The Remains of Informality

Social Networks and Wages
in Senegal's Formal Sector

Jean-Paul Azam [a,b] and Nicoletta Berardi [a] *

a: Toulouse School of Economics (ARQADE)

b: IDEI, IZA and Institut Universitaire de France

Abstract

We develop a theoretical framework that considers the role played by moral hazard and the diversity of networks and cultures in the choice of hiring channel. Our model explains why either informal or formal hiring channels are preferred and either positive or negative wage differentials emerge for workers hired through informal channels, depending on circumstances. It accounts for several stylized facts, such as the even more extensive use of informal hiring channels in developing countries than in industrialized ones, and for filling non-qualified vacancies rather than qualified jobs.

Estimating an endogenous switching model for the case of Senegal, we find that informal hiring channels are preferred to fill non-qualified 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.

1 Introduction

The number of vacancies 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 is impressive. Granovetter [1973], Rees [1966] and Corcoran [1980] found that about half of the jobs in the United States were filled through personal contacts and Ioannides and Loury [2004] notice that the role played by networks increased over time, if anything. 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 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 referrers' 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 and imply potential 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. The practice of hiring through social networks is even more pronounced in developing countries than in industrialized ones.[2] Moreover, empirical studies suggest that vacancies for unskilled occupations are much more likely to be filled through social networks than jobs requiring high qualifications.[3] Finally, wage differentials imputable to informal hiring channels are far from being always positive. For instance, Pellizzari [2004] finds that, out of 15

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

[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], Pellizzari [2004] and Antoninis [2006]).

industrialized countries, 3 are characterized by wage premia to networked workers, 4 by wage penalties, while in the 8 remaining countries there are not significant wage differentials due to the adopted hiring channel.

These discrepancies between theoretical predictions and empirical studies suggest that theories focusing on adverse selection overlook some crucial aspect. This paper argues that moral hazard plays a crucial role. Moreover, the existing theoretical literature does not consider the variety of social networks, not even in their most fundamental dimension, *i.e.* their tightness[4]. The latter may however play an important role, because tight networks are able to exert peer pressure to ensure proper behavior of members who are hired through them.[5] Indeed, when observing employees' effort is costly for firms, Shapiro and Stiglitz [1984] show that 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. However, the role played by peer pressure may decrease the monitoring costs for workers hired through social networks with respect to other employees.[6] Moreover, 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 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 emerge for workers hired through informal channels, depending on circumstances. It accounts for the stylized fact that developing countries rely even more on social networks as hiring channels than industrialized ones and informal hiring channels are

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[4]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.

[5]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, Glaeser et al. [1990], Barr [1999] and Miller and Rosenbaum [1997] provide experimental evidence of the positive relationship between social proximity and trustworthiness.

[6]In enriching the employer search framework with the efficiency wage theory, we carry out a step in the research path wished by Sicilian [1995].

often adopted to fill non-qualified vacancies. Finally, our theoretical framework implies that wage differentials between workers hired through informal and formal hiring channels may be positive or negative.

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. The Senegalese case entails particularly interesting features, because it is a developing country in Sub-Saharan Africa, a region that to our knowledge is unexplored in empirical studies on hiring channels and that is pervaded with informality to a greater extent than other developing countries[7]. 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.

Estimating an endogenous switching model, we find that informal hiring channels are preferred to fill non-qualified 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.

Section 2 analyzes the case of Senegal, providing details on the data and some descriptive statistics characterizing sampled firms and workers. Section 3 presents a theoretical framework that accounts for the elements intuitively singled out above and corroborated by the analysis of rough data. Section 4 presents econometric evidence supporting the hypotheses and the predictions of our theoretical framework. Finally, section 5 concludes.

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

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

workers in the formal[8] manufacturing[9] 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 and fellows are the main channel of matching between firms and workers in the dataset. On the demand side, the majority of firms use sometimes formal and sometimes informal hiring channels, and 60% of the sampled firms declares to mainly rely on informal networks in order to fill their vacancies. On the supply side, 64% of interviewed workers found their job through social networks.

In order to get some insights about the phenomenon, it is useful to go into a detailed analysis of the characteristics of both firms and workers thoroughly. Some characteristics of the sampled firms are reported in Table 1, which distinguishes between firms that declare to mainly rely on formal versus 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.[10] Enterprises where the owner is also the boss of the firm are also those that more often use informal hiring channels, while bigger firms tend to rely more on formal hiring channels.

Having noticed these characteristics at the firm level, we now investigate the characteristics of sampled workers.[11] Table 2 reports the 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 and fellows 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 the members of her extended family working in the firm. Rough data suggest that the ethnic group

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[8]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 lots of workers. Data available for 2001 indicate that it represented almost 55% of GDP and that about 1.2 million people worked for 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' choice concerning the hiring channel.

[9]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 2006 OECD and African Development Bank [2008].

[10]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.

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

	Firms mainly hiring through channel:			Total
	formal	informal	Difference	
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%

Table 1: Characteristics of sampled firms.

is one of the social networks whereby workers may be hired, since employees that belong to the same ethnic group as the boss of the firm are 21% among workers hired through an informal network and 13% in the formal labor market. Not surprisingly, networks based on kinship play an even bigger role.

Our data set provides evidence that workers are hired more often through social contacts for job requiring lower qualifications. Indeed, 76% of non-qualified workers found their job through their family or friends. The percentage falls to 60% for qualified blue collars and to 41% for qualified white collars and managers.[12] 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[13] is significantly lower for workers hired through social networks.

While the rigor of econometrics is necessary to disentangle the relative role played by different variables, the analysis of crude data suggests several potentially relevant dimensions which are

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

[13]Real wages are computed adjusting reported initial salaries for the harmonized consumer price index, provided by the Senegalese Prévision and Statistics Direction (Direction de la Prevision et de la Statistique).

| | Workers hired through channel: | | | Total |
	formal	informal	Difference	Total
number of workers	555	1018	-463	1573
same ethnicity as owner/manager	13%	21%	-18%***	18%
same family as owner/manager	5%	15%	-10%***	11%
job: managers	32	23	9***	55
qualified white collar	101	71	30***	172
qualified blue collar	238	351	-113***	589
non qualified workers	183	569	-38***	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	81%	83%	-2%	82%
marital status: married	68%	64%	4%*	65%
origin: Dakar	220	426	-206	646
Senegal	311	546	-235	857
Africa, Asia, other	17	42	-25	59
EU, US	7	3	4**	10
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%

Table 2: Characteristics of sampled workers.

integrated in the theoretical framework described in section 3. The incidence of informal hiring channels varies with jobs and networks' characteristics, and in particular the tighter the networks the more often they are used as hiring channels.

3   A Model of Hiring by the Informal Channel

The need of a theoretical framework accounting for what we observe in reality and in the data described in in section 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. We model a formal-sector firm that can hire labor either through the formal channel, at a market wage, or from a pool of workers who are linked to that firm by an informal network (Table 3 summarizes the vari-

ables introduced in the model). In the latter case, the wage rate is determined by bargaining between the firm and the worker. Assume that the outcome is determined by the Generalized Nash Bargaining Solution (Rubinstein [1982]), so that the wage rate paid to worker, when hired by the informal channel, maximizes $(w_{i,j}^N - \underline{w}_{i,j}^N)^{\eta_i} (\overline{w}_{i,j}^N - w_{i,j}^N)^{1-\eta_i}$. In this function, η_i is the worker's bargaining power, $\underline{w}_{i,j}^N$ is the minimum wage rate that employee i is willing to accept for working for firm j, rather than joining the formal segment of the labor market, and $\overline{w}_{i,j}^N$ is the maximum wage rate that the firm is prepared to pay this worker rather than hiring another one via the formal channel. The latter two variables are determined endogenously, as described below. Therefore, if the firm makes any hiring through the informal channel, it will pay the workers hired that way the following wage:

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

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.

3.1 Determinants of the Break Point

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 shirking or exerting 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 though 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 cultural).

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

	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	$e_i^F \in \{0, e\},$	$k \in \{F, N\}$ and $i = 1, ..., n$
		$e_i^N \in \{0, e + \delta\varphi_{i,j}\}$	
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	$0 \leq \varphi_{i,j} \leq 1$	$i = 1, ..., n$ and $j = 1, ..., m$
δ	Cultural factor	$\delta \in (-\infty, +\infty)$	
$\mu_{i,j}^k$	Probability of monitoring	$0 \leq \mu_j^k \leq 1$	$k \in \{F, N\}$, $i = 1, ..., n$ 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 $j = 1, ..., m$

Table 3: Description of variables in the model.

worker hired by the formal channel is:

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

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:

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

where $\zeta_{i,j}$ is 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.

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

$$\mu^F \geq \frac{\gamma e}{w^F} \tag{2}$$

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$$\mu_{i,j}^N \geq \frac{\gamma(e + \delta\varphi_{i,j})}{w_{i,j}^N + \zeta_{i,j} + \varphi_{i,j}} \tag{3}$$

Proof is provided in appendix A. The no-shirking conditions (2) and (3) suggest that the intensity of monitoring that maximizes firm's profit depends on the hiring channel chosen. When a social network is adopted as hiring channel, its tightness determines the level of monitoring inducing effort, as well as the cultural parameter δ. 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 (2) and (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:

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

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 $\mu^F < \frac{\gamma e}{w^F}$;

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

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

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

$$\Pi_j^F = \vartheta e - w^F - \xi_j \frac{\gamma e}{w^F} \tag{4}$$

$$\Pi_{i,j}^N = \vartheta e + \delta\varphi_{i,j} - w_{i,j}^N - \xi_j \frac{\gamma(e + \delta\varphi_{i,j})}{w_{i,j}^N + \zeta_{i,j} + \varphi_{i,j}} \tag{5}$$

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:

$$U^F = w^F - \gamma e \tag{6}$$

$$U_{i,j}^N = w_{i,j}^N + \zeta_{i,j} - \gamma(e + \delta\varphi) \tag{7}$$

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

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 $w_{i,j}^N \leq \overline{w}_{i,j}^N$, which is such that:*

$$\vartheta e + \delta\varphi_{i,j} - w_{i,j}^N - \xi_j \frac{\gamma(e + \delta\varphi_{i,j})}{w_{i,j}^N + \zeta_{i,j} + \varphi_{i,j}} \leq w^F + \xi_j \frac{\gamma e}{w^F} \tag{8}$$

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

$$w_{i,j}^N \geq \underline{w}_{i,j}^N = w^F - \zeta_{i,j} + \gamma\delta\varphi_{i,j} \tag{9}$$

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

At the other end of the range, the lower bound decreases, 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.

3.2 The Choice of the Hiring Channel

A glance at (8) and (9) shows that the bargaining set $w_{i,j}^N \in \left[\underline{w}_{i,j}^N, \overline{w}_{i,j}^N\right]$ might be empty, if the non monetary gain of networked workers is very small or the market wage of employees

hired through the formal channel very large. This remark allows us to establish the following proposition[14].

Proposition 2 (Choice of Hiring Channel). *When $\delta > 0$,*

1. *informal hiring channels will always be used if:*

   - $\gamma \leq \vartheta$, *or*

   - $\gamma > \vartheta$, $\zeta_{i,j} < \varphi_{i,j}\delta(\gamma - \vartheta)$ *and* w^F *below some threshold level* $\widehat{w}^F$;

2. *both informal and formal hiring channels will be used if either of previous conditions holds and* $\eta_i = 1$;

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

When $\delta < 0$,

1. *informal hiring channels will always be used if:*

   - $\gamma \geq \vartheta$, *or*

   - $\gamma < \vartheta$, $\zeta_{i,j} < \varphi_{i,j}\delta(\vartheta - \gamma)$ *and* w^F *below some threshold level* $\widehat{w}^F$;

2. *both informal and formal hiring channels will be used if either of previous conditions holds and* $\eta_i = 1$;

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

The intuition behind this result is pretty simple, and can be summarized by the familiar saying: 'it takes two for tango'. In other words, for the firm to hire through the informal channel, such a transaction must be worthwhile for both the firm and the worker. Figure 1, which depicts the set determined by proposition 2 when both channels may be chosen, 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 $\overline{w}_{i,j}^N$ and $\underline{w}_{i,j}^N$ coincide, workers do not want a job through social networks because firms are not willing to pay them enough through such hiring channel. It in only within the area labeled

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[14]A technical condition needed for the upper bounds $\overline{w}_{i,j}^N$ to be a well behaved function of w^F is $(\zeta_{i,j} + \varphi_{i,j})(2\sqrt{\xi_j\gamma} + \vartheta\delta\varphi_{i,j}) > \xi_j\gamma(e + \delta\varphi_{i,j})$
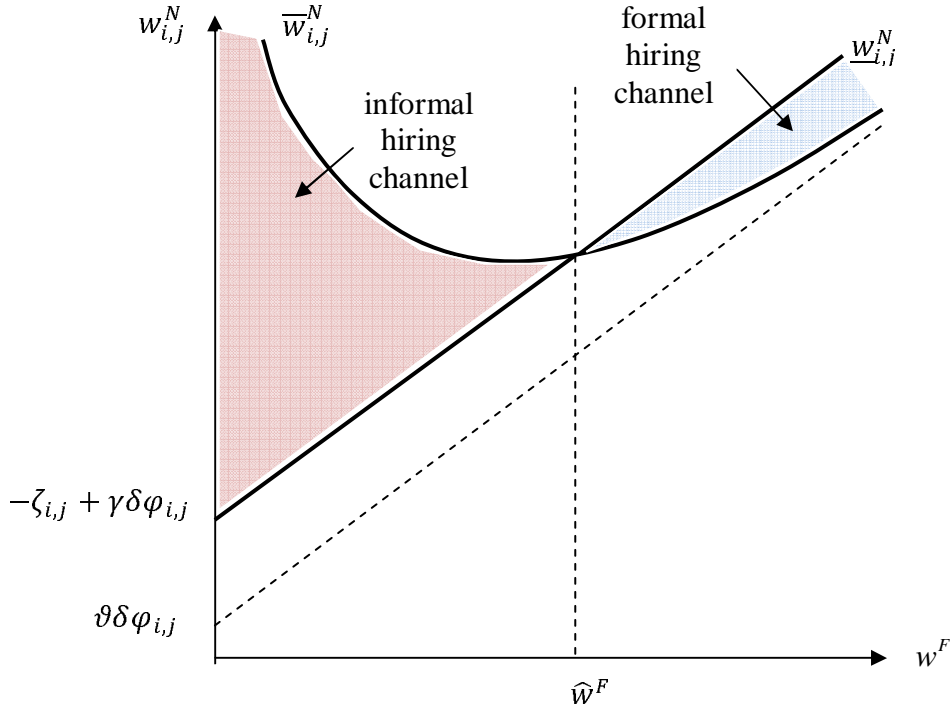
Figure 1: The choice of hiring channel.

'informal hiring channel' that both sides are willing to strike a bargain by the informal channel. This triangle becomes open-ended if $\zeta_{i,j} > \varphi_{i,j}\delta(\gamma - \vartheta)$, implying that when non-monetary gain from informal hiring are substantial social networks will prevail as hiring channels. Networks that do not provide a high enough non-monetary gain will instead not be adopted as hiring channel. Notice that in countries where informality reigns over the economy, which is often the case in developing countries, the relative weight of non-monetary benefit versus salary may be substantial, explaining why informal hiring channels are even more common than in industrialized countries. Since the same non-monetary gain will impact on workers' utility more if their salary is lower, our model also implies that social networks will be more often adopted as hiring channel for less qualified jobs. 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 ($delta > 0$), formal hiring channels are used only if the cost of effort is greater than productivity. Our model also predicts that in contexts of favoritism ($delta < 0$) more qualified vacancies should be filled through the formal channel, while non-qualified jobs through informal hiring channels.

3.3 The Wage Differential

We can now assess whether the 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 $\gamma \leq \vartheta$;*

2. *only wage premium to workers hired through social networks is possible if $\gamma > \vartheta$.*

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 suggested by the empirical literature discussed in section 1. When the bargaining power is limited, the salary earned by workers hired through the informal channel decreases with the non-monetary gain she enjoys. On the contrary, if networked workers have strong bargaining power, non-monetary gains do not affect the wage differential with other workers. In case of low bargaining power workers hired through social networks gain wage premia only when they reciprocate the working opportunity by exerting more effort than workers hired through the formal channel and the cost of effort is greater than productivity. In such culture, wages are *ceteris paribus* positively affected by network tightness and the intensity of reciprocity. However, when networked employees work less, the wage differential between the wage they perceive and the formal market wage is negatively affected by network tightness and favoritism.

4 Econometric analysis of hiring channel choice and wage differentials

We exploit the Senegalese data to investigate the determinants of the hiring channel choice and wage differentials imputable to hiring channel.[15] A fundamental concern undermines the

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[15]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.

analysis: is the hiring channel choice exogenous to unobservable determinants of wage? If hiring channel and salary share some unobservable determinants, sample selection[16] 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 endogenous sample selection and switching impact that wage determinants may have for workers hired through different channels is the endogenous switching model or Heckman's selection correction model (see Heckman [1979]). The details on endogenous switching econometric model are reported in appendix B. Roughly speaking it is a treatment effect model that allows for a full set of interaction terms between hiring channel and wage determinants.

4.1 Specification of estimation

To take advantage of the richness of available data, we take into account not only variables at the individual level as in the standard endogenous switching model, but also firms' characteristics.[17] Therefore, the system of equations of interest is as follows:

$$ln\ w_{i,j}^F = \beta_{worker}^F X_i + \beta_{firm}^F \Xi_j + \epsilon_{i,j}^F \tag{10}$$

$$ln\ w_{i,j}^N = \beta_{worker}^N X_i + \beta_{firm}^N \Xi_j + \epsilon_{i,j}^N \tag{11}$$

$$H_{i,j}^* = \gamma Z_{i,j} + u_{i,j} \tag{12}$$

---

[16]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).

[17]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, direction, sector, location, public capital) and the worker level (years of education, hours of work and marital status) are good proxies for their value at the time hiring occurred.

where the dependent variable of the wage regressions is the natural logarithm of 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, vector X_i is represented by worker i's years of education and experience before hiring, gender, marital status, place of origin, number of hours worked per week,[18] type of vacancy filled when hired and whether she belongs to the ethnic group or the family of firm's manager or owner. 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 runs the firm. The 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 (10) and (11), but significant in the selection equation (12). While by definition this hypothesis is not testable, economic reasoning supports our choice of this exclusion restriction since age should not be relevant in a wage determination once experience and education are accounted for. On the other hand, our theoretical framework suggests that people over 40 should be more likely to be hired through informal rather than formal channels, because of their lower productivity with respect to younger applicants.

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

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

4.2 Econometric results

Table 4 shows the estimation results for the three simultaneously estimated equations. The first part of the table reports the coefficients of the determinants of the hiring channel, which correspond to the parameters in equation (12). The determinants of salary for workers hired through social networks, corresponding to β^Ns in equation (11), are reported in the second part of the table in the first column, and through formal channels, corresponding to β^Fs in equation

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[18]We run the same estimation using the hours of work per week to obtain the wage rates from the monthly salaries. The results are identical, the only difference being that the significance of some variables slightly increases. However, we present the results obtained for monthly wages to avoid any concern of propagation of potential measurement errors from hours of work to the dependent variable.

(10), in the second column. Some estimated parameters and statistics follow.

The use of social networks as hiring channel greatly varies with the type of vacancy to be filled, a styled fact described in section 1. Non-qualified workers have a significantly higher probability of being hired through social networks than qualified blue collars, while the opposite is true for qualified white collars. Such result verifies the theoretical implications of the model that are developed in section 3.2. Productivity of non-qualified workers is below their cost of effort and non-monetary gains are likely to be indeed quite large with respect to the monetary wage, so that despite favoritism networks are likely to be adopted as hiring channel, while the opposite is true for qualified white collar workers. Managers are not significantly more likely to be hired through formal rather than informal channels probably because the two 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 earn significantly more if hired as manager or a qualified white collar and lower if hired as non-qualified worker than if she is hired as qualified blue collar, consistently with what intuition

Choice of informal hiring channel		
job: manager	-0.441	(0.286)
qualified white collar	-0.334**	(0.145)
non-qualified	0.251**	(0.112)
same family as boss	0.482***	(0.152)
only same ethnicity as boss	0.094	(0.157)
education (years)	-0.031**	(0.012)
previous experience (years)	-0.063***	(0.019)
previous experience sq. (years)	0.002***	(0.001)
age over 40 at hiring	0.305**	(0.141)
origin: Dakar	0.162*	(0.093)
EU, US	-0.170	(0.585)
Africa, Asia, other	0.278	(0.290)
married	0.108	(0.092)
gender: male	-0.042	(0.114)
hours worked	0.005	(0.005)
firm located in Dakar	-0.393*	(0.212)
ln of n.employees	-0.111***	(0.039)
owner and director	0.111	(0.110)
TFP at hiring	0.018	(0.155)
public firm	0.052	(0.253)
intercept	1.040**	(0.425)
sector dummies	yes	

Wage regression for workers hired through:	social networks		formal channel	
job: manager	0.605*	(0.337)	0.446***	(0.106)
qualified white collar	0.431***	(0.137)	0.199**	(0.099)
non-qualified	-0.434***	(0.075)	-0.182**	(0.085)
same family as boss	-0.301**	(0.134)	-0.260**	(0.110)
only same ethnicity as boss	0.016	(0.089)	0.094	(0.094)
education (years)	0.040***	(0.010)	0.058***	(0.009)
previous experience (years)	0.043***	(0.017)	0.029**	(0.014)
previous experience sq. (years)	-0.002**	(0.001)	-0.001	(0.001)
origin: Dakar	0.034	(0.067)	-0.011	(0.074)
EU, US	0.319	(0.571)	1.225***	(0.421)
Africa, Asia, other	-0.160	(0.237)	-0.296	(0.238)
married	0.100	(0.074)	0.166**	(0.066)
gender: male	-0.019	(0.083)	0.057	(0.085)
hours worked	0.000	(0.003)	0.004	(0.004)
firm located in Dakar	0.653***	(0.215)	0.673***	(0.195)
ln of n.employees	0.132***	(0.032)	0.053*	(0.028)
owner and director	-0.126*	(0.073)	-0.062	(0.071)
TFP at hiring	0.360***	(0.120)	0.441***	(0.127)
public firm	-0.038	(0.229)	-0.013	(0.132)
intercept	9.675***	(0.328)	9.000***	(0.398)
sector dummies	yes		yes	
ρ_N	-0.746***	(0.257)		
ρ_F	-0.116	(0.233)		
σ_N	0.840	(0.122)		
σ_F	0.622	(0.087)		
Log-likelihood	-1838.36			
Wald χ^2_{27}	129.12			
N	1139			

Note: Robust Standard Errors in brackets.

Significance levels : $*: 10\%$ $**: 5\%$ $***: 1\%$

Table 4: Endogenous switching model: determinants of the choice of hiring channel and of the wage depending on the hiring channel.

suggests, whatever the hiring channel.

One peculiar determinant of the salary results to be 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 the informal hiring channel. At the same time, relatives suffer a substantial wage penalty. For workers who do not belong to the same family as the boss of the firm, but to her ethnic group the effect is similar but not significant. The crucial role played by social network tightness reflects a key ingredient of our theoretical framework and

supports one of the most important prediction of our model. In contexts where favoritism is widespread, the tighter the social network that serves as hiring channel, the larger the potential wage penalties suffered by networked workers. Moreover, if workers have low bargaining power and enjoy large non-monetary gains, they work for even lower wages.

One more year of education significantly decreases the probability of being hired through social networks and the use of informal hiring channels is a decreasing and convex function of experience prior hiring.[19] 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. The fact that age is legitimately excluded from wage regressions, once controlled for education and experience, but it is a significant determinant of the hiring channel choice is the exclusion restriction that assures identification.

Whether a worker comes from Europe, America, Asia or the rest of Africa rather than from Senegal does not affect the probability of being hired through social networks. However, workers originally from Dakar have a significant higher probability of being hired through informal channels. Indeed, their social networks are likely to easily serve as hiring channel, since 96% of firms are located in Dakar. The place from where a worker comes from is not a significant determinant of wage for workers hired through social networks, while European or American origins increase wages of workers hired through formal channels.

The role played by marital status of workers suggests that, in a sense, some informal considerations play a role even when formal hiring channels are adopted. It is not a significant determinant of the hiring channel and married workers do not earn significantly more if they

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

were hired through social networks, but workers hired on the formal labor market enjoy significantly higher wages if they are married. A potential explanation is that firms believe that married employees behave better in their job. For instance, if firms think that married workers are more trustworthy, they will pay more married employees than not married ones hired on the formal market. At the same time, they won't pay more married workers hired through informal channels, since peer pressure exerted by the social networks whereby they got the job already assures (for free) their trustworthiness. Workers' gender and hours worked per week are maintained as control variables at the individual level, but they are never significant.

Table 4 also shows that there are a number of firms' characteristics affecting the choice of the hiring channel and the wages. The location of a firm in Dakar rather than in other towns decreases the likelihood of hiring somebody through informal hiring channels, which is not surprising if social structure in big cities entails weakened social networks.[20] At the same time, employees working in a firm in Dakar gain significantly higher wages.[21]

The size of the firm, in terms of total number of employees, has consistently with our theoretical predictions a significantly negative impact on the probability of being hired through informal channels and a positive one on wages.[22] Indeed, 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* if they had. 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 firm 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 nothing more than that.

To control for time effects due to the fact that surveyed workers were hired in different years,

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[20]This idea dates back to the nineteenth century (see Tonnies [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].

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

[22]Pistaferri [1999] also finds that large firm are less likely to hire through informal channels and pay higher wages.

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.

At the bottom of Table 4 are reported the estimated correlation coefficients between residuals of the regression for the choice of the hiring channel and wages. The correlation between the residuals of the selection equation (12) and the wage regression for worker hired through formal channels (10), ρ_F, is not significantly different from zero. However, the correlation between the residuals of the selection equation and the wage regression for worker hired through informal channels (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 suffered by workers who got their job through social networks due to unobservable factors 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.* $\mathbb{E}\left(ln\ w_{i,j}^N\right) = \widehat{\beta}_{worker}^N X_i + \widehat{\beta^N}_{firm}\Xi_j$. Figure 2 shows that true distribution
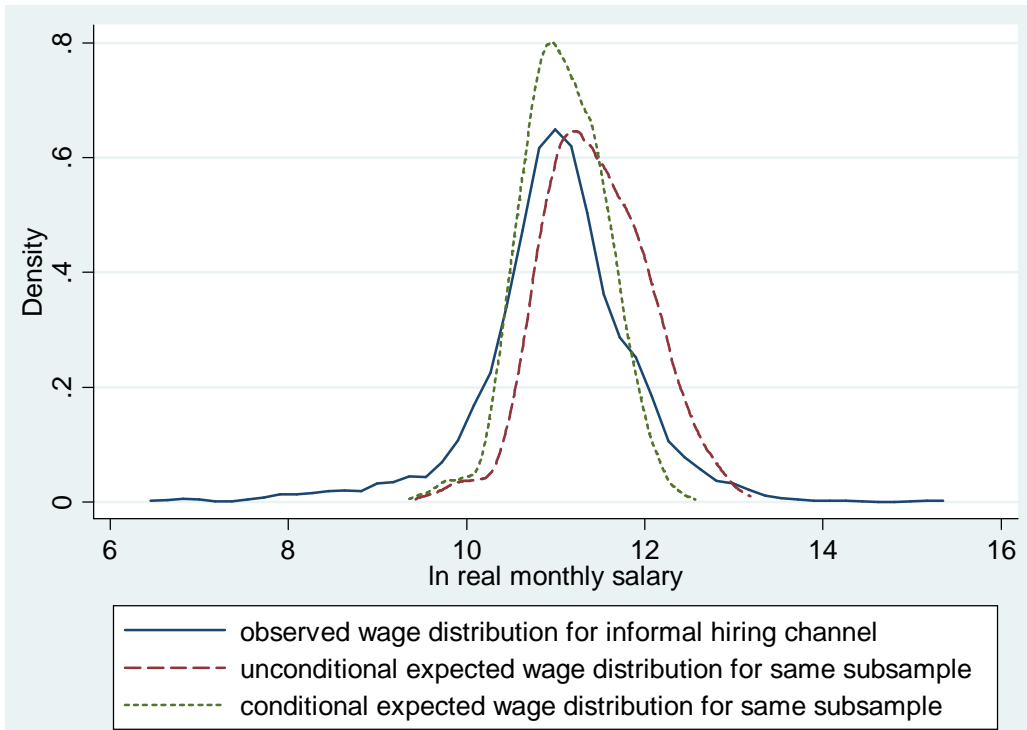

Figure 2: True distribution of wages for workers hired through informal hiring channels and distribution of unconditional and conditional expected wages for the same subsample of workers.

of wages for the subsample of workers hired through informal channels is to the left of the unconditional wage predicted for the same workers, while the distribution of expected wages for the subsample of workers hired through social networks conditional on the dependent variable being observed, *i.e.* $\mathbb{E}\left(ln\ w_{i,j}^{N}|H_{i,j}=N\right)=\widehat{\beta}_{worker}^{N}X_{i}+\widehat{\beta}_{firm}^{N}\Xi_{j}+\widehat{\sigma}_{N}\widehat{\rho}_{N}f(\widehat{\gamma}Z_{i,j})/F(\widehat{\gamma}Z_{i,j})$, fits quite well the true distribution of wages for the same subsample. The difference between unconditional and conditional expected wages is precisely the negative selection effect of informal hiring channels.

In order to reach a conclusion about whether informal hiring channels overall imply in 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 4 to asses whether the differences are statistically significant. Table 5 shows that hiring channel entails a wage penalty through the switching impact of a non-qualified job.

$\widehat{\beta}^{N}-\widehat{\beta}^{F}$		
job: manager	0.159	(0.399)
qualified white collar	0.232	(0.250)
non-qualified	-0.252*	(0.153)
same family as boss	-0.041	(0.267)
only same ethnicity as boss	-0.078	(0.184)
education (years)	-0.017	(0.036)
previous experience (years)	0.014	(0.038)
previous experience sq. (years)	-0.000	(0.002)
origin: Dakar	0.045	(0.115)
EU, US	-0.906	(0.798)
Africa, Asia, other	0.137	(0.418)
married	-0.066	(0.132)
gender: male	-0.076	(0.134)
hours worked	-0.004	(0.028)
firm located in Dakar	-0.020	(0.376)
ln of n.employees	0.079	(0.071)
owner and director	0.111	(0.110)
TFP at hiring	-0.080	(0.157)
public firm	-0.025	(0.302)
intercept	0.675	(1.819)

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

Table 5: Switching impact of the hiring channel on wages: difference between estimated coefficients of wage determinants for workers hired through informal and formal channels.

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.

5 Conclusions

This paper sheds light on the role played by social networks in the labor market and on wage differentials between employees hired through formal and informal hiring channels.

From a theoretical point of view, we focus on moral hazard effects and allow heterogeneity of networks' tightness. Our framework accounts for the fact that firms may prefer sometimes to adopt formal hiring channels and sometimes informal ones, depending on the situation they face. 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. The implications of the model account for two important stylized facts emphasized by the literature. First, the use of informal hiring channels, though widespread all over the world, is even more intense in developing countries. Second, vacancies for unskilled occupations are much more likely to be filled through informal hiring channels than jobs requiring high competences. Moreover, our theoretical framework allows for either wage premia or penalties due to the hiring channel, depending on the circumstances. This feature provides an interpretation for the rather mixed conclusion of the empirical literature on the impact that the hiring channel has on wages.

We empirically verify the implications of the model in the specially interesting case of the Senegalese formal manufacturing sector. While the analysis of a single country does not allow to study the relationship between the development 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 when favoritism is widespread social networks are often exploited as hiring channel for non-qualified jobs and when non-monetary gains are likely to be large, like in the case of relatives of the firm boss or in small firms. Formal hiring channels are instead adopted for filling qualified vacancies and when the competences are higher. Finally we find that workers hired through whatever informal channels 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 may indeed be at least partly compensated by larger non-monetary gains.

Further research could more completely consider the 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 ability among members. If the chief of a firm guarantees employment to her relatives, the pooling of business risk[23] within the family should be taken into account.

Another step would be taking into account the multimensionality of concerns arising from incompleteness of information in the labor market and developing a theoretical framework that takes simultaneously into account moral hazard and selection problems. The predictions of such model could then be tested in order to disentangle relative weight of the two.

A Theoretical Appendix

Proof of lemma 1. Worker i chooses whether to shirk (*i.e.*, $e_i = 0$) or not (*i.e.*, $e_i = 1$) by maximizing her utility.

If she was hired through formal channels, she does not shirk if $w^F - \gamma e \leq \left(1 - \mu_j^F\right) w^F$. Therefore, the no-shirking condition for workers hired on the formal labor market is (2).

If she was hired through a social network, she does not shirk if $w_{i,j}^N + \zeta_{i,j} - \gamma(e + \delta\varphi) \leq \left(1 - \mu_j^N\right)(w_{i,j}^N + \zeta_{i,j}) - \mu_j^N \varphi_{i,j}$, *i.e.* if condition (3) is satisfied. $\qquad\square$

Proof of proposition 1.   1. the firm prefers hiring through social networks worker i if per worker profits when hiring through informal channels (5) are greater or equal to when an employee is hired through the formal one (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, $w_{i,j}^N \leq \overline{w}_{i,j}^N$, such that:

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

2. the worker will accept a job from the informal channel if her utility (7) is greater or equal to the one she could get if she got a job through the formal channel (6):

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

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

$\square$

B 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 estimate binary and continuous parts of the model.[24] Endogenous switching models describe the behavior of an agent with two regression equations, and a criterion function that determines which regime of wages the agent faces:

$$ln \ w_i^F = \beta^F X_i + \epsilon_i^F \tag{13}$$

$$ln \ w_i^N = \beta^N X_i + \epsilon_i^N \tag{14}$$

$$H_i^* = \gamma Z_i + u_i \tag{15}$$

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

---

[24]FIML involves forming the joint distribution of the random variables characterizing the equations of the model and then maximizing the full log-likelihood function. The estimation of the switching regression model and the counterfactuals are based on the FIML algorithm implemented as a Stata program movestay Lokshin and Sajaia [2004].

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 vector parameters are β^N, β^F, and γ. The disturbance terms are ϵ_i^F, ϵ_i^N and u_i. 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 from the sample of workers hired through formal channels to 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:

$$
H_i =
\begin{cases}
1 & if\ H_i^* > 0 \\
0 & otherwise
\end{cases}
\tag{16}
$$

As in any model entailing latent variables, it is necessary to take care of identification. Endogenous switching models are identified by construction through non-linearities introduced by the selection equation (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 her 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 (13) and (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 (15), and σ_F^2 and σ_N^2 are

variances of the error terms in the regression equations (13) and (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 the 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 (13) and (15) is designated by ρ_F:

$$\rho_F = \frac{\sigma_{uF}}{\sigma_u \sigma_F} \tag{17}$$

and the correlation between residuals in equation (14) and (15) by ρ_N:

$$\rho_N = \frac{\sigma_{uN}}{\sigma_u \sigma_N} \tag{18}$$

If the unobserved factors determining the hiring choice are not correlated with unobserved determinants of the 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 through which 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.

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 hiring through informal channels	Number of firms that declared to mainly hire through informal channels
Number of employees	Number of employees working in a firm
Monitoring personnel proportion	Number of security and management personnel over total number of employees in a firm
Unionized employees proportion	Percentage of unionized employees in a firm
Workers hired through informal channel prop.	Number of workers hired through informal channel over total number of employees as extrapolated from interviewed sample
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
Marital status	Dummy variable indicating whether a worker is married
Same ethnicity as owner/manager	Dummy variable indicating whether a worker belongs to the same ethnic group as the owner or the manager running the firm
Same family as owner/manager	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
Unionized workers	Dummy variable stating whether a worker belongs to a union
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

Table 6: Description of variables used in section 2 and 4.

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