribution option is relatively less attractive than in the case of a unique parent company that wholly-owns the project. The success of the project is enhanced for two reasons. First, investment *per se* tends to improve the likelihood that a project is doing well. Second, the enhanced credibility in committing to adequate reinvestment makes the initial undertaking of the project more likely.

Good reputation acquired through successful projects also fosters the development of new projects. Several examples can be found among infrastructure projects. In Chile good progress in the construction of La Higuera hydro-plant, which started in 2005 and came on line in 2010, was followed by new investments to build upstream another power plant with similar capacity, La Confluencia. The fact that La Higuera project was undertaken by the power generator Tinguiririca Energia, a 50-50 JV formed in 2004 between Pacific Hydro Chile and the Norwegian Statkraft Norfund Power Invest may have contributed to the credibility of commitment necessary to the success of the project and its follow-up.

Another example of the importance of the ability to build up a reputation of credibility is the potential development of Inga's hydro-power infrastructures in the Democratic Republic of Congo (DRC). A 5GW power station, known as Inga III, was supposed to be built by WestCor, a JV which includes the power utilities of the DRC, Angola, Namibia, Botswana, and South Africa. However, DRC authorities eventually gave the Inga III project to the mining giant BHP Billiton. Hopefully, this decision will not jeopardize the final stage of Inga, known as Grand Inga. Indeed, Grand Inga is conceptualized at 39GW capacity (nearly twice the size of the Three Gorges dam) and it is capital for Africa. The project will be approved or rejected in 2014. If realized, it would

be the world's biggest hydro-power generator. The project has been on the continent's electricity agenda for more that three decades. Besides other crucial circumstances, the credibility of WestCor in committing against rent-seeking by lobbying groups could contribute to the undertaking of the project.

An equal sharing of costs and benefits is crucial in providing incentives against distribution of early revenues or *ex post* expropriation. As discussed in the theoretical section, asymmetry in the shares held by the parent firms may weaken the ability of joint ownership to provide a commitment device.[9]

Itaipú Binacional in Paraguay, for example, is a JV between Paraguay and Brazil. This hydro-plant, located on one of the world's five largest river systems, is capable of generating 14GW of electricity. At the time of construction, Brazil bore most of the costs in terms of financial and technical contributions. Both countries signed an accord on repayment of Itaipú and that agreement envisaged that no profit would be distributed until the loan were completely paid off. Initial arrangements benefited Brazil in that they stated that each country has the right to use 50% of the energy produced, but if not, the excess must be sold to the other partner at a price based on production cost. Since Paraguay needs only a tiny fraction of its power (about 7%), it sells most of its share back to Brazil at a predetermined (low) rate. Brazil purchases 97% of the plant's power, which accounts for about 20% of its energy consumption. After twelve years of indecision about how to adjust the low prices that the countries had negotiated in the original treaty, in 1985 Paraguay and Brazil signed five revisions to cover matters of financial compensation. Paraguay gained significantly from the 1985 revisions, but most analysts considered that Paraguay deserved still greater compensation for its electricity. In less than a decade the loan will be paid off so that each country would be free to charge market prices. However, President Lugo has threatened to end the contractual obligations that require Paraguay to sell its unused electricity to Brazil at well

[9] Among the 35 cases that we analyzed, when JVs are characterized by asymmetric benefits from profits generated by infrastructures, lack of commitment always arises.

below the market rate and seeks to earn seven times more from Itaipú energy.

Something similar happens between Paraguay and Argentina for the hydro-plant of Yacyretá. While none of the electricity produced by Yacyretá was intended for use by Paraguayans, the energy that it produces provides 15% of the total energy demanded in Argentina. In the words of a BBC reporter "Argentina has good reason to be worried too, as it has its own Yacyretá hydro-electric JV with Paraguay".

The asymmetry in benefits from infrastructures dramatically weakens the commitment ability of the parties not to lobby for benefits *ex post*. The lack of commitment in turn hinders the undertaking of new infrastructure projects. If Paraguay decides to break Itaipú's contractual obligations with Brazil, several projects along the Río Paraná will be threatened. These include the Corpus plant, expected to be comparable in size to Yacyretá, and several smaller hydro-electric power plants downstream from Yacyretá, including Itatí-Itá-Corá.

The paper is structured as follows. Section 3.2 situates the paper in the literature on corporate governance and JVs. Section 3.3 sets out the model and derives the main results. Section 3.4 illustratively investigates a crucial theoretical prediction of the model, namely that organizations under tough internal or external pressure tend to choose JVs, based on BEEPS data from 27 countries. Section 3.5 concludes.

3.2 Review of the Literature

Arguments that some governance structures are better than others at resisting lobbying and other forms of influence-seeking are not new in the literature on industrial organization. Meyer et al. [1992] argued that demergers and spin-offs are often a good way for firms to lower the costs of internal influence-seeking, and since these costs are arguably higher in periods of depressed demand (because managers have lower relative benefits from devoting their energies to

productive activities), we should expect to see more demerger activity in recessions than in booms. A similar logic explains why privatization by the state should be more frequent in recessions than in booms. Crémer [1995] argues likewise that 'arms-length relationships' are better at committing managers to making subordinate individuals or subsidiary divisions work hard, since they make it credible that managers can refuse to consider excuses (especially valid excuses) for poor performance. Subordinates who know that not even valid excuses will be considered favorably have even greater incentives to work hard. Such theories have so far, though, focused on the role of organizational frontiers as commitment devices, not on the role of joint ownership.

While many types of commitment mechanisms are possible within the firm (*e.g.* incentive contracts, delegated decision making, etc), as far as we are aware, the role of the joint ownership of a production project as commitment device is new to the present paper.[10] This paper sheds light on the hitherto unexplored possibility that joint ownership of a production project may provide a commitment device against lobbies, while it does not compare it to other possible commitment devices.

An early attempt to provide theoretical foundations for JVs was proposed by Kogut [1988]. His main contribution is based on a transactions cost framework, defined by Gibbons [2005] as a rent-seeking theory of the firm. According to Kogut, JVs allow partners to solve situations with high uncertainty about the contracting parties' behavior, thanks to the unification of control rights in the new hierarchical structure.

However, in the property rights theories of the firm, due to Grossman and Hart [1986] or Hart and Moore [1989], the returns from relationship-specific investments can be appropriated by the non-investing partner; thus, *ex ante* investment incentives are distorted and the classical hold-up problem arises. More recently, Cai [2003] finds that when general and specific investments are

[10]Neven et al. [1998] set out a purely verbal form of the present argument.

substitutes, efficient levels of relationship-specific investments can be achieved. On the other hand, when investments are complements the standard conclusion of property rights theories is that joint ownership is not optimal.

Some form of relationship-specific investment must be necessary in our model to explain why a project takes place within a parent firm at all rather than being a purely independent entity that transacts with the parent firm entirely through the market. But relationship-specific investments play no part in our explanation of why there is joint ownership of a project rather than ownership by a single parent.

Within the framework of property rights theories other explanations for joint ownership have been proposed. Hauswald and Hege [2003] show that in a setup with just one type of investment and where higher levels of investment erode rent-seeking activity regimes characterized by 50%-50%, 50% plus one, and majority ownership can coexist in equilibrium and each can be optimal for wide set of different JVs. Finally, international JVs may result from national policies. For example, Abe and Zhao [2005] study the impact of a country's emission taxes on the formation of IJVs or fully owned FDI. This paper sheds light on a hitherto unexplored rationale for joint ownership and does not assess its quantitative relevance with respect to other rationales to form JV that have been already explored by the literature, nor it develops a cost-benefit analysis of joint ownership.[11]

According to Moskalev and Swensen [2007], between 1990 and 2000 alone 60,446 JVs took place around the world. Most JVs (87%) had two partners, and 9.1% had three. Their analysis shows some characteristics of JVs that are consistent with our theoretical framework. JVs are more common in some industries than in others. In particular, Moskalev and Swensen [2007] suggest

[11]There are of course disadvantages in joint ownership. For instance, it might be cheaper to manage centrally different tax systems than to respond to each of them separately; by a parallel argument, it may be cheaper to plan a worldwide production than to coordinate each JV partner to achieve the same goal; finally, JVs pose a constant threat of undesired technology transfers due to weak property rights legislation.

that JVs are more common in industries where firms face higher risks. Indeed, they show that 54.5% of all JVs from 1990-2000 were concentrated in ten industries that are technologically intensive. Moreover, partners in JVs have a preference for equal asset ownerships; this holds both for agreements between national firms and for international JVs.

Although the papers in this literature have provided many important insights into the motives for forming JVs, especially in the presence of specific investments, none of them has investigated the role of rent-seeking and lobbying in the absence of such investments. In the model developed in section 3.3, there are no investments that are specific to the relationship between the parents of the JV, but JVs will nevertheless play a crucial role in providing incentives for efficient investment. How can such joint ownership commit the parties to managing the project's investment profile more efficiently? The reason is that JVs provide a commitment mechanism that makes giving in to lobbying pressures more expensive for the owners of a project. Indeed, joint ownership commits the parties to equality of treatment in respect of the revenues generated by the project. When revenues are realized the owners of the project are of course free to reinvest those revenues back into the project, or to distribute them as they see fit. Lobbying activity, we have suggested (in line with the arguments of Meyer et al. [1992]), will create a bias toward distribution and away from reinvestment. However, an economic agent who is only part-owner of the project will find that distribution becomes relatively expensive: choosing to distribute revenues implies a duty to distribute to the other owners as well. This greater cost may help, therefore, to redress the balance and make reinvestment relatively more attractive again. It is to this model that we now turn.

3.3 The Model

There are M firms, $i = 1, ..., M$.[12] For each firm there are n lobbies $n_i = 1, ..., n$.[13]

There are four time periods, $t = 0, 1, 2, 3$. Period 0 is when the rules are made and decisions taken about whether or not to form JVs.[14] Decisions about resource allocation take place in periods 1 and 2. Period 3 is when final profits are enjoyed. To fix ideas, call period 0 the 'set-up' period, period 1 the 'initial investment' period, period 2 the 'follow-up investment' period, and period 3 the 'results' period.

We begin with the strategies and payoffs of firms in the absence of lobbies. That is, we consider what the project should and would do if its investment and other decisions could be made without any pressure from lobbies (section 3.3.1). We then consider what effect lobbies have on these decisions and how firms will behave differently when they know lobbies are active (section 3.3.2). Finally, the possibility of creating JVs is taken into account (section 3.3.3).

3.3.1 Investment without lobbies

We set out here a simple framework in which each firm makes an investment in period 1 and another in period 2, after the results of the first investment have been observed. We allow for the possibility that the time lag between investment and results differs for investment in period 1 and in period 2. The results of period 1 investment are informative, because the higher the returns to the first investment, the higher are likely to be the returns to the second. Specifically, the productivity of the investments are correlated by a factor θ,

[12] As explained in section 3.1, the term 'firm' is used as a shortcut to indicate the decision maker of a firm or of another type of organization. For instance, in the case of JVs for infrastructure projects, national or local governments are likely to own part of the project, especially in developing countries.

[13] As illustrated in section 3.1, the term 'lobbies' designates groups either internal or external with respect to the organization, whose interests are not aligned with those of the firm.

[14] A JV is characterized as a joint ownership agreement, as detailed in section 3.1.

which we define formally below. This means that a firm that has had good results in the first period will want to invest more in the second. For instance, if a hydro project has been built on time and under budget and if indeed it has provided power to a large number of users who previously were under-connected, it is worth investing in the project's maintenance. Moreover, it also suggests that it may be worth building further hydro projects in similar conditions as well.

However, investment in each period must come at the expense of more immediate uses of the funds. This is just the same as saying that there is a budget constraint in each period. This budget constraint creates a tension: as we shall see later when we introduce lobbies, the circumstances when investment requirements are high are precisely those in which the pressure to pay out profits are also high.

The way to state these assumptions formally is as follows. At $t = 1, 2$ each firm makes investments $k_i^t \geq 0$ costing $bk_i^t + d\left(k_i^t\right)^2$, which result in output Q_i^t one period later, namely at $t = 2, 3$. The cost function is strictly increasing and strictly convex so $b, d > 0$.

Output depends on investment and on a random productivity shock as follows. Investments made in period 1 give rise to output in period 2 according to the following production function:

$$Q_i^2 = \theta_i^1 k_i^1 \tag{3.1}$$

where θ_i^1 is an initial productivity shock distributed on $\left[\underline{\theta}, \overline{\theta}\right]$ with an expected value of $H > 1$.

Productivity shocks are autocorrelated, which makes expected returns on investment in period 2 depend on the realization of the productivity shock in period 1. In addition we assume that capital is durable, so that investments made in period 1 lead to output in period 3 as well as in period 2 (nothing of importance in the qualitative results turns on this assumption). Thus, output

in period 3 is given by the following production function:

$$Q_i^3 = \theta_i^2 \left(k_i^1 + k_i^2 \right) \tag{3.2}$$

where θ_i^2 is a second productivity shock and $\mathbb{E}\left(\theta_i^2 \mid \theta_i^1\right) = \theta\theta_i^1$.

Each firm has an initial endowment E_i^1 out of which it finances period 1 investment; period 2 investment must be financed out of period 2 output. Normalizing output price to 1, this leads to budget constraints for the three periods as follows:

$$bk_i^1 + d\left(k_i^1\right)^2 + \pi_i^1 = E_i^1 \tag{3.3}$$

$$bk_i^2 + d\left(k_i^2\right)^2 + \pi_i^2 = Q_i^2 \tag{3.4}$$

$$\pi_i^3 = Q_i^3 \tag{3.5}$$

Firms are risk-neutral. Each firm maximizes the expected weighted sum of profits $\Pi = \pi_i^1 + \beta\pi_i^2 + \beta\gamma\pi_i^3$ subject to the constraints (3.1), (3.2), (3.3), (3.4), (3.5), and to the non-negativity constraints $k_i^1, k_i^2, \pi_i^1, \pi_i^2, \pi_i^3 \geq 0$. Note that the discounting of profit between period 1 and period 2 involves a discount factor β, while discounting between period 2 and period 3 involves a discount factor γ. There is no inconsistency in this, just a recognition that the lapse of time involved in realizing the fruits of the initial investments may not be the same as that involved in realizing the fruits of the second round of investments.[15]

Our first result concerns the optimal choice of investments that each firm would make in the absence of lobbying activity. We begin by considering the optimal choice of investments without lobbies, solving the model backwards as usual, beginning in period 2 and then, assuming that the firm anticipates

[15]If we imposed that the two lapses of time were equal and that $\gamma > \beta$, this modeling could reflect time inconsistency.

what it will do in period 2, solving the model for period 1.

Optimization at period 2 requires: $Max_{k_i^2}\mathbb{E}\left[\pi_i^2 + \gamma\pi_i^3 \mid \theta_i^1\right]$ subject to (3.1), (3.2), (3.4), and (3.5). This is equivalent to:

$$Max_{k_i^2}\left[\theta_i^1 k_i^1 - bk_i^2 - d\left(k_i^2\right)^2 + \gamma\theta\theta_i^1\left(k_i^1 + k_i^2\right)\right]$$

for which the first order condition is:

$$k_i^2 = \frac{\gamma\theta\theta_i^1 - b}{2d} \tag{3.6}$$

Optimization at period 1 therefore requires:

$$Max_{k_i^1}\mathbb{E}\left\{E_i^1 - bk_i^1 - d\left(k_i^1\right)^2 + \beta\left[\theta_i^1 k_i^1 - bk_i^2 - d\left(k_i^2\right)^2\right] + \beta\gamma\left[\theta\theta_i^1\left(k_i^1 + \frac{\gamma\theta\theta_i^1 - b}{2d}\right)\right]\right\}$$

for which the first order condition is $k_i^1 = \frac{\beta H(1+\gamma\theta)-b}{2d}$.

We summarize these findings in the following proposition:

Proposition 4. *In the absence of lobbying, each firm chooses investment levels in periods* 1 *and* 2 *given by* $k_i^1 = \frac{\beta H(1+\gamma\theta)-b}{2d}, k_i^2 = \frac{\gamma\theta\theta_i^1-b}{2d}$. *Both investment levels are decreasing in the level and concavity of the cost of investment and increasing in the autocorrelation of productivity shocks as well as in the discount factor* γ. *In addition first-period investment is increasing in expected productivity and in the discount factor* β, *while second-period investment is increasing in the realization of the first-period productivity shock.*

It is important to note that optimal investment is greater when first-period output is high, not because of profit-smoothing considerations (since utility is linear in profit) but rather because of the auto-correlation in productivity. However, it is precisely this which causes problems once lobbies enter the picture, since lobbies will assume that high output provides opportunities for high payouts.

3.3.2 Introducing lobbies

Now suppose that for each firm there exist n lobbies $n_i = 1, ..., n$. For simplicity we assume the number of lobbies is the same for each firm, though as will be seen nothing in the argument depends on this. Each lobby can ask for a payout p_i^n at period 2,[16] to be paid out of the output produced by investments in period 1. Before asking for the payout the lobby can invest resources r_i^n in 'persuasion'. It may lobby politicians and regulators directly, or it may engage in high-profile campaigning in the press designed to pressurize the firm into accepting that the profits of the project should be 'returned to the people'. The effect of persuasion is to make the request 'hard to refuse'. Formally we assume that lobbying imposes a cost $\lambda k_i^2 r_i^n$ of refusal, which is increasing in k_i^2 as well as in r_i^n. The idea is that the more the firm is investing in the project, the harder it is to justify refusing the lobby's request. The parameter λ captures the 'effectiveness' of lobbying. If it is too low, the lobbies will not invest in lobbying at all, but we shall see that once it is above a certain threshold they all do so, and as a result the firm invests less in the second period.

We can therefore rewrite the second-period budget constraint as:

$$bk_i^2 + d\left(k_i^2\right)^2 + \pi_i^2 = Q_i^2 - a_i p_i^n - (n - a_i)\,\lambda k_i^2 r_i^n \tag{3.7}$$

where a_i is the number of payout requests that the firm accepts.

The lobby's payoff function is simply the expected value of payouts minus investments in persuasion. We also modify the payoff function of each firm by assuming that it internalizes some proportion α of the benefits to the lobbies. We can describe the parameter α as the extent to which the firm 'sympathizes' with the aims of the lobbies. We shall see that, paradoxically, the more sympathetic the firm is to the lobbies' aims, the harder it finds to resist their requests, and therefore the more inefficiently it chooses investment levels.

[16] We assume that lobbies only have one chance to do so, or equivalently that they are equally impatient. Indeed, otherwise a common pool problem would arise.

The objective function of the firm therefore becomes:

$$\Pi = \pi_i^1 + \beta\left(\pi_i^2 + \alpha a_i p_i^n\right) + \beta\gamma\pi_i^3 \tag{3.8}$$

The time-line of the actions is as follows:

- Period 1: Firms choose levels of investment k_i^1.
- Period 2: Output Q_i^2 is realized, then lobbies choose how much r_i^n to invest in persuasion, and request a payout p_i^n.
- Period 2′: Firms then decide whether to grant the payout or not, and choose levels of investment k_i^2.
- Period 3: Output Q_i^3 is realized.

We can then solve the model as before, but this time taking the actions of lobbies into account.

First it is evident that in period 2 each lobby asks for the maximum payout that the firm will give. That is:

$$(1-\alpha)\, p_i^n = \lambda k_i^2 r_i^n \tag{3.9}$$

Thus, we can re-write the firm's period 2 optimization as:

$$Max_{k_i^2}\mathbb{E}\left\{\pi_i^2 + \alpha a_i p_i^n + \gamma\left[\theta_i^2\left(k_i^1 + k_i^2\right)\right] \mid \theta_i^1\right\}$$

subject to $a_i = n$, and to equations (3.7), (3.1), and (3.9), which is equivalent to:

$$Max_{k_i^2}\left\{\theta_i^1 k_i^1 - b k_i^2 - d\left(k_i^2\right)^2 - n\lambda k_i^2 r_i^n + \gamma\theta\theta_i^1\left(k_i^1 + k_i^2\right)\right\}$$

for which the first order conditions are:

$$k_i^2 = \frac{\gamma\theta\theta_i^1 - n\lambda r_i^n - b}{2d}$$

We now consider the choice of r_i^n by the lobbies. Each lobby $Max_{r_i^n}\left(0, p_i^n - r_i^n\right)$, which is equivalent to:

$$Max_{r_i^n}\left(0, \frac{\lambda r_i^n\left(\gamma\theta\theta_i^1 - n\lambda r_i^n - b\right)}{2d\left(1-\alpha\right)} - r_i^n\right)$$

for which the first order conditions at an interior solution are $\frac{\lambda\left(\gamma\theta\theta_i^1 - 2n\lambda r_i^n - b\right)}{2d(1-\alpha)} = 1$, implying that:

$$r_i^n = Max\left[0, \frac{\lambda\gamma\theta\theta_i^1 - \lambda b - 2d\left(1-\alpha\right)}{2n\lambda^2}\right] \tag{3.10}$$

Note that $r_i^n > 0$ if and only if $\lambda > \frac{2d(1-\alpha)}{\left(\gamma\theta\theta_i^1 - b\right)}$.

The choice of investment in period 2 is given by:

$$\begin{aligned} k_i^2 &= \frac{\gamma\theta\theta_i^1 - b - Max\left[0, \frac{1}{2\lambda}\left(\lambda\gamma\theta\theta_i^1 - \lambda b - 2d\left(1-\alpha\right)\right)\right]}{2d} \\ &= \frac{\gamma\theta\theta_i^1 - b}{2d} - Max\left[0, \frac{\lambda\left(\gamma\theta\theta_i^1 - b\right) - 2d\left(1-\alpha\right)}{4d\lambda}\right] \end{aligned} \tag{3.11}$$

Comparing it to the efficient level (3.6), we can see that investment is lower than the efficient level if and only if $\lambda > \frac{2d(1-\alpha)}{\left(\gamma\theta\theta_i^1 - b\right)}$, and it is lower by the amount $\frac{\lambda\left(\gamma\theta\theta_i^1 - b\right) - 2d(1-\alpha)}{4d\lambda}$.

Note also that if the choice of persuasion by lobbies had been made in period 1, before θ_i^1 were realized, the choice of r_i^n would have been:

$$r_i^n = Max\left[0, \frac{\lambda\gamma\theta H - \lambda b - 2d\left(1-\alpha\right)}{2n\lambda^2}\right]$$

Comparing it with expression (3.10), it is qualitatively similar to the choice of persuasion actually made in period 2, except that if $\lambda > \frac{2d(1-\alpha)}{(\gamma\theta H - b)}$ the lobbies would always have invested in persuasion, whereas in fact they may fail to do so for low realizations of θ_i^1 if $\lambda < \frac{2d(1-\alpha)}{(\gamma\theta\underline{\theta} - b)}$.

Replacing (3.1) into (3.7), (3.2) into (3.5), (3.3), and (3.10) into (3.8), firm's

optimization at period 1 now requires:

$$Max_{k_i^1}\mathbb{E}\left\{\begin{array}{c} E_i^1 - bk_i^1 - d\left(k_i^1\right)^2 + \\ +\beta\left\{\theta_i^1 k_i^1 - bk_i^2 - d\left(k_i^2\right)^2 - n\lambda k_i^2 \cdot Max\left[0, \frac{\lambda\gamma\theta\theta_i^1 - \lambda b - 2d(1-\alpha)}{2n\lambda^2}\right]\right\} + \\ +\beta\gamma\left[\theta\theta_i^1\left(k_i^1 + k_i^2\right)\right] \end{array}\right\}$$

subject to (3.11), for which the first order condition is still $k_i^1 = \frac{\beta H(1+\gamma\theta)-b}{2d}$.

We summarize these results in the following proposition:

Proposition 5. *If $\lambda > \frac{2d(1-\alpha)}{\left(\gamma\theta\theta_i^1 - b\right)}$, the presence of lobbies induces investment in persuasion by each lobby equal to $r_i^n = \frac{\lambda\gamma\theta\theta_i^1 - \lambda b - 2d(1-\alpha)}{2n\lambda^2}$, which is increasing in first-period productivity shock, in the autocorrelation of productivity, and in the degree to which the firm internalizes the payout to the lobbies. It also reduces k_i^2 below the efficient level by an amount $\frac{\lambda\left(\gamma\theta\theta_i^1 - b\right) - 2d(1-\alpha)}{4d\lambda}$, which is increasing in these same parameters. First-period investment is unaffected by the presence of lobbies, and both total investment in persuasion and the reduction in second-period investment are independent of the number of lobbies.*

It is striking that lobbying has a more damaging effect on investment in the project if the lobbies are ones with which the firm sympathizes. It is also worth noting that additional lobbies do not affect the total amount of lobbying activity: more lobbies just undertake less investment each, with the same overall results. While this latter finding might be different with a differently specified model, the result that lobbies with which the firm has more sympathy do more damage to investment is a result that seems to be quite general. It is hard to resist pressure from people you like!

3.3.3 The effect of joint ventures

What is the effect of a JV? The time-line of the actions is in this case as follows:

- Period 0: Firms decide whether or not to form JVs.[17]

- Period 1: Firms choose levels of investment k_i^1.

- Period 2: Output Q_i^2 is realized, then lobbies choose how much r_i^n to invest in persuasion, and request a payout p_i^n.

- Period 2′: Firms then decide whether to grant the payout or not, and choose levels of investment k_i^2.

- Period 3: Output Q_i^3 is realized.

Consider a JV among M partners.[18] This obliges a part owner to make a payout to the partner each time it chooses to make a payout to itself. This makes payouts more expensive to the firm, and makes it more expensive to the lobby to invest in persuasion. To see this, note that the cost to the firm of granting a payout p_i^n to lobby n_i is now Mp_i^n, and furthermore this second payout benefits recipients whose utility does not enter at all into the firm's objective function. This reduces the maximum payout that the firm will be willing to grant:

$$(M-\alpha)\, p_i^n = \lambda k_i^2 r_i^n$$

This means that the period 2 objective function of the firm becomes:

$$Max_{k_i^2}\left[\theta_i^1 k_i^1 - bk_i^2 - d\left(k_i^2\right)^2 - \frac{n\lambda k_i^2 r_i^n\,(1-\alpha)}{(M-\alpha)} + \gamma\theta\theta_i^1\left(k_i^1 + k_i^2\right)\right]$$

for which the first order conditions are:

$$k_i^2 = \frac{\gamma\theta\theta_i^1 - n\lambda r_i^n\left(\frac{1-\alpha}{M-\alpha}\right) - b}{2d}$$

[17] We rule out any action by lobbies in period 0 to impede JV formation.

[18] In this setting intermediate coalitions do not arise since for simplicity no coordination costs are taken into account.

The lobbies' problem becomes:

$$Max_{r_i^n}\left\{0, \frac{\lambda r_i^n\left[\gamma\theta\theta_i^1 - n\lambda r_i^n\left(\frac{1-\alpha}{M-\alpha}\right) - b\right]}{2d\left(M-\alpha\right)} - r_i^n\right\}$$

for which the first order condition is $\frac{\lambda\left[\gamma\theta\theta_i^1 - 2n\lambda r_i^n\left(\frac{1-\alpha}{M-\alpha}\right) - b\right]}{2d(M-\alpha)} = 1$. This implies that:

$$r_i^n = Max\left[0, \frac{\left(\lambda\gamma\theta\theta_i^1 - \lambda b - 2d\left(M-\alpha\right)\right)\left(M-\alpha\right)}{2n\lambda^2\left(1-\alpha\right)}\right]$$

so that if $\lambda > \frac{2d(M-\alpha)}{\gamma\theta\theta_i^1 - b}$:

$$k_i^2 = \frac{\gamma\theta\theta_i^1 - b}{2d} - Max\left[0, \frac{\lambda\left(\gamma\theta\theta_i^1 - b\right)}{2d} - \left(M-\alpha\right)\right] \tag{3.12}$$

which is strictly higher than without the JV whenever the presence of lobbies reduces investment below the efficient level.

The following proposition summarizes the results of forming a JV and shows how they vary according to the parameter λ that measures the effectiveness of lobbying.

Proposition 6. *In the presence of lobbies, a JV between M firms results in second-period investments k_i^2 that compare with those undertaken by firms acting in the absence of the JV as follows:*

a) When $\lambda \leq \frac{2d(1-\alpha)}{\gamma\theta\theta_i^1 - b}$, investment levels are efficient with or without the joint venture;

b) When $\frac{2d(1-\alpha)}{\gamma\theta\theta_i^1 - b} < \lambda \leq \frac{2d(M-\alpha)}{\gamma\theta\theta_i^1 - b}$, investments are efficient with the JV but below the efficient levels without the JV;

c) When $\lambda > \frac{2d(M-\alpha)}{\gamma\theta\theta_i^1 - b}$, investment levels with the JV are below the efficient level but above those without the JV.

What this proposition shows us is that if lobbying is relatively ineffective, JVs are unnecessary. If lobbying is somewhat effective, JVs can prevent it from having any effect on investment. If it is highly effective, JVs can limit the damage done by lobbying to investment, but not avoid such damage alto-

gether. These results suggest therefore that JVs may be more appropriate for firms whose ability to commit themselves is particularly weak. In the case of infrastructure projects in developing countries, where governments' commitment ability is often very limited, the above theoretical prediction is especially relevant.

Interestingly, although the number of lobbies has no impact on the behavior of firms, the number of JV partners is positively related to second-period investment. This has an interesting implication for the role of symmetry in the distribution of the benefits of the arrangement. Asymmetric JVs will be less effective as commitment device than symmetric ones, for a very simple reason. This is that in an asymmetric JV the partner with the largest share will act as though it was a partner in a JV with fewer than M partners. Therefore λ is more likely to exceed the upper bound in condition b) of proposition 6, so that investment levels are more likely to fall below the efficient level.

3.4 Is joint ownership chosen more often by firm under pressure?

Our theoretical framework suggests that JVs can provide a commitment device against lobbying. Therefore, we would expect the corporate governance structure of JV to be more often chosen by firms that feel severe pressure either from outside the organization or from other interest groups inside it.

This section illustratively investigates this prediction of the model. The objective is to assess whether firms subject to tough internal or external pressure are more likely to choose the corporate governance structure of JV, rather than other structures.[19]

The analysis is based on a large dataset of firms interviewed in the context of the European Bank of Reconstruction and Development - World Bank

[19]We classify as JV a firm that was established as a JV with private partner(s) or has agreed to form a JV in last 3 years.

Business Environment and Enterprise Performance Surveys (BEEPS).

We consider data from 4 waves (1999, 2002, 2004, and 2005) and from 28 countries[20] in the regions of CIS, Baltic, Eastern-Central and Southern-Eastern Europe for a total of 19,130 observations. More than 10% of firms in the dataset are JVs. A simple exploration of the data reveals that JVs do indeed tend to differ from other firms in some dimensions, as shown in table 3.1. Concerning the external environment, JVs suffer on average from tougher pressure by their trading partners than other firms. Indeed, 63% of JVs had to resolve overdue payments in the previous 3 years, while less than half of other firms had to do so. The dataset also provides some descriptive evidence that the JV structure is more likely to be chosen by firms that face pressures for the internal reallocation of resources. Reallocation of responsibility and budgetary resources between departments is much more common for JVs than for other firms. Indeed, 66% of JVs had over the previous 3 years some or major reallocations of responsibility and resources between departments or a completely new organizational structure, while this happened for 41% of other firms. Finally, there is also some evidence in favor of the model's prediction that JVs manage to reinvest a larger share of their profits. Indeed, the percentage of earnings reinvested in fixed investment in the subsequent year is 6% larger in JVs than in other firms. That is, although JVs appear to suffer more from internal reallocation of resources and external pressure through overdue payments by trading partners, they are still more likely to reinvest their profit in fixed capital than other firms.

While some characteristics of the phenomenon have already emerged from the simple exploration of the data, a multivariate analysis is clearly necessary

[20]Russia, FYROM, Serbia and Montenegro, Albania, Croatia, Turkey, Bosnia and Herzegovina, Slovenia, Poland, Ukraine, Belarus, Hungary, Czech Republic, Slovak Republic, Romania, Bulgaria, Moldova, Latvia, Lithuania, Estonia, Georgia, Armenia, Kazakhstan, Azerbaijan, Uzbekistan, Tajikistan, and Kyrgyz Republic. Interviewed firms operate in different sectors: manufacturing; construction; real estate, renting and business services; wholesale, retail, repairs; hotels and restaurants; transport storage and communication; and mining and quarrying.

Table 3.1: Some Characteristics of Sampled Firms by Corporate Governance Structure.

	Corp. governance struct.: not JV	JV	Δ	Obs.
number of firms	17,087	2,043	·	19,130
any overdue payment to resolve (prop)	0.472	0.633	***	20,725
	(0.499)	(0.482)		
any reallocation between departments (prop)	0.406	0.664	***	24,306
	(0.491)	(0.473)		
fixed investment % financed by earnings	72.251	66.574	***	11,846
	(34.153)	(35.990)		
sales % from: mining and quarrying sector	0.786	1.574	***	20,775
	(8.371)	(11.914)		
construction sector	11.133	7.957	***	20,775
	(30.378)	(25.653)		
manufacturing sector	30.929	38.706	***	20,775
	(44.177)	(46.004)		
transport sector	5.655	9.434	***	20,775
	(22.368)	(28.337)		
wholesale, retail sector	29.289	24.943	***	20,775
	(43.201)	(40.051)		
real estate sector	9.748	9.748		20,775
	(28.820)	(28.417)		
hotel sector	7.219	3.878	***	20,775
	(25.410)	(18.686)		
other sector	5.242	3.759		20,775
	(20.837)	(17.058)		
number of employees: 0-1 (prop)	0.175	0.256	***	3,429
2-49 (prop)	0.660	0.431	***	11,953
50-249 (prop)	0.115	0.189	***	2,289
250-9999 (prop)	0.050	0.124	***	1,066
year: 1999 (prop)	0.000	0.100	***	204
2002 (prop)	0.287	0.413	***	5,753
2004 (prop)	0.233	0.173	***	4,333
2005 (prop)	0.480	0.314	***	8,840
region: CIS (prop)	0.407	0.486	***	6,155
Baltics (prop)	0.071	0.082		1,067
Central Europe (prop)	0.220	0.116	***	3,074
South-East Europe (prop)	0.237	0.261	**	3,546

Note: Standard deviation in brackets. Significance levels: *: 10% **: 5% ***: 1%.

Table 3.2: JVs, Internal and External Pressure.

	[I]	[II]	[III]
any reallocation between departments	0.347***	0.312***	0.334***
	(9.00)	(7.87)	(9.65)
any overdue payments to resolve	0.182***	0.238***	0.206***
	(4.16)	(4.90)	(4.80)
sales % from: mining and quarrying sector	0.002	0.003	0.003
	(1.04)	(1.27)	(1.43)
construction sector	-0.003***	-0.004***	-0.004***
	(-4.89)	(-4.38)	(-4.45)
transport sector	0.002**	0.002**	0.002*
	(2.23)	(2.35)	(1.78)
wholesale, retail sector	-0.002**	-0.001**	-0.002**
	(-2.57)	(-2.03)	(-2.52)
real estate sector	-0.000	-0.001	-0.001
	(-0.42)	(-0.78)	(-1.30)
hotel sector	-0.004***	-0.004***	-0.004***
	(-3.95)	(-3.22)	(-3.51)
other sector	-0.002**	-0.002	-0.002
	(-2.19)	(-1.59)	(-1.61)
number of employees: 2-49	0.030	0.056	0.057
	(0.63)	(1.22)	(1.30)
50-249	0.519***	0.544***	0.552***
	(8.33)	(8.54)	(7.96)
250-9999	0.729***	0.700***	0.697***
	(10.02)	(9.51)	(9.25)
intercept	-1.737***	-1.620***	-1.529***
	(-11.78)	(-10.30)	(-20.08)
time dummies	yes	yes	yes
region dummies		yes	
country dummies			yes
N	18551	14241	14241
Pseudo R^2	0.086	0.090	0.117
Log-likelihood	-5363	-4235	-4107

Note: Robust Standard Errors in brackets, clustered by country.

Significance levels: *: 10% **: 5% ***: 1%.

Table 3.3: JVs and Internal Pressure.

	[I]	[II]	[III]
any reallocation between departments	0.365***	0.341***	0.356***
	(9.38)	(8.34)	(10.01)
sales % from: mining and quarrying sector	0.002	0.002	0.003
	(1.00)	(1.24)	(1.40)
construction sector	-0.003***	-0.003***	-0.004***
	(-4.69)	(-4.12)	(-4.36)
transport sector	0.002**	0.002**	0.002*
	(2.22)	(2.29)	(1.68)
wholesale, retail sector	-0.002***	-0.001**	-0.002***
	(-2.74)	(-2.24)	(-2.72)
real estate sector	-0.000	-0.001	-0.001
	(-0.42)	(-0.82)	(-1.41)
hotel sector	-0.004***	-0.004***	-0.005***
	(-4.23)	(-3.62)	(-3.86)
other sector	-0.002**	-0.002**	-0.002**
	(-2.47)	(-1.97)	(-1.96)
number of employees: 2-49	0.058	0.081*	0.074*
	(1.22)	(1.74)	(1.69)
50-249	0.565***	0.586***	0.584***
	(9.32)	(9.39)	(8.58)
250-9999	0.777***	0.755***	0.738***
	(10.46)	(9.97)	(9.84)
intercept	-1.719***	-2.053***	-1.990***
	(-11.73)	(-12.92)	(-25.49)
time dummies	yes	yes	yes
region dummies		yes	
country dummies			yes
N	18587	14277	14277
Pseudo R^2	0.0831	0.0846	0.1137
Log-likelihood	-5400	-4277	-4141

Note: Robust Standard Errors in brackets, clustered by country.

Significance levels: *: 10% **: 5% ***: 1%.

Table 3.4: JVs and External Pressure.

	[I]	[II]	[III]
any overdue payments to resolve	0.216***	0.274***	0.241***
	(4.69)	(5.52)	(5.49)
sales % from: mining and quarrying sector	0.002	0.003	0.003
	(1.18)	(1.44)	(1.59)
construction sector	-0.004***	-0.004***	-0.004***
	(-5.24)	(-4.59)	(-4.65)
transport sector	0.002**	0.002**	0.002*
	(2.21)	(2.31)	(1.68)
wholesale, retail sector	-0.002***	-0.002**	-0.002***
	(-2.86)	(-2.29)	(-2.81)
real estate sector	-0.000	-0.001	-0.001
	(-0.55)	(-0.84)	(-1.40)
hotel sector	-0.004***	-0.004***	-0.004***
	(-4.12)	(-3.32)	(-3.65)
other sector	-0.002**	-0.002*	-0.002*
	(-2.49)	(-1.82)	(-1.91)
number of employees: 2-49	0.046	0.077*	0.077*
	(0.99)	(1.69)	(1.75)
50-249	0.590***	0.604***	0.611***
	(9.47)	(9.23)	(8.79)
250-9999	0.820***	0.772***	0.768***
	(11.48)	(10.22)	(10.14)
intercept	-1.116***	-2.121***	-1.315***
	(-11.35)	(-13.41)	(-18.33)
time dummies	yes	yes	yes
region dummies		yes	
country dummies			yes
N	18701	14368	14368
Pseudo R^2	0.0716	0.0781	0.1043
Log-likelihood	-5512	-4339	-4215

Note: Robust Standard Errors in brackets, clustered by country.

Significance levels: *: 10% **: 5% ***: 1%.

to investigate whether firms suffering greater internal or external pressure are more likely to choose a JV structure. We thus estimate a probit model, where the dependent variable is whether a firm is part of a JV or not (table 3.2). The main variables of interest are proxies for internal and external pressure. We interpret reallocation of resources across departments of the firm as proxying internal pressure that may deprivate a project of its early profits to redistribute them to other departments. External pressure is instead proxied by overdue payments to resolve. Indeed, overdue payments can be seen as a form of rent extraction from trading partners.

Column [I] reports the estimates including time dummies, while we add regional dummies in column [II] and country dummies in column [III]. The results are qualitatively very similar. Confirming the descriptive statistics, firms operating in contexts where internal and external pressure is probably greater are more likely to choose a JV structure. While the coefficients proxying external and internal pressure are large and significantly different from zero in table 3.3 and 3.4, these variables are likely to be endogenous. Notice that the theoretical framework suggests that the coefficients are likely to be biased downwards. Indeed, although JVs are more necessary when a firm is under potential lobbying pressure, they should also serve to reduce the effects of such pressure. Before turning to test this conjecture by instrumental variable estimation, notice that the results of the simple probit estimation are basically unchanged when taking into account separately internal and external pressure (table 3.3 and 3.4). This remark is helpful because unfortunately the instrumental variable probit estimation taking into account that both internal and external pressure may be endogenous does not converge. Therefore, we can only consider the endogeneity of internal and external pressure separately.[21]

Table 3.5 reports the estimates resulting from a first stage, where we use instrumental variables to predict the vulnerability of firms to internal pres-

[21]Obviously this cannot help to decide whether internal or external pressures are more important.

Table 3.5: JVs and Endogenous Internal Pressure.

	[I]	[II]	[III]
First stage:			
capacity utilization %	-0.001***	-0.001**	-0.001**
	(-3.56)	(-2.13)	(-2.16)
largest shareholder %	-0.001***	-0.001***	-0.001***
	(-3.30)	(-4.05)	(-5.23)
intercept	0.426***	0.283***	0.818***
	(5.32)	(5.85)	(17.48)
Second stage:			
any reallocation between departments	1.252***	1.421***	1.363***
	(3.85)	(4.72)	(4.54)
intercept	-1.777***	-1.906***	-1.962***
	(-14.16)	(-9.23)	(-16.59)
sector % sales	yes	yes	yes
firm size dummies	yes	yes	yes
time dummies	yes	yes	yes
region dummies		yes	
country dummies			yes
ρ	-0.473**	-0.593***	-0.534**
	(-2.23)	(-2.60)	(-2.52)
Wald test of exogeneity	4.99**	6.74***	6.38**
N	14710	13634	13634
Log-likelihood	-14282	-13133	-12832

Note: Robust Standard Errors in brackets, clustered by country.

Significance levels: *: 10% **: 5% ***: 1%.

sure as proxied by resource reallocation.[22] The instruments are the capacity utilization and the percentage hold by the largest shareholder. Indeed, a low utilization of the installed capacity increases the probability that resource reallocation is undertaken to improve efficiency. The decision to reallocate resources from a department to another may instead be more difficult when the largest shareholder owns smaller shares of the firm as an agreement among several shareholders is more likely to be needed. As we conjectured, when the endogeneity of resource reallocation is taken into account, the estimated coefficient of the regressor becomes much larger (compare the second stage of table 3.5 with table 3.3). This result is consistent with the idea that joint ownership can help to protect firms against internal pressures and JVs are therefore more

[22]To limit the size of the instrumental variable tables, the estimated coefficients of sectoral sales percentage and number of employees are not reported.

Table 3.6: JVs and Endogenous External Pressure.

	[I]	[II]	[III]
First stage:			
courts are quick	-0.122***	-0.088***	-0.072***
	(-5.84)	(-5.31)	(-4.99)
confidence in legal system	-0.038***	-0.033***	-0.029***
	(-2.98)	(-2.81)	(-2.83)
number of cases in court as plaintiff	0.018***	0.016***	0.015***
	(10.43)	(9.47)	(8.22)
law interpretation is unpredictable	0.033***	0.031***	0.030***
	(2.94)	(3.25)	(3.37)
intercept	0.602***	0.674***	0.622***
	(19.72)	(29.16)	(46.63)
Second stage:			
any overdue payments to resolve	0.426**	0.694***	0.692***
	(2.19)	(4.38)	(4.69)
intercept	-1.237***	-1.774***	-1.635***
	(-10.02)	(-10.44)	(-16.57)
sector % sales	yes	yes	yes
firm size dummies	yes	yes	yes
time dummies	yes	yes	yes
region dummies		yes	
country dummies			yes
ρ	-0.103	-0.207***	-0.215***
	(-1.20)	(-2.91)	(-3.37)
Wald test of exogeneity	1.45	8.45***	11.36***
N	12939	11992	11992
Log-likelihood	-12475	-11233	-10838

Note: Robust Standard Errors in brackets, clustered by country.

Significance levels: *: 10% **: 5% ***: 1%.

likely to be chosen.

Similarly, table 3.6 reports the estimates resulting from a first stage, where we use instrumental variables to predict the vulnerability of firms to external pressure as proxied by overdue payments. In this case the instruments are the firm perception of courts rapidity, their confidence in the legal system, the number of cases a firm has in court as plaintiff, and whether the interpretation of laws is perceived as unpredictable. Indeed, the more a firm can rely on the legal system to mitigate external pressure, the less problems with overdue payments are expected. Similarly to what happens with internal pressure, the role played by external pressure as a determinant of JVs is stronger when its

likely endogeneity is taken into account - a result that is expected if the effect of JVs is to better to resist external pressure to pay out early revenues.

In conclusion, to the extent that internal resource reallocation and overdue payments can serve as proxies for internal and external pressures respectively, the BEEPS data provide some supporting evidence that when either internal or external interest groups are effective, the corporate governance structure of a JV is more likely to be chosen. This is a long way from constituting a rigorous test of the model, but it provides suggestive corroborating evidence that the model's main conclusions are not evidently at odds with the data.

3.5 Conclusions

This paper investigates an unexplored rationale for organizations to enter into JVs, namely the fact that joint ownership of production projects may provide a commitment mechanism enabling more efficient levels of investment.

In our theoretical framework internal or external interest groups may pressurize owners into paying out early revenues from such investments when the autocorrelation of productivity implies they should be reinvesting them in the project. The main predictions are that in the presence of effective lobby groups, JVs help the firm to resist their pressure.

While not claiming to provide any kind of rigorous test of this result, we have found illustrative corroborating evidence in case studies of infrastructure projects in developing countries and in a large dataset of Business Environment and Enterprise Performance Surveys. Indeed, we find that firms operating in contexts where external or internal pressure are likely to be greater choose a JV structure more often than other firms.

Bibliography

Abe, K. and L. Zhao (2005). Endogenous international joint ventures and the environment. *Journal of International Economics 67*, 221–40.

Abowd, J. M., F. Kramarz, and D. N. Margolis (1999). High wage workers and high wage firms. *Econometrica 67*(2), 251–333.

Abowd, J. M., F. Kramarz, and S. Roux (2006). Wages, mobility and firm performance: advantages and insights from using matched worker-firm data. *The Economic Journal 116*(512), 245–85.

Adler, P. S. and S. Kwon (2002). Social capital: Prospects for a new concept. *Academy of Management Review 27*, 17–40.

African Economic Outlook (2009). OECD and African Development Bank.

Alexander, C. (1973). The city as a mechanism for sustaining human contact. *Urbanman: The Psychology of Urban Survival*.

Amato, P. R. (1993). Urban-rural differences in helping friends and family members. *Social Psychology Quarterly 56*(4), 249–62.

Antoninis, M. (2006). The wage effects from the use of personal contacts as hiring channels. *Journal of Economic Behavior and Organization 59*, 133–46.

Arrow, K. J. and R. Borzekowski (2004). Limited network connections and the distribution of wages. *Finance and Economics Discussion Series*.

Assaad, R. (1997). Kinship ties, social networks and segmented labor markets: evidence from the construction. *Journal of Development Economics 52*, 1–30.

Azam, J. P., B. Biais, M. Dia, and C. Maurel (2001). Informal and formal credit markets and credit rationing in Côte d'Ivoire. *Oxford Review of Economic Policy 17*(4), 520–34.

Azam, J. P. and J. Y. Lesueur (1997). Efficiency-wage and supervision: Theory and application to the Ivoirian manufacturing sector. *Journal of African Economies* (6), 445–62.

Bandiera, O., I. Barankay, and I. Razul (2010). Social incentives in the workplace. *The Review of Economic Studies 77*(2), 417–458.

Banerjee, B. (1984). Information flow, expectations and job search. *Journal of Development Economics 15*, 239–57.

Barabási, A. L. (2002). *Linked: How Everything is Connected to Everything Else and What it Means for Business, Science, and Everyday Life*. Penguin Group.

Barr, A. (2004). Kinship, familiarity, and trust: An experimental investigation. *Foundations of human sociality: Economic experiments and ethnographic evidence from fifteen small-scale societies*, 305–34.

Barr, A. and G. Genicot (2008). Risk-pooling, commitment, and information: An experimental test. *Journal of the European Economic Association 6*(6), 1151–185.

Barr, A. and A. Oduro (2002, August). Ethnic fractionalization in an african labour market. *Journal of Development Economics 68*(2), 355–379.

Bayer, P., S. Ross, and G. Topa (2008). Place of work and place of residence:

Informal hiring networks and labor market outcomes. *Journal of Political Economy 116*(6), 1150–96.

Beaman, L. (2011). Social networks and the dynamics of labor market outcomes: Evidence from refugees resettled in the us. *Review of Economic Studies, forthcoming*.

Ben-Porath, Y. (1980, March). The f-connection: Families, friends, and firms and the organization of exchange. *Population and Development Review 6*, 1–30.

Bentolila, S., C. Michelacci, and J. Suarez (2010). Social contacts and occupational choice. *Economica 77*(305), 20–45.

Binzel, C. and D. Fehr (2010). Social relationships and trust. Institute for Advanced Studies (IHS).

Bowls, S. and H. Gintis (2002). Social capital and community governance. *The Economic Journal 112*(483), 419–36.

Boxman, E. A. W., P. M. De Graaf, and H. D. Flap (1991). The impact of social and human capital on the income attainment of dutch managers. *Social Network 13*(1), 51–73.

Bulow, J. and L. Summers (1976). A theory of dual labor markets with applications to industrial policy, discrimination and keynesian unemployment. *Journal of Labor Economics 4*, 376–414.

Burt, R. (1992). *Structural Holes: The Social Structure of Competition*. Cambridge, MA: Harvard University Press.

Cai, H. (2003). A theory of joint asset ownership. *The RAND Journal of Economics 34*, 63–77.

Calvó-Armengol, A. (2006, January). Social networks and labor market outcomes. *Els Opuscles del CREI 17*.

Calvó-Armengol, A. and M. O. Jackson (2004). The effects of social networks on employment and inequality. *The American Economic Review 94*(3), 426–54.

Coleman, J. (1988). Social capital in the creation of human capital. *American Journal of Sociology 94*, 95–120.

Combarnous, F. (2001). Typologie des contrats, mode de rémunération des travailleurs et segmentation dans les entreprises modernes de Côte d'ivoire. In *Entreprises et emploi en Côte d'Ivoire*, Volume Serie de Recherche 5. Université Montesquieu-Bordeaux IV.

Conley, T. and G. Topa (2002). Socio-economic distance and spatial patterns in unemployment. *Journal of Applied Econometrics 17*(4), 303–27.

Corcoran, M. (1980). Most workers find jobs through word of mouth. *Monthly Labor Review 103*(8), 33–5.

Crémer, J. (1995). Arms-length relationships. *Quarterly Journal of Economics 110*, 275–95.

Delattre, E. and M. Sabatier (2007). Social capital and wages: An econometric evaluation of social networking's effects. *Labour 21*(2), 209–36.

Dorogovtsev, S. N. and J. F. F. Mendes (2002). Evolution of networks. *Advances in Physics 51*, 1079–187.

Durlauf, S. N. (2002). On the empirics of social capital. *The Economics Journal 112*(483), 459–79.

Fafchamps, M. (2006, October). Development and social capital. *Journal of Development Studies 42*(7).

Fafchamps, M., S. Goyal, and M. van der Leij (2010). Matching and network effects. *European Economic Association 8*(1), 203–31.

Fafchamps, M. and A. Moradi (2009). Referral and job performance: Evidence from the ghana colonial army. CSAE Working Paper Series.

Fernandez, R. M., E. J. Castilla, and P. Moore (2000). Social capital at work: Networks and employment at a phone center. *American Journal of Sociology 105*, 1288–356.

Fisman, R. J. (2003). Ethnic ties and the provision of credit: Relationship-level evidence from african firms. *Advances in Economic Analysis and Policy 3*(1), art.4.

Fontaine, F. (2007). A job search model with social networks. the better match hypothesis. Mimeo.

Friebel, G. and A. Matros (2005, 07). A note on CEO compensation, elimination tournaments and bankruptcy risk. *Economics of Governance 6*(2), 105–11.

Frydman, C. and D. Jenter (2010). CEO compensation. *Annual Review of Financial Economics 102*(2), 75–102.

Gibbons, R. (2005). Four formal(izable) theories of the firm? *Journal of Economic Behavior and Organization 58*, 200–45.

Glaeser, E. L., D. Laibson, and B. Sacerdote (2002). An economic approach to social capital. *The Economic Journal 112*(483), 437–58.

Glaeser, E. L., D. I. Laibson, J. A. Scheinkman, and C. L. Soutter (1990, August). Measuring trust. *The Quarterly Journal of Economics 115*(3), 811–46.

Granovetter, M. (1973, August). The strength of weak ties. *American Journal of Sociology 78*, 1360–80.

Granovetter, M. (1985). Economic action and social structure: The problem of embeddedness. *American Journal of Sociology 91*(3), 481–510.

Granovetter, M. (1995). *Getting a Job: A Study of Contacts and Career* (2nd edition ed.). Cambridge MA: Harvard University Press.

Grieco, M. (1987). *Keeping it in the Family: Social Networks and Employment Chance*. Routledge Kegan & Paul.

Grossman, S. J. and O. Hart (1986). Costs and benefits of ownership: A theory of vertical and lateral integration. *Journal of Political Economy 94*, 691–719.

Hart, O. and J. Moore (1989). Property rights and the nature of the firm. *Journal of Political Economy 98*, 1119–58.

Hauswald, R. and U. Hege (2003). Ownership and control in joint ventures. CEPR Discussion Paper 4056.

Hayashi, F. (2000). *Econometrics*. Princeton, NJ: Princeton University Press.

Heckman, J. J. (1979, January). Sample selection bias as a specification error. *Econometrica 47*(1), 153–61.

Hennig, C. and M. Lieberg (1996). Strong or weak ties? neighbourhood networks in a new perspective. *Scandinavian Housing and Planning Research 13*, 3–26.

Hewitt, I. (2008). *Joint Ventures* (4th Edition ed.). London: Thomson , Sweet and Maxwell.

Holzer, H. J. (1988, January). Search method use by unemployed youth. *Journal of Labor Economics 6*, 1–20.

Ioannides, Y. M. and L. Loury (2004, December). Job information networks, neighborhood effects, and inequality. *Journal of Economic Literature 42*, 1056–93.

Ioannides, Y. M. and A. R. Soetevent (2006). Wages and employment in a random social network with arbitrary degree distribution. *The American Economic Review 96*(2), 270–4.

Jackson, M. O. (2006). *The Economics of Social Networks*, Volume Advances in Economics and Econometrics of *Econometric Society Monographs*.

Jackson, M. O. (2008). *Social and Economic Networks*. Princeton University Press.

Jensen, M. C. and K. J. Murphy (1990). Performance pay and top-management incentives. *Journal of Political Economy 98*(2), 225–264.

Kogut, B. (1988). Joint ventures theoretical and empirical perspective. *Strategic Management Journal 9*, 319–32.

Kugler, A. D. (2003). Employee referrals and efficiency wages. *Labor Economics 10*, 531–56.

Lalanne, M. and P. Seabright (2011). Women, executive jobs and networks. Mimeo.

Lazaer, E. P. (1991). Labor economics and the psychology of organizations. *Journal of Economic Perspective 5*(2), 89–110.

Lin, N. (1999). Social networks and status attainment. *Annual Review of Sociology 25*(1), 467–87.

Lokshin, M. and Z. Sajaia (2004). Maximum-likelihood estimation of endogenous switching regression models. *STATA Journal 4*(3), 227–34.

Luke, N. and K. Munshi (2006). New roles for marriage in urban africa: Kinship networks and the labor market in kenya. *Review of Economics and Statistics 88*(2), 264–282.

Magruder, J. (2010). Intergenerational networks, unemployment, and persistent inequality in south africa. *American Economic Journal: Applied Economics 2*(1), 62–85.

Mansky, K. J. (2000). Economic analysis of social interactions. *The Journal of Economic Perspectives 14*(3), 115–36.

Meyer, M., P. Milgrom, and J. Roberts (1992). Organizational prospects, influence costs and ownership changes. *Journal of Economics and Management Strategy 1*, 9–36.

Milgram, S. (1970). The experience of living in cities. *Science 167*(3924), 1461–8.

Miller, S. and J. Rosenbaum (1997). Hiring in a hobbesian world. social infrastructure and employers' use of information. *Work and Occupations 24*(4), 498–523.

Montgomery, J. (1991). Social networks and labour market outcomes: toward an economic analysis. *American Economic Review 81*(5), 1408–18.

Moody, J. (2004). The structure of a social science collaboration network: Disciplinary cohesion from 1963 to 1999. *American Sociological Review 69*, 213–38.

Moskalev, S. and R. B. Swensen (2007). Joint ventures around the globe from 1990-2000: Forms, types, industries and ownership patterns. *Review of Financial Economics 16*, 29–67.

Munshi, K. (2003). Networks in the modern economy: Mexican migrants in the u.s. labor market. *Quarterly Journal of Economics 118*(2), 549–97.

Munshi, K. and M. Rosenzweig (2006, September). Traditional institutions meet the modern world: Caste, gender, and schooling choice in a globalizing economy. *American Economic Review 96*(4), 1225–1252.

Murphy, K. J. (1999). Executive compensation. *Handbook of Labor Economics 3*(2), 2485–563.

Neven, D., P. Papandropoulos, and P. Seabright (1998). Trawling for minnows: European competition policy and agreements between firms. Centre for Economic Policy Research.

Oi, W. Y. and T. L. Idson (1999, September). Firm size and wages. In O. Ashenfelter and D. Card (Eds.), *Handbook of Labor Economics*, Volume 3 of *Handbook of Labor Economics*, Chapter 33, pp. 2165–2214. Elsevier.

Patacchini, E. and Y. Zenou (2008). Ethnic networks and employment outcomes. IZA Discussion Paper.

Pellizzari, M. (2009). Do friends and relative really help in getting a good job? *Industrial and Labor Relations Review 63*(3).

Pistaferri, L. (1999). Informal networks in the italian labor market. *Giornale degli Economisti e Annali di Economia 58*, 355–75.

Podolny, J. M. and J. N. Baron (1997). Resources and relationships social networks and mobility in the workplace. *American Sociological Review 62*(5), 673–93.

Putnam, R. D. (2000). *Bowling Alone: The Collapse and Revival of American Community*. Simon & Schuster.

Redfield, R. (1947). The folk society. *American Journal of Sociology 53*, 293–308.

Rees, A. (1966). Information networks in labor markets. *American Economic Review 56*, 559–66.

Rees, A. and G. Schultz (1970). *Workers in an Urban Labor Market*. University of Chicago Press.

Rubinstein, A. (1982, January). Perfect equilibrium in a bargaining model. *Econometrica 50*(1), 97–109.

Saloner, G. (1985). Old boy networks as screening mechanism. *Journal of Labor Economics 3*, 255–67.

Shapiro, C. and J. E. Stiglitz (1984, June). Equilibrium unemployment as a worker discipline device. *The American Economic Review 74*(3), 433–44.

Sicilian, P. (1995, June). Employer search and worker-firm match quality. *The Quarterly Review of Economics and Finance*, 515–32.

Simmel, G. (1903). *Die Grosstädte und das Geistesleben*. Dresden: Petermann.

Simon, J. C. and T. Warner (1992, July). Matchmacker, matchmaker: the effect of the old boy networks on job match quality, earnings and tenure. *Journal of Labor Economics 10*(3), 306–30.

Tönnies, F. (1887). *Gemeinschaft und Gesellsschaft*. Leipzig.

Wahba, J. and Y. Zenou (2005). Density, social networks and job search methods: Theory and application to Egypt. *Journal of Development Economics 78*, 443–73.

Wasserman, S. and K. Faust (1994). *Social Network Analysis: Methods and applications*. Cambridge University Press.

Watts, D. J. (2004). The "new" science of networks. *Annual Review of Sociology 30*, 243–70.

Weiss, A. and H. J. Landau (1984). Wages, hiring standards, and firm size. *Journal of Labor Economics 2*, 477–99.

Wirth, L. (1938). Urbanism as a way of life. *American Journal of Sociology 33*, 57–71.