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The Remains of Informality in the Formal Sector Social Networks and Wages in Senegal's Labor Market

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Social Networks and Wages in Senegal's Labor Market

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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. We show that, conditional on being employed, in favoritism contexts social networks are likely to be adopted as hiring channels for unskilled jobs and to result in wage penalties and the more so the stronger the ties, while otherwise the opposite happens. We then estimate an endogenous switching model for the case of Senegal's manufacturing formal sector and we find, consistently with our theoretical predictions in case of favoritism, 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 are increasing with the strength of ties.

JEL classification: O12; J31

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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. 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 economists¹ 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 the 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 the enhanced selection guaranteed by informal hiring channels should be exploited specially for vacancies requiring high skills and should 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, many empirical studies suggest that vacancies for unskilled occupations are more likely to be filled

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

²See 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.

through social networks than jobs requiring high skills,³ while some find the opposite⁴. Finally, wage differentials imputable to informal hiring channels are far from being always positive.⁵ For instance, Pellizzari [2009] finds that, out of 15 industrialized countries, 3 are characterized by wage premia to networked workers, 4 by wage penalties, while in the 8 remaining countries there are no 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 tightness⁶. 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.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. However, the role played by peer pressure may decrease the monitoring costs for workers hired through social networks with respect to other employees.⁸ 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 encour-

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.

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

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

⁵While 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. [2009].

⁶A 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]:

⁷Several 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.

⁸In enriching the employer search framework with the efficiency wage theory, we carry out a step in 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 lowering monitoring cost, but within a matching framework.

ages 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 often adopted to fill unskilled 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. Most of the empirical literature on social networks is largely confined to developed countries studies, while very few studies have analyzed the crucial role of social networks in less developed countries's labor markets.⁹ Moreover, to our knowledge no analysis exists concerning 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 countries¹⁰, and none takes into account the fact that social networks differ in their tightness. 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 yet 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.

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

⁹Notable exceptions are Egypt's studies by Assaad [1997] and Wahba and Zenou [2005].

¹⁰An example of the economic relevance of informality in Africa is provided by Azam et al. [2001] concerning the credit market.

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 workers in the formal¹¹ manufacturing¹² 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 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.

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 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.¹³ 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.

Having noticed these characteristics at the firm level, we now investigate the characteristics

¹¹The 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 la great number 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' choices concerning the hiring channel.

 $^{^{12}}$ 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 14% of GDP in 2006 (African Economic Outlook [2006]).

¹³Indeed, 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.

	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%

Table 1: Characteristics of sampled firms.

of sampled workers.¹⁴ 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 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 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. 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 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.¹⁵ Workers who found their job through informal contacts are also

¹⁴Notice 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.

¹⁵The survey categorizes workers into ten types of jobs. We group them into four occupational categories: man-

	Workers	s hired through	channel:	
	formal	informal	Difference	Total
number of workers	555	1018	-463	1573
same ethnicity as firm's head	553	1016	-463***	1569
same family as firm's head	554	1017	-463***	1571
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
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%

Table 2: Characteristics of sampled workers.

less educated, experienced, and younger than employees hired on the formal labor market. Finally, the mean of the natural logarithm of real monthly salary¹⁶ 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 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.

ager, 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).

¹⁶Real wages are computed adjusting reported initial salaries for the harmonized consumer price index, provided by the Senegalese Prevision and Statistics Direction (Direction de la Prévision et de la Statistique).

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 w^F , or from a pool of workers who are linked to that firm by an informal network.¹⁷ In the latter case, the wage is determined by bargaining between the firm and the worker.¹⁸ Assume that the outcome is determined by the Generalized Nash Bargaining Solution (Rubinstein [1982]), so that the wage paid to worker, when hired by the informal channel, maximizes $(w_{i,j}^N - w_{i,j}^N)^{\eta_i} (\overline{w}_{i,j}^N - w_{i,j}^N)^{1-\eta_i}$. In this function, η_i is the worker's bargaining power, $\underline{w}_{i,j}^N$ is the minimum wage 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 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:

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

¹⁷Table 5 in appendix A summarizes the variables introduced in the model.

¹⁸A vacancy posted through formal channels is likely to propose a wage and this leaves narrower margins for negotiation than when informal hiring channels are used.

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 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:

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

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.¹⁹

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

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

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

Proof is provided in appendix A. The no-shirking conditions (2) and (3) suggest that the intensity of monitoring that maximizes the firm's profit depends on the hiring channel cho-

¹⁹The potential role played by non-pecuniary benefits is stressed in Fontaine [2007] and Bentolila et al. [2009].

sen. 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:

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

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

$$\Pi_{i,j}^{N} = \vartheta e_{i}^{N} - (1 - q_{i,j}^{N}) w_{i,j}^{N} - \xi_{j} \mu_{i,j}^{N}$$

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

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

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

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

and

$$U_{i,j}^{N} = w_{i,j}^{N} + \zeta_{i,j} - \gamma(e + \delta\varphi)$$
⁽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 $w_{i,j}^N \leq \overline{w}_{i,j}^N$, where $\overline{w}_{i,j}^N$ is the maximum of $w_{i,j}^N$ fulfilling:

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

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

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

Proposition 1 thus specifies the acceptable range of values of the informal wage 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 the 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.

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, which depicts the set determined by proposition 1, makes clear that this



Figure 1: The choice of hiring channel and the wages of workers hired through formal and informal hiring channels.

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 a hiring channel. Only within the area labeled 'informal hiring channel' both sides are willing to strike a bargain by 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:
 - 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.

The intuition behind proposition 2 is that 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 $\delta(\gamma - \vartheta) \leq 0$. The first condition suggests that social networks prevail as hiring channels 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 nonmonetary gain will impact on workers' utility more if their salary is lower, our model also implies that social networks should be more often adopted as hiring channel for less skilled jobs. The second condition for informal hiring channels to prevail implies that, even when networks do not provide a high non-monetary gain, they are adopted as hiring channel if $\vartheta \ge \gamma$ when $\delta > 0$ and if $\gamma \leq \vartheta$ 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, 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 $(\delta > 0)$, to fill skilled vacancies, while in contexts of favoritism ($\delta < 0$) to for unskilled jobs and more skilled vacancies should be filled through the formal channel.

3.3 The Wage Differential

Figure 1 shows that the stronger the willingness to reciprocate a job opportunity obtained through social networks (the larger δ), the tightness of the social network adopted as hiring channel, and the bargaining power (*i.e.*, $w_{i,j}^N$ close to $\overline{w}_{i,j}^N$) the higher tend to be the wage of workers hired through informal channels, while the opposite is true the stronger the culture of favoritism, the tighter the social network adopted as hiring channel, and the weaker the bargaining power (*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 they enjoy, while, if networked workers have strong bargaining power, the effect is weaker and the more so the larger the non-monetary gains.

We now assess formally 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 $\zeta_{i,j} > \gamma \delta \varphi_{i,j}$;
- 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 suggested by the empirical literature discussed in section 1. In particular, wage penalties should be more likely in contexts of favoritism and wage premia in the opposite case.²⁰ 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 the formal channel 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 the intensity of reciprocity. On the other hand, in context of favoritism, only if the bargaining power is particularly strong workers hired through informal hiring channels can get wage premia.

 $^{^{20} {\}rm Interestingly\ enough,\ Pellizzari\ [2009]\ finds\ wage\ penalties\ in\ Italy\ and\ wage\ premia\ in\ countries\ like\ Belgium\ and\ the\ Netherlands.$

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.²¹ 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 selection²² 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]). Details on the endogenous switching econometric model are given 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.²³

 $^{^{21}}$ 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.

²²Sample 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).

 $^{^{23}}$ 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

Therefore, the system of equations of interest is as follows:

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

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

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

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_i 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,²⁴ 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. Vector Ξ_i 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.²⁵ Our theoretical framework suggests that people that look for a job when they are over 40 should instead be more likely to be hired through informal rather than formal channels in contexts of favoritism.²⁶

Finally, the observed dichotomous realization of the latent variable $H_{i,j}^*$ is whether each

education, hours of work and marital status) are good proxies for their value at the time hiring occurred.

²⁴We 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 in order to avoid any concern of propagation of potential measurement errors from hours of work to the dependent variable.

 $^{^{25}}$ Hayashi [2000] precisely cites age as example of a good instrument for wage regressions including education and experience in the section dedicated to endogeneity bias of his textbook on Econometrics (pages 199-200).

²⁶Indeed, 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.

sampled worker was hired through social networks $(H_{i,j} = 1)$ or not $(H_{i,j} = 0)$:

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

4.2 Econometric results

Table 3 shows the results for the simultaneous estimation of equations 10, 11, and 12. 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^N s in equation (11), are reported in the second part of the table in the first column, and through formal channels, corresponding to β^F s in equation (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 stylized fact described in section 1. Unskilled workers have a significantly higher probability of being hired through social networks than skilled blue collars, while the opposite is

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)	
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 ne	tworks	formal c	hannel
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)
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)		
$ ho_F$	-0.142	(0.270)		
σ_N	0.840	(0.122)		
σ_F	0.632	(0.088)		
Log-likelihood	-1844.84			
Wald χ^2_{26}	128.49			
Ν	1139			

Note: In brackets Robust Standard Errors, clustered by 239 firms.

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

Table 3: Endogenous switching model: determinants of the choice of hiring channel and of the wage for workers hired through formal and informal hiring channels.

true for skilled white collars. Such result verifies the theoretical implications of the model that are developed in section 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.

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. The crucial role played by social network tightness reflects a key ingredient of our theoretical framework and supports one of the most important predictions 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.

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.²⁷ 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.

Marital status is not a significant determinant of the hiring channel and married workers do not earn significantly more if they were hired through social networks, but workers hired on

²⁷The same result is found for example by Pistaferri [1999].

the formal labor market enjoy significantly higher wages if they are married. Workers' gender, place of origin, and hours worked per week are maintained as control variables at the individual level, but they are never significant.

Table 3 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.²⁸ At the same time, employees working in a firm in Dakar gain significantly higher wages.²⁹

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.³⁰ 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 nothing more than that.

To control 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.

At the bottom of Table 3 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 workers hired through formal

²⁸This finding is coherent with the view that big cities entail weaker social networks, an idea that 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].

 $^{^{29}}$ 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.

³⁰Pistaferri [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.

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 workers 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.*, $\mathbb{E} (\ln w_{i,j}^N) = \hat{\beta}_{worker}^N X_i + \hat{\beta}_{firm}^N \Xi_j$. Figure 2 shows that the true distribution 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, while the distribution of expected wages for the subsample of workers hired through social networks conditional on the dependent variable being observed, *i.e.*, $\mathbb{E} (\ln w_{i,j}^N | H_{i,j} = N) =$ $\hat{\beta}_{worker}^N X_i + \hat{\beta}_{firm}^N \Xi_j + \hat{\sigma}_N \hat{\rho}_N f(\hat{\gamma} Z_{i,j}) / F(\hat{\gamma} Z_{i,j})$, fits quite well the true distribution of wages for



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.

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 $\hat{\beta}^N$ and $\hat{\beta}^F$ of Table 3 to asses whether the differences are statistically significant. Table 4 shows that the hiring channel entails a wage penalty through the switching impact of an unskilled job.

$\widehat{\beta}^N - \widehat{\beta}^F$		
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	0.111	(0.110)
TFP at hiring	-0.117	(0.170)
public firm	-0.027	(0.239)
intercept	0.709	(2.538)

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

Table 4: 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, contributing to a very scarce 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. Instead, When skilled workers are often hired through informal hiring channel, they are likely to get wage premia, and the more so the tighter the network.

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, 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 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.

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 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 risk³¹ within the family should be taken into account. A fundamental step would be taking into account the multi-dimensionality 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 a such model could then be empirically tested in order to disentangle the relative weight of the two.

A 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 $w^F - \gamma e \leq (1 - \mu^F) w^F$. 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 $w_{i,j}^N + \zeta_{i,j} - \gamma(e + \delta \varphi_{i,j}) \leq (1 - \mu_{i,j}^N) (w_{i,j}^N + \zeta_{i,j}) - \mu_{i,j}^N \varphi_{i,j}$, *i.e.*, if condition (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 (5) are greater than or equal to when an employee is hired

³¹Several empirical studies find evidence of risk pooling within highly clustered networks in African countries (see for example Barr [2002]).

through the formal one (4):

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

Therefore,

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

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 (7) is greater than or equal to the one she could get if she got a job through the formal channel (6):

$$w_{i,j}^{N} + \zeta_{i,j} - \gamma(e + \delta\varphi) \ge w^{F} - \gamma e$$
$$w_{i,j}^{N} \ge \underline{w}_{i,j}^{N} = w^{F} - \zeta_{i,j} + \gamma \delta\varphi_{i,j}.$$

	Variable	Support	Index
\overline{k}	Hiring channel	$k \in \{F, N\}$	
η_i	Worker's bargaining power	$0 \le \eta_i \le 1$	$i = 1, \dots, n$
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 $i = 1,, n$
U		$e_i^N \in \{0, e + \delta \varphi_{i,j}\}$	
ϑ	Productivity of effort	$\vartheta > 0$	
$\zeta_{i,j}$	Non-monetary benefit	$\zeta_{i,j} \ge 0$	i = 1,, nand $j = 1,, m$
$\varphi_{i,j}$	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	$0 \leq \mu_{i,j}^k \leq 1$	$k \in \{F, N\}, i = 1,, n \text{ and } j = 1,, m$
ξ_j	Unit cost of monitoring	$\xi_j > 0$	$j = 1, \dots, m$
$q_{i,j}^{k}$	Probability of firing	$0 \leq q_{i,j}^k \leq 1$	$k \in \{F, N\}, i = 1,, n \text{ and } j = 1,, m$
$w_{i,i}^{k}$	Worker's salary	$ w_{i,i}^k > 0$	$k \in \{F, N\}, i = 1,, n \text{ and } j = 1,, m$

Table 5: Description of variables used in the theoretical framework (section 3).

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.³² 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 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

 $^{^{32}}$ 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) by Lokshin and Sajaia [2004].

form:

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

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

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 informal hiring channels	Number of firms that declared to mainly hire through infor-
	mal 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
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

Table 6: Description of variables used in the empirical analysis (sections 2 and 4).

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