ECONOMETRICA

JOURNAL OF THE ECONOMETRIC SOCIETY

An International Society for the Advancement of Economic Theory in its Relation to Statistics and Mathematics

http://www.econometricsociety.org/

Econometrica, Vol. 77, No. 4 (July, 2009), 1047–1094

SOCIAL CONNECTIONS AND INCENTIVES IN THE WORKPLACE: EVIDENCE FROM PERSONNEL DATA

ORIANA BANDIERA
London School of Economics and Political Science, London WC2A 2AE, U.K.

IWAN BARANKAY
The Wharton School, University of Pennsylvania, Philadelphia, PA 19104, U.S.A.

IMRAN RASUL
University College London, London WC1E 6BT, U.K.

Econometrica, Vol. 77, No. 4 (July, 2009), 1047–1094

SOCIAL CONNECTIONS AND INCENTIVES IN THE WORKPLACE: EVIDENCE FROM PERSONNEL DATA

BY ORIANA BANDIERA, IWAN BARANKAY, AND IMRAN RASUL[1]

We present evidence on the effect of social connections between workers and managers on productivity in the workplace. To evaluate whether the existence of social connections is beneficial to the firm's overall performance, we explore how the effects of social connections vary with the strength of managerial incentives and worker's ability. To do so, we combine panel data on individual worker's productivity from personnel records with a natural field experiment in which we engineered an exogenous change in managerial incentives, from fixed wages to bonuses based on the average productivity of the workers managed. We find that when managers are paid fixed wages, they favor workers to whom they are socially connected irrespective of the worker's ability, but when they are paid performance bonuses, they target their effort toward high ability workers irrespective of whether they are socially connected to them or not. Although social connections increase the performance of connected workers, we find that favoring connected workers is detrimental for the firm's overall performance.

KEYWORDS: Favoritism, managerial incentives, natural field experiment.

1. INTRODUCTION

THIS PAPER EXPLORES the effects of social relationships between individuals within a firm on the productivity of individuals and on the firm's overall performance. The idea that human relations affect behavior in the workplace has been long discussed in the sociology literature (Mayo (1933), Barnard (1938), Roethlisberger and Dickson (1939), and Roy (1952)). Economists have joined this debate relatively recently, due both to the burgeoning theoretical literature on how social relations and social preferences matter for economic behavior, in general, and to the increasing availability of personnel data, in particular.

In the context of firms, much of the literature—theoretical and empirical—has studied the effect of social relations within a single tier of the firm hierarchy, such as among managers or among workers.[2] However, it is reasonable to

[1]Financial support from the ESRC is gratefully acknowledged. We thank a co-editor, three anonymous referees, Simon Burgess, Arnaud Chevalier, Paul Grout, Costas Meghir, Antonio Merlo, Paul Oyer, Torsten Persson, Canice Prendergast, Kathryn Shaw, David Stromberg, John Van Reenen, Fabrizio Zilibotti, and numerous seminar and conference participants for comments and suggestions that have helped improve the paper. Brandon R. Halcott provided excellent research assistance. We thank all those involved in providing the data. This paper has been screened to ensure no confidential information is revealed. All errors remain our own.

[2]Lazear (1989), Kandel and Lazear (1992), and Rotemberg (1994) developed models incorporating social concerns into the analysis of behavior within firms. While they emphasized that individuals have social concerns for others at the same tier of the firm hierarchy, their analysis is equally applicable across tiers of the hierarchy. Bewley (1999) offered extensive evidence from interviews with managers arguing that concerns over fair outcomes for workers and the morale of employees are important determinants of their behavior.

 DOI: 10.3982/ECTA6496

expect that such social connections might also span across layers of the hierarchy, in particular between managers and their subordinates, and this is likely to have important consequences for individual and firm performance, the optimal design of compensation schemes, and the structure of organizations (Prendergast and Topel (1996)).[3]

In general, social connections between managers and workers can help or harm firm performance. On the one hand, social connections may be beneficial to firm performance if they allow managers to provide nonmonetary incentives to workers or help reduce informational asymmetries within the firm. On the other hand, managers may display favoritism toward workers they are socially connected with, and this might be detrimental to the firm's overall performance.[4]

In this paper, we present evidence on whether the existence of social connections between workers and managers affects the performance of connected workers and that of the firm as a whole. The firm we study is a leading producer of soft fruit in the United Kingdom. We focus on the behavior of individuals at two tiers of the firm hierarchy—workers and managers. The main task of the workers is to pick fruit, whereas managers are responsible for logistics. Two key features of this setting are that workers are paid piece rates and that managerial effort is complementary to worker effort and can be targeted to individual workers. Taken together, these features imply managers can significantly influence a worker's productivity and hence his earnings.

Managers and workers are all hired for one fruit picking season. They are university students from eight Eastern European countries and are thus of similar ages and backgrounds. In addition, they live on the farm site for the entire duration of their stay. Both features increase the likelihood of managers and workers forming strong social connections with each other.

To measure social connections we exploit three sources of similarity between managers and workers—whether they are of the same nationality, whether they live in close proximity to each other on the farm, and whether they arrived at a similar time on the farm. Our underlying assumption is that individuals are more likely to befriend others if they are of the same nationality, if they are neighbors, or if they share early experiences in a new workplace.

To identify the effect of social connections we exploit two sources of variation. First, the organization of the workplace is such that the allocation of

[3]A related theoretical literature emphasizes the inefficiencies that arise from collusion between managers and workers (Tirole (1986), Kofman and Lawarrée (1993)) influence activities and other forms of rent seeking behavior by workers (Milgrom (1988), Milgrom and Roberts (1990)).

[4]Both the positive and negative effects of social connections have been stressed in the organizational behavior and sociology literatures. Examples of such work includes that on the effect of manager–subordinate similarity on subjective outcomes such as performance evaluations and job satisfaction (Tsui and O'Reilly (1989), Thomas (1990), Wesolowski and Mossholder (1997)), and on how social networks within-firm influence within-firm promotions (Podolny and Baron (1997)).

workers to managers changes on a daily basis. We exploit this variation to identify the effect of social connections from the comparison of the performance of a given worker on days when he is socially connected to his manager and days when he is not. Exploiting the within worker variation allows us to separate the effect of social connections from the effect of unobservable individual traits, such as ability, that make workers more likely to befriend managers and to have higher performance regardless of their connections.

Similarly, as we observe the same manager managing both workers she is socially connected to and workers she is not connected to, we are also able to control for time invariant sources of unobserved manager heterogeneity that affect the productivity of connected and unconnected workers alike, such as their management style or motivational skills.[5]

Second, we designed and implemented a field experiment to exogenously vary the strength of managerial incentives. In the experiment we changed the managerial compensation scheme from fixed wages to the same level of fixed wages plus a performance bonus that is increasing in the average productivity of the workers on the field that day. Workers were paid according to the same compensation scheme—piece rates—throughout.

The experiment allows us to identify whether and how the effect of social connections between the same managers and workers changes once managers are given performance pay, and thus provides an ideal counterfactual to assess the effect of social connections on the overall firm's performance. To be precise, if the managers' behavior toward connected workers changes once their interests are more closely aligned with the firm's, their previous behavior under fixed wages could have not been maximizing the firm's average productivity. We provide further evidence on this issue by quantifying the net effect of social connections on the firm's overall performance.

Our main findings are as follows. First, when managers are paid fixed wages, the productivity of a given worker is 9% higher when he is socially connected to his manager, relative to when he is not, all else equal. As workers are paid piece rates, this translates into the same proportionate change in earnings. Second, when managers are paid performance bonuses that tie their pay to the average productivity of workers they manage, being socially connected to the manager has no effect on workers' productivity.

Third, the introduction of managerial performance pay significantly decreases the productivity of low ability workers when they are connected to their manager relative to when they were connected to their manager and she was paid a fixed wage. The introduction of managerial performance pay increases the productivity of high ability workers, especially when they are not connected

[5]Our empirical strategy is informed by the evidence that individual "styles" of managers affect firm performance over and above firm level characteristics themselves (Bertrand and Schoar (2003), Malmendier and Tate (2005)).

to their managers. These findings indicate that when managers face low powered incentives, they favor the workers they are socially connected to, regardless of the workers' ability. In contrast, when they face high powered incentives, managers favor high ability workers regardless of the workers' connection status.

Fourth, an increase in the level of social connections between managers and workers has a detrimental effect on the firms' average productivity when managers are paid fixed wages and has no effect when managers are paid performance bonuses. In this setting, social connections are therefore detrimental for the firm because their existence distorts the allocation of managerial effort in favor of lower ability workers.

To the best of our knowledge, this paper is the first to provide quantitative evidence on the productivity effect of social connections across tiers of the firm hierarchy. The paper builds on our earlier findings on the effects of the introduction of high powered managerial incentives in the same setting (Bandiera, Barankay, and Rasul (2007)). The earlier paper focuses on the allocation of managerial effort under performance pay, irrespective of the social connections within the firm. The current paper provides novel evidence on the importance of social connections in a firm setting, a previously unexplored determinant of managers' behavior.

The paper contributes to the growing empirical evidence on the interplay between social networks and individual and firm performance. This literature has explored how the response of workers to incentives depends on their social connections with their co-workers at the same tier of the firm hierarchy (Bandiera, Barankay, and Rasul (2005)), and how the demographic differences between managers and their subordinates affect the subordinates' rate of quits, dismissals and promotions (Giuliano, Levine, and Leonard (2005)).[6,7] Our paper also relates to the literature on employee and employer discrimination (Becker (1957)), and in particular to the findings of Black and Strahan (2001), who exploited a deregulation in product markets to show that when competition is low, firms favor male over female employees, both in terms of wages and promotion prospects.

[6]Another branch of this literature has explored the effects of the CEO or managerial board of firms being socially connected to those outside of the firm, such as local politicians and bureaucrats (Bertrand, Kramarz, Schoar, and Thesmar (2005), Kramarz and Thesmar (2005), Mian and Khwaja (2005)). In nonfirm settings, Garicano, Palacios, and Prendergast (2005) presented evidence from soccer matches on how referees favor home teams in order to satisfy the crowds in the stadium. Laband and Piette (1994) showed that journal editors use professional contacts to identify high impact papers. In that context, favoritism thus reduces informational asymmetries and is efficiency enhancing in the market for scientific knowledge.

[7]Fehr and Fischbacher (2002) provided an overview of the laboratory evidence on social preferences in workplace environments. One branch of this stems from Akerlof (1982) and Akerlof and Yellen (1988), who viewed the labor relation as a partial gift exchange. A separate branch of this experimental literature presents evidence that workers care about their pay relative to other workers (Charness and Kuhn (2005)).

Finally, it is important to stress from the outset that as in all the studies using detailed data from one particular firm, precision comes at the cost of generality. In the last section we highlight the key characteristics of this workplace and discuss the external validity of our findings.

The paper is organized as follows. Section 2 describes our context and experimental research design. Section 3 develops a theoretical framework to highlight the central forces at play when social connections can have potentially positive and negative effects on worker productivity. Section 4 describes the data and the identification strategy. Section 5 presents the main results on the effect of social connections on worker productivity under each managerial incentive scheme. Section 6 then explores whether there are heterogeneous effects of social connections across workers of different ability to derive implications for the firm's overall productivity. Section 7 concludes. Proofs and further robustness checks are given in the Appendix.

2. THE CONTEXT AND EXPERIMENTAL DESIGN

2.1. *Context*

We analyze the behavior of managers and workers in the fruit picking division of a leading U.K. producer of soft fruit during the 2003 season. Workers and managers are hired from eight countries in Eastern Europe on seasonal contracts that last between three and six months.[8] To be recruited, individuals must be full-time university students and have at least one year remaining before graduation. Two features of the work environment increase the likelihood of individuals forming strong social connections to each other: (i) workers and managers are of similar ages and have similar socioeconomic backgrounds; (ii) they live and work on the farm site for the entire duration of their stay, which on average is 100 days.

The workers' primary task is to pick fruit. They typically pick on two or three different fields each day. At the start of a field-day the manager allocates each worker to a row of fruit to be picked. Once a worker clears this row, the manager is responsible for reallocating the worker to another row within the field. This process continues until all fruit within the field is picked. As each worker picks on his own row, his productivity is independent of the efforts of other workers on the same field-day, so that there are no complementarities between workers arising from the production technology. Workers do not choose how many hours to work—all workers are present on the field-day for the number of hours it takes to pick all the available fruit. Once a field is picked, workers and managers move on to other fields. As explained below, the match of

[8]Their work permit allows them to work on other U.K. farms subject to the approval of the permit agency. Their outside option to employment at the farm is therefore to return home or to move to another farm during the season. Few workers are hired for consecutive seasons and workers are not typically hired from the local labor market.

workers to managers can change across fields on the same day. The only choice variable of workers is how much effort to exert into picking.[9]

Workers are paid a piece rate per kilogram of fruit picked. Each worker's pay is thus related to his productivity, which is an increasing function of his effort, the quantity of fruit available on the rows he is assigned, and the managerial effort targeted toward him.

Managers are each assigned a group of around 20 workers, and their task is to monitor the quality of fruit picking and to organize the field logistics for this group. Managers on the same field focus on their assigned group of workers and work independently of each other. Managers control quality on three dimensions—that all ripe fruit is picked, that fruit is not damaged, and that fruit is correctly classified by size. Field logistics include the allocation of workers to rows and organizing the movement of fruit from the field to the packaging plant.[10]

The key choice variables of each manager are the allocation of workers to rows and the allocation of effort among her workers. Managers are responsible for allocating workers to rows at the start of the field-day and for reallocating workers to new rows once they have finished picking the row they were originally assigned. How the manager matches workers to rows is important because there is considerable variation in the quantity of fruit across rows within a field. Some of this is due to the natural variation in fruit quantity on different plants. This variation also stems from some rows being closer to pillars that support the plastic covering over the field. Rows close to pillars are harder to pick, air circulation is worse, and hence heat tends to accumulate. These factors reduce the marginal productivity of worker's effort in these rows, other things equal.

The manager chooses how to allocate her effort across workers along two dimensions. First, if several workers finish picking their rows at the same time, the manager has to decide who to reallocate to a new row first. Second, workers place the fruit they have picked into crates. Once these are full, managers have to ensure that new empty crates are provided to workers and that full crates are removed from the field and shipped to the packaging plant. If several workers simultaneously fill their crates, the manager chooses who to help first. In this environment, managerial effort is therefore complementary to worker's effort.

The effort costs to the manager are considerable because the workers she is responsible for are dispersed over a large area. The median field size is such

[9]Work is offered on a casual basis with no daily guarantee of employment. In practice, managers manage each day, and workers are engaged in picking tasks every other day. On other days workers are asked to perform nonpicking tasks such as planting or weeding, or may be left unemployed for the day. Over the season, individuals are not observed moving across tiers of the hierarchy from picking tasks to managerial tasks or vice versa.

[10]A separate group of individuals, called field runners, are responsible for physically moving fruit from the field to the packaging plant. They do not themselves pick fruit nor do they manage workers.

that each manager has to cover an area of around one hectare. To ensure she is aware of which workers need to be reallocated to new rows and which need their crates replaced, managers need to continuously walk around the field.[11]

Social connections between managers and workers can have two effects. First, if a manager is concerned about the pay of the workers she is socially connected to, she can allocate more of her effort toward them, thus increasing their productivity and their earnings. The effect of managerial effort on worker productivity can be substantial. Assuming that workers pick at a constant speed, if the manager slacks for 5 minutes every hour and a worker is left to wait for a new crate for the same time, his productivity would be $5/60 = 8\%$ lower. Second, a manager might be better informed about the ability or skills of workers she is socially connected to or be able to exert stronger social pressure on them to work hard, both of which generate a difference in the allocation of managerial effort between connected and unconnected workers.[12]

We now discuss the two features of this work environment that allow us to assess whether social connections shape the managers' effort allocation choice and, as a consequence, workers' earnings, and how this depends on the compensation scheme in place for managers.

2.2. *Key Feature 1: Natural Variation*

The production technology is such that the demand and supply of picking labor varies across field-days. On any given field-day the demand for labor depends on the size of the field, on the orders received from supermarkets for the specific variety of fruit grown on that field, and on the number of plants that have reached maturity. This varies over time and declines during the life cycle of the field. The supply of labor depends on the demand for picking labor on other fields, which varies for the same reasons, and the demand for nonpicking tasks such as planting and weeding.[13]

Due to this natural variation, the number of workers and managers varies within the same field across different days and across different fields within the same day. Importantly for our study, this also implies that the same worker can be supervised by different managers on different field-days. In particular, a worker can be supervised by a manager he is socially connected to on some

[11]The disposition of plants in the field is such that it is not practical for workers to retain a stock of empty crates.

[12]In principle, a manager could boost connected workers' productivity by letting them slack on quality, namely by allowing connected workers to leave hard to reach fruits on the plants. In practice, however, this is unlikely to be the case for two reasons. First, damaged or misclassified fruit is identified at the packing stage of the production process. The monitoring system in place then allows senior management to attribute fruit quality to individual managers. Second, a permanent employee of the farm checks that no ripe fruit is left on the plants at the end of each day.

[13]The fruit is planted some years in advance, so the quantity of fruit to be picked is given. The order in which fields are picked is decided at the start of the season.

field-days and by another manager that he is not socially connected to on others.

Managers and workers are allocated to fields by a higher tier permanent employee of the farm, who we refer to as the chief operating officer (COO).[14]

2.3. *Key Feature 2: The Experimental Research Design*

We designed and implemented a field experiment in which we exogenously changed the compensation scheme of the managers and the COO. At the start of the 2003 season, the managers and the COO were paid a fixed wage. Midway through the 2003 season, we added a performance bonus to the same level of fixed wages. The experiment left the compensation scheme of the workers unchanged—workers were paid piece rates throughout the 2003 season.[15]

The bonus payment was awarded on field f and day t if the workers' average productivity on the field-day, $\overline{Y}_{ft}$, exceeded an exogenously fixed threshold Y^*. Conditional on reaching the threshold, the total monetary value of the bonus payment available to the managers, $B(\overline{Y}_{ft})$, increases at an increasing rate in the average field-day productivity. The personnel software does not allow the exact match between workers and managers within the field-day to be recorded, but it does record the identity of all the managers and all the workers on the field-day. Each manager then obtains an equal share of the bonus payment generated on the field-day. If there are M_{ft} managers present, each obtains a payment of $(1/M_{ft})B(\overline{Y}_{ft})$.[16]

[14]Section 4 makes precise the underlying assumptions that allow us to exploit this source of variation to identify the effects of social connections in the workplace. In the Appendix we present evidence in support of these identifying assumptions.

[15]The change was announced to the COO and managers a week in advance of the actual change. During this week, we spent time going through numerical examples with management to make sure they understood how the performance bonus would be calculated. Workers were not informed of the change in managerial compensation, but given that managers and workers live on the farm, they are likely to have understood the change over time.

[16]The bonus payment schedule is piecewise linear:

$$B(\overline{Y}_{ft}) = \begin{cases} 0 & \text{if } Y^* > \overline{Y}_{ft}, \\ a_1 + b_1\overline{Y}_{ft} & \text{if } Y^* + c_1 > \overline{Y}_{ft} \geq Y^*, \\ a_2 + b_2\overline{Y}_{ft} & \text{if } Y^* + c_2 > \overline{Y}_{ft} \geq Y^* + c_1, \\ a_3 + b_3\overline{Y}_{ft} & \text{if } \overline{Y}_{ft} > Y^* + c_2, \end{cases}$$

where a_i, b_i, and c_i are constants such that $a_3 < a_2 < a_1$, $b_3 > b_2 > b_1$, $c_2 > c_1$. This reflects the fact that the marginal cost of supplying managerial effort is increasing. The parameters a_i, b_i, and c_i are set such that $B(\overline{Y}_{ft})$ is a continuous and convex function. The values of a_i, b_i, c_i, and Y^* cannot be provided due to confidentiality. Finally, we note that since the bonus payment is shared by all managers on a field, free-riding might reduce the strength of incentives. Three features of this context make free-riding unlikely: (i) there are between two and four managers on most field-days; (ii) managers can monitor each other on the field; (iii) managers interact repeatedly both on and off the field.

The daily bonus payment that accrues to the COO for any given field is 1.5 times that which accrues to a manager on the field. Moreover, since the COO is responsible for every field operated on a given day, his bonus equals the sum across all fields operated that day and is therefore equal to $1.5\sum_f(1/M_{ft})B(\overline{Y}_{ft})$.

The introduction of the bonus might affect managers' behavior through three channels: (i) because they now have a stake in the firm's productivity, (ii) because the COO might exert more pressure to maximize his bonus payments, and (iii) because of increased competition for managerial jobs. Indeed, given that the quantity of fruit to be picked is constant, if the introduction of the bonus increases productivity, the demand for picking and managerial labor might fall as fewer workers are needed to pick the same amount. All three channels lead managers to take actions that increase the firm's productivity.

Finally, to avoid multitasking concerns (Holmstrom and Milgrom (1991)), the performance bonus was not awarded if the quality of fruit picking declined.[17]

The fraction of field-days on which the bonus was earned varies from 20 to 50% across managers. The ex post monetary value of the performance bonus to managers is substantial. Averaged across all field-days worked under the bonus, managerial hourly earnings increased by 7%. Conditional on obtaining the bonus, managerial hourly earnings increased by 25%. The true expected hourly earnings increase to managers of the performance bonus lies between these bounds.[18,19]

To identify whether managers allocate more effort to workers they are socially connected to, we compare the productivity of the same worker on field-days in which he is socially connected to his manager and his productivity on field-days in which he is not socially connected to his manager. We exploit the exogenous variation in managerial incentives our research design provides to identify whether the effects of social connections depend on the managerial in-

[17]Quality is defined along two dimensions: (i) the quantity of damaged fruit; (ii) classification as either suitable for market or supermarket, largely based on the size of each fruit. If the percentage of damaged or misclassified fruit rose by more than 2% from a preestablished norm, then the bonus was not awarded.

[18]Given that (i) managers are from Eastern Europe, (ii) their base pay is 20% higher than the U.K. minimum wage, and (iii) most individuals save earnings to spend later in their home country, these increases in hourly earnings translate into large increases in real income. As of January 2003, gross monthly earnings at the U.K. minimum wage (€1105) are 5 times as high as at the minimum wage in Poland (€201), where 40% of managers come from, and almost 20 times higher than in Bulgaria (€56), where 30% of managers come from.

[19]The managers were unaware they were taking part in an experiment and that the data would be used for scientific research. As such, our experiment is a natural field experiment according to the taxonomy of Harrison and List (2004). The managers were, however, aware that productivity data were recorded and kept by the farm owner, and that the data would be analyzed to improve the firms' overall efficiency.

centive scheme in place. The comparison allows us to establish whether social connections are beneficial or detrimental to the firm's overall performance as explained in the next section.

3. THEORETICAL FRAMEWORK

We present a simple theoretical framework to illustrate the effect of social connections on the level and allocation of managerial effort across workers, and on firm productivity. The framework illustrates that the existence of social connections weakly increases managerial effort, but also changes the allocation of effort in favor of workers the manager is socially connected to. The net effect on the firm's aggregate productivity is ambiguous. The framework makes precise how we can sign the allocation effect by exploiting the exogenous change in the strength of managerial incentives.

3.1. *Technology and Incentives*

We assume production requires one manager and two workers in any given field. Workers pick fruit and the manager organizes logistics for each worker. The manager chooses her level of effort and how to allocate it between the workers. To make matters concrete, the managerial effort directed toward a worker can be thought of as the effort devoted to ensure he is allocated a new row of fruit as soon as he is done picking the current one or the effort devoted to ensure he does not have to wait for his crates to be replaced.

For simplicity and without loss of generality, we do not model workers' effort choices. Also, for simplicity we assume the manager's effort targeted toward worker i affects worker i alone. The output of worker i is then given by $y_i = \theta_i k_i m_i$, where θ_i measures his innate ability, m_i is the managerial effort targeted toward him, and $k_i > 0$ is a measure of the strength of the complementarity between the manager's and worker's efforts. We assume the two workers have ability levels θ and 1, with $\theta > 1$, and index them with subscripts h and l for high and low ability, respectively.[20]

Managerial effort takes two values, high ($m = \bar{m} > 1$) and low ($m = 1$). The disutility of effort to the manager, $C(m)$, equals 0 if effort is low and is greater than 0 if effort is high.[21]

[20]The qualitative results are unchanged if we allow workers to also choose effort. The qualitative results are also unchanged if we allow m_i to have a positive spillover effect on the output of the nontargeted worker j, as long as the direct effect of m_j on the productivity of worker j is sufficiently stronger than the effect of m_i on j.

[21]The assumption reflects the fact that in our setting the manager's cost of effort depends on total effort rather than on the identity of the workers targeted. Namely the cost of moving around the field to identify which crates to replace and which workers to reallocate does not depend on the ability of the worker who gets reallocated.

The productivity of worker i is measured as the kilograms of fruit picked per hour. As all workers in the field work for the same time, we normalize hours to 1 so output and productivity coincide. Total output is $\sum_i y_i$ as there are no spillovers across workers or complementarities in production.

As in our empirical setting, we assume worker i's pay, p_i^W, equals his productivity, y_i, to reflect the fact that workers are paid piece rates, and hence their earnings are a linear function of their productivity. The manager's compensation schedule is $p^M = f + b\overline{Y}$, where f is a fixed wage and $\overline{Y} = \sum_i y_i$ is the aggregate output of her subordinates. The parameter $b \geq 0$ captures the strength of managerial incentives, namely the variable component of managerial pay which is linearly related to aggregate worker productivity.

3.2. *Social Connections*

Social connections can affect in reduced form both agents' preferences and the production technology. To capture the first channel, we follow Prendergast and Topel (1996) in assuming the manager's utility depends on her pay and the pay of her subordinates, that is,

$$u^M = p^M + \sum_{i \in (h,l)} \sigma_i p_i^W, \tag{1}$$

where σ_i measures the social connection between the manager and worker i. We assume that $\sigma_i = \sigma > 0$ if worker i is connected to the manager while $\sigma_i = 0$ if he is not. These preferences can be seen to represent managers' altruism toward their subordinates, but also as the reduced form of a model in which the manager cares about the connected workers' earnings because she receives kickbacks from them.[22]

If social connections ameliorate the moral hazard problem between the manager and workers, or if they help foster cooperation or improve communication between managers and workers, they affect workers' productivity directly. To capture this second channel, we assume the strength of the complementarity between managerial and worker effort depends on their social connections. That is, given worker i's productivity, $y_i = \theta_i k_i m_i$, we assume $k_i = k > 1$ if worker i is connected to the manager ($\sigma_i = \sigma$), while $k_i = 1$ if he is not ($\sigma_i = 0$).

[22]We focus on whether managers and workers are socially connected or not, rather than on the strength of the social connection. What matters for the analysis is that managers may be connected to a greater extent to some workers than to others. We also focus on the case in which $\sigma \geq 0$. A negative weight could be interpreted as the manager being spiteful toward the worker.

3.3. *The Manager's Effort and Allocation Choices*

The manager chooses (m_h, m_l), namely how much effort to allocate to the high and low ability worker, to maximize her utility, as given in (1). Substituting for the manager's and workers' pay, the manager's problem is

$$\max_{m_h, m_l} (b + \sigma_h)\theta k(\sigma_h) m_h + (b + \sigma_l) k(\sigma_l) m_l - C(m_h + m_l). \tag{2}$$

The two propositions below describe the effect of social connections on managerial effort and, hence, on the firm's productivity, respectively. All proofs are given in the Appendix.

PROPOSITION 1: *Social connections weakly increase the level of managerial effort and might alter the allocation of effort in favor of the worker the manager is socially connected to*.

The existence of social connections implies $\sigma_i > 0$ and $k(\sigma_i) > 1$. Thus social connections raise the marginal benefit of effort both because the manager internalizes the effect of her effort on the connected worker earnings and because the marginal effect of managerial effort on worker's productivity is higher when the manager and the worker are socially connected. Other things equal, social connections therefore have an unambiguous effect on the *level* of effort, namely a manager is more likely to choose $m = \bar{m}$, when she is socially connected to one or both workers. This follows immediately from the fact that since both the production and the cost of effort functions are linear in (m_h, m_l), and there are no spillovers across workers, the manager's utility function (2) is linear in (m_h, m_l). This implies that, regardless of the level of effort chosen, the manager will target only the worker who yields the highest marginal benefit.[23]

Social connections, however, affect the *allocation* of managerial effort. Indeed, the marginal benefit of targeting worker i is equal to $(b + \sigma_i)k(\sigma_i)$; thus, other things being equal, the manager is more likely to target worker i if $\sigma_i > 0$ and $k(\sigma_i) > 0$. Therefore, social connections also have an allocation effect on managerial effort. In the Appendix we show that (i) if the manager is connected to the *high* ability worker, she always targets him; (ii) if the manager is connected to the *low* ability worker, there exists a set of parameters for which she targets her effort toward him.

In this second case, social connections distort the allocation of managerial effort toward low ability workers and might therefore be detrimental to the firm overall. Whether social connections are beneficial or detrimental for the

[23]The manager chooses $\bar{m}$ if and only if $\{\max[\theta k_h(b + \sigma_h), k_l(b + \sigma_l)]\}(\bar{m} - 1) > c$. The right-hand side is increasing in (σ_h, σ_l). In a model with continuous managerial effort and convex costs, the effect of social connections on managerial effort would be strictly positive.

firm in this case depends on the sign and relative magnitude of the level and allocation effects as described in the following result.

PROPOSITION 2: *If the manager is connected to the high ability worker, social connections have an unambiguously positive effect on the firm's productivity. If the manager is connected only to the low ability worker, the effect of social connections on the firm's productivity is ambiguous. It is more likely to be negative if the complementarity with the connected worker is low or if the difference in workers' ability is large.*

To summarize, the existence of social connections has both a level effect and an allocation effect on managerial effort. As the firm's productivity is increasing in managerial effort and social connections weakly increase effort, the level effect of social connections is always weakly positive. The sign of the allocation effect is, however, ambiguous. If the manager is connected only to the high ability worker, she targets him and the allocation effect is positive. In the Appendix we provide the precise conditions under which if the manager is connected only to the low ability worker, she targets him and the allocation effect is negative.[24]

3.4. *Testing for a Negative Allocation Effect*

The framework above makes precise that social connections can be detrimental for the firm only if their existence distorts the allocation of managerial effort in favor of low ability workers who are connected to managers. We now show that an exogenous change in the strength of managerial incentives b can be used to test whether the allocation effect is negative. The test relies on two sources of variation: the variation in the strength of managerial incentives and the variation in social connections. The first stems from the fact that the productivity of the same workers is measured both when managerial incentives are low powered (fixed wage) and when they are high powered (bonus scheme). The second stems from the fact that the productivity of the same workers is observed both on field-days when they are socially connected to managers and on field-days in which they are not while their co-workers are.

An increase in b increases both the marginal benefit of effort and the relative weight the manager places on productivity vis-à-vis the utility of the connected workers. Increasing b can thus affect both the level and the allocation of managerial effort. Our empirical test is then based on a revealed preference argument: if the manager changes her effort allocation from the low to the high ability worker when she has a larger stake in the firm's productivity, namely

[24]Note that since manager's pay is increasing in productivity, social connections affect the wage bill. Thus even if social connections increase the firm's productivity, they might reduce the firm's profits.

when the performance bonus is in place, the allocation of managerial effort across workers under the wage regime could have not been maximizing productivity. The test then consists of measuring the effect of social connections on connected workers of different ability by managerial incentive scheme and testing whether the manager reallocates effort from low to high ability workers as a result of the increase in the strength of her incentives, b.

If the allocation effect is indeed detrimental to productivity, the allocation of effort should depend on the managerial incentive scheme as follows. First, when the manager is paid a fixed wage, she should target connected workers regardless of their ability. Hence, the productivity of both low and high ability workers should be higher when they are connected to their manager compared to when they are not. Second, when the manager is paid performance bonuses, she should target high ability workers regardless of their connections. Hence the introduction of the bonus should (i) strictly *increase* the productivity of *high* ability workers on field-days in which they are not connected and (ii) strictly *decrease* the productivity of the *low* ability workers on field-days in which they are connected.

Finding evidence consistent with these predictions would provide support for the hypothesis that social connections have a negative allocation effect on productivity against the joint alternative hypotheses that the allocation effect is nonnegative or that the increase in b is not sufficiently large to change managerial behavior. Finally, we present evidence on the net effect of social connections on productivity by incentive scheme. This allows us to gauge whether any beneficial levels effect of social connections on managerial effort more than offset the distortionary effects they have on the allocation of managerial effort.

4. DATA AND DESCRIPTIVES

4.1. *Data Sources*

Our primary data source is the firm's personnel records. These contain three types of information. First, they list each worker's productivity on every field-day they pick fruit. Productivity is defined as the kilograms of fruit picked per hour and is electronically recorded with little measurement error. Second, while they do not contain information on the exact worker–manager match, the data identify all the workers and managers present on each field-day. On most field-days there are between 40 and 80 workers, and between 2 and 4 managers, so we are able to build a measure of the probability that a given worker–manager pair is matched. Finally, the personnel records contain information on each individual's nationality, date of arrival, and accommodation location on the farm, which we use to measure social connections as described below.

Throughout, we analyze data on the main fruit type and focus on the main farm site during the peak picking season from May 1st until August 31st 2003.

As part of our experimental design, the change in managerial incentives occurred midway through the peak season—June 27th—so there are 43 days in the prebonus period and 51 days postbonus. To ensure that changes in field composition do not drive the results, we focus on fields that were picked at least one week either side of the change in managerial incentives. Note that a given field is not picked on every day and more than one field is picked on any given day. To ensure our estimates are not contaminated by changes in the composition of the workforce over the season, we restrict the sample to individuals who work at least one week either side of the change in managerial incentives. The final sample then contains 10,148 worker-field-day productivity observations from 241 field-days. This covers 144 workers, 10 managers, 13 fields, and 94 days.[25]

4.2. *Measuring Social Connections*

We measure social connections between managers and workers along three dimensions: nationality, time of arrival on the farm, and the location on the farm where individuals reside during the season.

The first measure defines a worker and manager to be connected if they are of the same nationality, based on the assumption that people are more likely to befriend others who come from the same country and share the same mother tongue. As individuals are hired from eight Eastern European countries, we observe considerable variation along this dimension.[26]

The second measure of social connections is based on the time that individuals arrive on the farm. This varies across individuals for reasons that are exogenous to the worker's performance, such as their university term dates in their home countries and the date on which their work permit is issued. On arrival, individuals are consecutively assigned a worker number and then attend an induction program with others who have arrived at a similar time. Hence the first group of people that each individual is exposed to, and may form social ties with, are those who arrive on a similar date. If two individuals have a worker number within the same 10 digit window, we define the two to be socially connected through their arrival cohort.

The third measure of social connections is based on the geographic location where individuals live during their stay on the farm. Each worker lives in a caravan with up to five others, and each caravan is assigned a unique number. On the main farm site, caravans are arranged around a communal space and

[25] Fields are located on two sites on the farm, of which we only use the largest for the analysis as fruit in the smaller site began to ripen only after the introduction of the managerial performance bonus scheme.

[26] Among workers, the most common nationalities are Polish (35%), followed by Ukrainian (29%) and Bulgarian (10%). Among managers, 40% are Polish, 30% are Bulgarian, and the others are Lithuanian.

numbered consecutively from 1 to 46. We define two individuals to be socially connected through their living site if they live within five caravan numbers of each other. The underlying assumption is that individuals are more likely to form social ties with their neighbors.[27]

While we do not have direct information on the social relations between managers and workers, we can provide evidence that the three measures of similarity—nationality, arrival cohort, and neighborhood—are predictors of friendship in this setting. In 2004, that is one year after the season we analyze here, we administered a worker survey to workers in the same farm to collect information about friendship links. Using those data, in Bandiera, Barankay, and Rasul (2009) we found that the odds of a worker j to be named as a friend by another worker i if they are of the same nationality is 14.7 times larger than the odds of worker j being named by i if they are of different nationalities. The corresponding figures for arrival cohort and geographical neighborhood are 14.3 and 9.7. These odds are all significantly different from 1, and the results are robust to conditioning on a host of other controls for the similarity in observables between workers.

Based on these three criteria of similarity, most workers are connected to at least one manager along at least one dimension. Of the 10,148 worker-field-day observations in our sample, 8884 correspond to workers who are socially connected to managers. We therefore identify the causal effect of social connections on worker performance from the observed within worker variation in productivity. In other words, instead of comparing the productivity of workers who are connected to the productivity of workers who are not, we identify the effect of social connections by comparing the productivity of the same worker on field-days in which he is connected to his manager, to his productivity on field-days in which he is not connected. Since workers who are never connected to any manager do not contribute to these estimates, we restrict the sample to the 8884 worker-field-day observations of workers who are socially connected to at least one manager on the farm.[28]

To measure whether a worker is connected to his manager on any given field-day we first define $c_{ij} = 1$ if worker i and manager j are connected along any dimension and $= 0$ otherwise. Second, we note that while each worker is assigned to only one manager, we do not know the exact match of workers to managers within the field. On most field-days there are between 2 and 4 managers and between 40 and 80 workers present. Given M_{ft} managers present on the field-day, we can compute the probability that worker i is connected to his manager as the share of managers worker i is connected to on the field-day,

[27]There are no opportunities for workers themselves to choose their caravan or worker numbers.

[28]Unconnected workers are, however, not significantly different from connected workers on observables such as age, gender, and previous work experience.

$C_{ift} = (\sum_j c_{ij})/M_{ft}$, where the summation in the numerator is over all managers j on field-day ft.[29]

4.3. *Descriptives*

Table I reports descriptive statistics for our variable of interest C_{ift}, the share of managers on field-day ft that are socially connected to worker i. The first row shows that, on average, the share is .425 when managers are paid fixed wages and .412 when managers are paid performance bonuses. The fact that the shares are almost identical under the two compensation schemes suggests that the process by which managers and workers are allocated to fields is orthogonal to the compensation scheme in place.

The empirical analysis exploits the variation in social connections within a worker over time. Table I shows that, reassuringly, at least one-third of the overall variation in social connections arises from variation within a worker

TABLE I

DESCRIPTIVES ON THE SOCIAL CONNECTIVITY BETWEEN WORKERS AND MANAGERS BY MANAGERIAL INCENTIVE SCHEME[a]

	Managerial Incentive Scheme	
Share of Managers	Fixed Wages	Performance Bonus
Connected to i (C_{ift})	.425 (.297) [.196]	.412 (.300) [.154]
Who are the same nationality as i	.304 (.344) [.145]	.285 (.319) [.111]
Who are in the same living area as i	.139 (.116) [.167]	.138 (.172) [.138]
Who are from the same arrival cohort as i	.038 (.076) [.079]	.056 (.101) [.074]

[a]All variables are defined at the worker-field-day level. Means, standard deviation between workers is in parentheses, and standard deviation within worker is in brackets. A manager and worker are defined to be resident in the same living area if they live within five caravans from each other on the farm. A manager and worker are defined to be in the same arrival cohort if they have identification numbers within the same 10 digit window. A manager and given worker i are defined to be connected if they are either of the same nationality, live in the same area, or are in the same arrival cohort. The sample is restricted to the 129 workers who work for at least one week under both incentive schemes and are connected to at least one manager on at least one dimension. On average, each worker is observed picking on 41 field-days when managers are paid fixed wages and 30 field-days when managers are paid a performance bonus. Overall there are 5137 worker-field-day observations when managers are paid fixed wages, and 3747 worker-field-day observations when managers are paid a performance bonus.

[29]The median number of managers and workers is 3 and 59, respectively. Field-days with less than 4 managers account for 83% of the sample.

TABLE II

WORKER PRODUCTIVITY (KG/HR), BY SOCIAL CONNECTIVITY TO MANAGERS AND MANAGERIAL INCENTIVE SCHEME[a]

	Managerial Incentive Scheme:		
	Fixed Wages	Performance Bonus	Difference
Panel A: All Workers			
Unconnected on field-day ($DC_{ift} = 0$)	7.21	9.52	2.30***
	(.211)	(.600)	(.535)
Connected on field-day ($DC_{ift} = 1$)	8.98	9.70	.712
	(.345)	(.527)	(.272)
Difference	1.77***	.179	1.596***
	(.352)	(.750)	(.609)
Panel B: Low Ability Workers			
Unconnected on field-day ($DC_{ift} = 0$)	6.10	6.60	.506
	(.248)	(.342)	(.423)
Connected on field-day ($DC_{ift} = 1$)	7.37	6.77	−.603**
	(.173)	(.212)	(.211)
Difference	1.27***	.161	1.11**
	(.287)	(.368)	(.435)
Panel C: High Ability Workers			
Unconnected on field-day ($DC_{ift} = 0$)	7.76	10.79	3.03***
	(.259)	(.672)	(.609)
Connected on field-day ($DC_{ift} = 1$)	10.32	11.61	1.28***
	(.519)	(.668)	(.338)
Difference	2.56***	.815	1.75**
	(.518)	(.899)	(.719)

[a]Means, standard errors are given in parentheses. *** denotes significance at 1%, ** at 5%, and * at 10%. All variables are defined at the worker-field-day level. The standard errors on the differences and difference-in-difference are estimated from running the corresponding least squares regression, allowing the standard errors to be clustered by worker. Productivity is measured as the number of kilograms of fruit picked per hour by the worker on the field-day. A manager and given worker i are defined to be connected if they are either of the same nationality, live in the same area, or are in the same arrival cohort. A worker is defined to be unconnected on the field-day if she is not socially connected to any of her managers that field-day. A worker is defined to be connected on the field-day if she is socially connected to at least one of her managers. Low (high) ability workers are those whose average productivity under the bonus is below (above) the median average productivity.

over field-days. This is true under both managerial incentive schemes, and along each dimension that defines social connections.[30]

Throughout we analyze the effect of social connections on worker productivity because, in our setting, productivity can be directly affected by managers' behavior and it determines workers' earnings given that they are paid piece rates. Table II presents descriptive evidence on productivity by connection status, managerial incentive scheme, and workers' ability. For ease of exposition,

[30]For the variance decomposition to sum to the total variance in an unbalanced panel, it is necessary to weight the between component by the number of workers on the field-day.

we employ a discrete measure of social connections, DC_{ift}, which is equal to 1 if worker i is connected to at least one manager on field-day ft and equal to 0 otherwise. To analyze whether the effect of connections differs by workers' ability, we rank workers according their average productivity when managers are paid bonuses and use the median to split them into two ability groups.[31]

Panel A of Table II pools all workers and illustrates that when managers are paid fixed wages, worker productivity is 7.21 kg/hr when workers are unconnected and rises significantly to 8.98 kg/hr when workers are managed by individuals they are socially connected to. In contrast, when managers are paid bonuses, the average worker's productivity is no different on field-days when he is socially connected to field-days when he is socially unconnected. The unconditional difference-in-difference in workers' productivity by their social connections to managers and across managerial incentive scheme is 1.59 kg/hr, and is significantly different from zero. As workers are paid piece rates, differences in worker productivity by social connectivity to managers and managerial incentive scheme translate into similar differences in worker earnings. This is quantitatively important both in percentage terms and in absolute terms when aggregated over the season.[32]

As highlighted by the theoretical framework in Section 3, the evidence in panel A is consistent with two interpretations of managers' behavior following the introduction of the bonus: either managers exert more effort and target *all* workers regardless of their connection status, or managers exert more effort and reallocate it from connected workers toward high ability workers to maximize average productivity. To distinguish between these interpretations, panels B and C provide evidence on the effect of social connections on workers who are below and above the median level of ability, respectively. Three points are of note.

First, when managers are paid fixed wages, the first data column in panels B and C shows that social connections increase worker productivity for both groups, suggesting that managers target connected workers regardless of their ability level.

Second, panel B shows that the introduction of the bonus does not affect the productivity of low ability workers in days in which they are not connected,

[31]The theoretical framework makes clear that the probability of social connections affecting the managers' allocation decisions is decreasing in the strength of managerial incentives. Thus if social connections affect productivity only when managers are paid fixed wages, the productivity under the bonus better reflects a worker's true ability. It is important to note that there is little churning of workers in this ranking—the rank correlation between workers' average productivity when managers are paid wages and when managers are paid bonuses is .69.

[32]The average worker picks on two to three fields per day and stays on the farm for 100 days. A back of the envelope calculation suggests that over the course of a season, a worker would earn £500 more if managers were always paid a fixed wage and workers were always managed by individuals they are socially connected to. Given that workers in our sample live in Eastern Europe and much of their earnings are saved to spend in their home country, the real value of these differences is substantial.

while it *reduces* their productivity by around 8% on connected field-days. This is consistent with the view that managers target low ability connected workers when paid fixed wages, but stop engaging in such behavior when paid bonuses. Consequently, the productivity of low ability workers when managed by those they are connected to significantly falls as managers interests become more aligned with those of the firm.

Third, panel C shows the introduction of managerial performance bonuses *increases* the productivity of high ability workers both on field-days in which they are unconnected and on field-days in which they are connected. The effect on unconnected field-days is more than twice as large as the effect on connected field-days, and the difference-in-difference is positive and precisely estimated. This indicates that the introduction of the bonus increases the productivity of high ability workers because managers' efforts are both higher and more likely to be targeted toward them.

Overall, the evidence in Table II indicates that managers target connected workers irrespective of their ability when paid fixed wages, whereas they reallocate their efforts in favor of high ability workers when paid performance bonuses irrespective of whether they are socially connected to them or not. This suggests that social connections distort the allocation of managerial effort across workers and that this effect is detrimental to the firm's productivity as managers stop targeting connected workers when their interests become more closely aligned with the firms'.

In the remainder of the paper, we present formal evidence to shed light on whether these descriptive results are robust to controlling for other determinants of productivity. In doing so, we make precise the underlying identifying assumptions required to interpret this evidence as causal and present evidence in support of these identifying assumptions.

5. SOCIAL CONNECTIONS AND WORKER PRODUCTIVITY

5.1. *Methodology*

The empirical analysis proceeds in two stages. First, we estimate the effect of social connections on the average worker by managerial incentive scheme. Next, we allow the effect of social connections and managerial incentives to differ across workers. To identify whether social connections affect worker's productivity and how this depends on the managerial compensation scheme in place, we estimate the panel data regression

$$
\begin{aligned}
(3) \qquad y_{ift} = {} & \alpha_i + \lambda_f + \gamma_0(1 - B_t) \times C_{ift} + \gamma_1(B_t \times C_{ift}) + \rho B_t \\
& + \sum_k \sum_{d \in N_k} \tau_d^k (B_t \times D_{id}^k) + \sum_{s \in M_{ft}} \mu_s S_{sft} \\
& + \delta X_{ift} + \eta Z_{ft} + \varphi t + u_{ift},
\end{aligned}
$$

where y_{ift} is worker i's log productivity on field f and day t. The worker fixed effects α_i account for permanent productivity differences across workers, such as those arising from innate ability or motivation, and the field fixed effects λ_f capture permanent productivity differences across fields, such as those arising from soil quality.[33]

C_{ift} is the log of the share of managers worker i is socially connected to on the field-day. B_t is a dummy variable equal to 1 after the performance bonus is introduced (June 27th) and equal to 0 otherwise. The parameters of interest throughout are γ_0, which measures the effect of social connections when managers are paid a fixed wage, and γ_1, which measures the effect of social connections when managers are paid performance bonuses. The null hypothesis is that social connections do not affect productivity, so $\gamma_0 = \gamma_1 = 0$.

Since connectivity is defined along the lines of nationality, living site, and arrival cohort, γ_0 and γ_1 might be biased if, for example, the introduction of the bonus has different effects on workers of different nationalities. This is because the connection measure C_{ift} would then also be picking up any differential effect of the performance bonus by worker nationality. Obviously, similar concerns arise if workers are differentially affected on the basis of their living site or time of arrival on the farm once managerial performance bonuses are introduced. To address these concerns, we control for a set of interactions between the performance bonus dummy B_t and the complete set of nationality, arrival cohort, and living site dummies.

To do so we define a dummy variable $D^k_{id} = 1$ if worker i is of type d along dimension k and $= 0$ otherwise, and N_k denotes the total number of types along dimension k. For example, when k is nationality, $D^k_{id} = 1$ when the worker is of nationality d, and $N_k = 8$ as this is the number of different nationalities in our data. These interactions flexibly control for any heterogenous effect on workers of the change in managerial incentives along these dimensions. Hence we estimate the effect of the within worker variation in social connectivity conditional on any heterogeneous effects between workers that may arise as managers respond to the introduction of performance bonuses along other margins apart from those arising from social connections with their subordinates.

S_{sft} is a dummy equal to 1 if manager s works on field f on day t and equal to 0 otherwise, and M_{ft} is the set of managers who work on the field-day. Hence $\sum_{s \in M_{ft}} \mu_s S_{sft}$ in (3) corresponds to a full set of manager dummies. These control for time invariant traits of each manager, such as their ability to motivate workers and their management style, that affect the performance of managed workers. These allow us to address the concern that there are unobservable

[33] If this specification is estimated only with worker fixed effects, they explain 25% of the variation in worker productivity, suggesting there is considerable heterogeneity across workers. Estimating the specification conditional on only field fixed effects explains 11% of the overall variation. Estimating the specification conditional only on manager fixed effects explains 3.5% of the overall variation.

managers' characteristics that drive both their social connections and the performance of their subordinates.

X_{ift} is the worker's picking experience, defined as the cumulative number of field-days they have picked fruit on the farm. Z_{ft} captures time-varying field characteristics. This includes the field's life cycle, defined as the nth day the field is picked divided by the total number of days the field is picked over the season. This captures the natural within field trend in productivity as fields deplete over time. We also include a time trend t to capture learning by farm management and any aggregate trends in productivity.[34]

We also note that the social connections between a worker and his managers are unlikely to be identically and independently distributed within a worker over field-days. We therefore adopt a conservative strategy in estimating standard errors and allow the disturbance terms u_{ift} to be clustered by worker throughout.[35]

The parameters of interest (γ_0, γ_1) identify the causal effect of social connections on worker productivity under each managerial incentive scheme by comparing the productivity of a given worker on field-days when he is socially connected to his manager to his productivity on field-days when he is unconnected. The validity of the identification strategy and the causal interpretation given to the results relies on two key assumptions. The first is that unobserved determinants of workers' allocation to managers are orthogonal to the managerial incentive scheme in place. The second is that any effect of social connections on individual productivity that is unrelated to the managerial incentive scheme in place remains unchanged over time. We provide detailed evidence in support of both of these identifying assumptions in Section 5.3.

5.2. *Baseline Results*

Table III presents estimates of our baseline specification (3). In column 1 we measure social connections with the dummy variable DC_{ift} that equals 1 if worker i is connected to any of the managers in field-day ft and equals to 0 otherwise. This is the variable used for the previous descriptive evidence in Table II. The results show that the pattern of unconditional differences in worker productivity by social connections and managerial incentive scheme is robust to conditioning on a rich set of determinants of worker productivity. In particular, column 1 shows that when managers are paid a fixed wage, the average worker has significantly higher productivity on field-days on which he is

[34] As fields are operated on at different parts of the season and not all workers pick each day, the effects of the field life cycle and workers' picking experience can be separately identified from that of the time trend. The average field life cycle is not significantly different under the two managerial compensation schemes.

[35] Clustering the disturbance terms u_{ift} by field-day—say because workers on the same field-day face common productivity shocks—leads to the standard errors on the parameters of interest, γ_0 and γ_1, being considerably smaller than those we report.

TABLE III

SOCIAL CONNECTIONS AND MANAGERIAL INCENTIVES[a]

	1. Any Managers Connected To	2. Share of Managers Connected To	3. Heterogeneous Effects of the Bonus on Workers	4. Field-Date Fixed Effects
Any managers connected to i, fixed wages for managers (DC_{ift})	.049**			
	(.019)			
Any managers connected to i, performance bonus for managers (DC_{ift})	.016			
	(.032)			
Share of managers connected to i, fixed wages for managers (C_{ift})		.158***	.143***	.106**
		(.040)	(.040)	(.045)
Share of managers connected to i, performance bonus for managers (C_{ift})		−.083	−.079	−.060
		(.088)	(.088)	(.061)
Difference-in-difference estimate	.033	.241***	.222**	.167**
	(.034)	(.095)	(.096)	(.075)
Interactions of nationality × performance bonus dummy	Yes [.147]	Yes [.042]	No	No
Interactions of living site × performance bonus dummy	Yes [.000]	Yes [.000]	No	No
Interactions of arrival cohort × performance bonus dummy	Yes [.000]	Yes [.000]	No	No
Interactions of worker fixed effect × performance bonus dummy	No	No	Yes [.000]	Yes [.000]
Field-date fixed effects	No	No	No	Yes
Adjusted R-squared	.4355	.4361	.4479	.5817
Number of observations (worker-field-day)	8884	8884	8884	8884

[a]Dependent variable = log of worker's productivity (kilograms picked per hour on the field-day). *** denotes significance at 1%, ** at 5%, and * at 10%. In columns 1 to 3 the standard errors allow for clustering at the worker level. In column 4 standard errors are clustered at the field-date level. All specifications control for worker, field, and manager fixed effects. The other controls included in specifications 1 to 3 include the managerial performance bonus dummy, the worker's picking experience, the field life cycle, a time trend, and interactions between the performance bonus dummy and the worker's nationality, arrival cohort, and living site. The field life cycle is defined as the nth day the field is picked divided by the total number of days the field is picked over the season. In column 4 these interactions are replaced by interactions of the worker fixed effect and the performance bonus dummy, and a series of field-date fixed effects and hence the field life cycle and time trend are dropped from this specification. All continuous variables are in logarithms. A manager and given worker i are defined to be connected if they are either of the same nationality, live in the same area, or are in the same arrival cohort. All sample workers are connected to at least one manager on at least one field-day and work at least one week under each incentive scheme. In column 1 a worker is defined to be unconnected on the field-day if she is not socially connected to any of her managers that field-day, and the worker is defined to be connected on the field-day if she is socially connected to at least one of her managers. The difference-in-difference estimate is the difference in the effect of social connections on worker productivity by managerial incentive scheme. At the foot of each column we report the p-value on the F-test on the joint significance of the interaction terms with the performance bonus dummy.

socially connected to his managers ($\widehat{\gamma}_0 > 0$). When managers are paid performance bonuses, there is no effect on the average worker's productivity of being socially connected to her managers on the field-day ($\widehat{\gamma}_1 = 0$).

The magnitude of $\widehat{\gamma}_0$ implies that when managers are paid a fixed wage, being connected to at least one manager on the field, increases productivity by 5% for the average worker, whereas there is no such effect when managers are paid performance bonuses, although the difference in the effects is not statistically significant.

In column 2 we measure social connections by the share of managers on field-day ft that are connected to worker i by either nationality, living site, or arrival cohort. Compared to the dummy variable DC_{ift}, this is a more precise measure as it distinguishes between field-days in which a worker is more likely to be connected to his manager. The pattern of coefficients is the same as in column 1 but the implied magnitude of the effect is larger. Evaluating at the mean, the magnitude of $\widehat{\gamma}_0$ implies that when managers are paid a fixed wage, the productivity of a worker on field-days when he is socially connected to all the managers on the field relative to his productivity on field-days when he is socially unconnected to managers will be .642 kg/hr higher, other things being equal. Relative to a baseline average worker productivity of 7.21 kg/hr when managers are paid fixed wages and workers are not connected, this represents a 9% increase of productivity on connected days. Since workers are paid piece rates based on productivity, earnings increase by the same percentage.[36,37]

Taken together, this pattern of results suggests the effect of social connections in the workplace is for managers to favor workers they are connected to when their incentives are low powered. At the foot of columns 1 and 2 we report the implied difference-in-difference estimate, $(\widehat{\gamma}_0 - \widehat{\gamma}_1)$. In line with the descriptive evidence, this is positive in both cases and significantly different

[36]The difference between the estimated $\widehat{\gamma}_0$ parameters in columns 1 and 2 lends support to the idea that managers and workers do not choose who they work with, even within a field-day. Namely, if managers favor socially connected workers and workers could sort across managers within the field, workers should assign themselves to a manager they are socially connected to if such a manager were present. In that case, however, the effect of being connected to one manager should be no different than being connected to two or more. The fact that the implied effect of being connected to all managers (from column 2) is almost double the effect of being connected to at least one (from column 1) indicates that workers cannot assign themselves to a manager who they are connected to.

[37]While these baseline results focus on the effects of social connections on worker productivity, we also explored whether the strength of social ties between a worker and his managers affect worker productivity. We can define the strength of the social tie as the *number* of dimensions along which the two are connected, $\sum_k DC^k_{ift}$. We find that a worker's productivity is monotonically increasing in the number of dimensions along which he is connected to his managers when his managers are paid a fixed wage and that there is no such effect under performance bonuses. However, these results should be interpreted with caution because, given that each dimension of connectivity is orthogonal to the others, there are only 5% of observations from which the effects of being connected along strictly more than one dimension can be identified.

from zero at the 1% significance level when using the continuous measure of social connections.

The pattern of coefficients helps rule out three alternative hypotheses of why social connections may matter in this workplace. First, if workers were always assigned to socially connected managers when productivity on the field is exogenously higher, connections should have the same positive effect under both schemes, that is, $\widehat{\gamma}_0 = \widehat{\gamma}_1 > 0$. Second, when they are on the field-day with managers they are socially connected to, if workers prefer to socialize with their managers, connections should have the same negative effect under both schemes, that is, $\widehat{\gamma}_0 = \widehat{\gamma}_1 < 0$. Third, the pattern of coefficients allows us to rule out the hypothesis that the effect of social connections is driven by workers' rather than managers' behavior. Indeed, if workers were to internalize the effect of their effort on their manager's pay when socially connected to her, we would observe workers exerting more effort when this actually affects the manager's pay, namely when the manager is paid the performance bonus, that is $\widehat{\gamma}_0 = 0 < \widehat{\gamma}_1$.

A concern with these results is that the difference-in-difference estimate of social connections might be picking up heterogeneous effects of the managerial bonus scheme across workers that are unrelated to workers' social connections. To account for this, we introduce a complete set of interactions between each worker's fixed effect and the performance bonus dummy. This flexibly captures any differential effects across workers of the change in managerial incentives. The result, reported in column 3, shows that the magnitude and significance of the parameters of interest are similar to those in the baseline estimates.[38]

Finally, we address the concern that there may exist field-day factors that create a spurious correlation between social connections and productivity. For example, managers might lobby the COO to be allocated workers they are connected to on field-days when productivity is exogenously higher. Also, the effect of social connections might depend on the field-day piece rate, which is on average lower when managers are paid performance bonuses as shown in Bandiera, Barankay, and Rasul (2007). To address this concern, the final specification includes field-day fixed effects. The effects of social connections C_{ift} under each managerial incentive scheme are then identified off the variation across workers in the same field-day in the level of their social connections in deviation from the workers' average level of social connections under each managerial compensation scheme. The result in column 4 shows the previous results to be robust to conditioning on factors that vary across field-days, such as managers lobbying for workers, field conditions, the hours worked on the field-day, or the level of the piece rate for workers.[39]

[38]The results are robust to controlling for a complete set of worker-field dummies that allow the productivity of each worker to differ across fields.

[39]To ensure the estimates do not capture the effect of the composition of the workforce changing over the season, throughout we restrict the sample to workers who work at least one week

5.3. *Evidence in Support of the Identifying Assumptions*

We have identified the causal effect of social connections on worker productivity under each managerial incentive scheme by comparing the productivity of a given worker on field-days when he is socially connected to his manager to his productivity on field-days when he is unconnected. The validity of the identification strategy and the causal interpretation given to the results relies on two assumptions.

The first is that unobserved determinants of workers' allocation to managers are orthogonal to the managerial incentive scheme in place. As discussed in Section 2.2, the within worker variation in social connections is exogenous to the behavior of workers and managers because the allocation of individuals to fields is determined by the COO, based on the demand for labor for picking and nonpicking tasks across fields. Nevertheless, workers' allocation to managers might still depend on factors that affect performance and are observable to the COO. Alternatively, workers and managers might engage in behaviors to influence their assignment to each other.

To provide support for this identifying assumption, the Appendix presents evidence that the allocation rules do not change with the change in managerial incentives. We show that (i) compared to workers who are not connected to any manager, connected workers are equally likely to be selected to pick or to be selected to work on any task as opposed to stay unemployed on a given day, regardless of the incentive scheme in place; (ii) field-day and worker-field-day specific determinants of productivity do not predict the level of social connections C_{ift} differentially under the two managerial incentive schemes; (iii) all managers are equally likely to be assigned connected workers under both incentive schemes; (iv) we exploit the fact that some dimensions of connectivity, such as nationality, are more easily observable to the COO than others, such as time of arrival. If the COO systematically assigns workers to managers on the basis of their connections, we should find the effect of social connections to be mostly driven by dimensions that are easier to observe. We find no evidence to support this assertion.

The second underlying identifying assumption is that the effect of social connections on individual productivity does not change over time for reasons other than the change in managerial incentives. This ensures that there are no time-varying unobservables that (i) are correlated with the introduction of the bonus and (ii) determine the effect of social connections on productivity.

The Appendix shows two pieces of evidence in support of this assumption. First we show that the effect of social connections does not depend on the time of the season, the field life cycle or the workers' tenure. Rather, the effect

either side of the change in managerial incentives. The results are robust to less conservative sample definitions, namely to including all workers on payroll or only workers who have worked at least one day either side of the change in managerial incentives.

of social connections changes *discontinuously* when the bonus is introduced.[40] Second, we analyze the effect of a placebo bonus on productivity in a different season (2004) and in different fields within the 2003 season, neither of which were subject to the introduction of managerial performance pay. Reassuringly, the effect of connections on productivity does not change with the introduction of the placebo bonus, suggesting the effect of social connections does not change spuriously at a specific point in time or in the field life cycle that happens to coincide with the introduction of the performance bonus in 2003.

6. THE EFFECT OF SOCIAL CONNECTIONS ON THE FIRM'S PERFORMANCE

We have presented evidence that the average worker benefits from being connected to his manager—in terms of his productivity and hence earnings—only when managers are subject to low powered incentives. In contrast, there are no such benefits to being socially connected to managers when they are paid performance bonuses. As highlighted by the theoretical framework in Section 3, two interpretations on managerial behavior are consistent with the findings.

First it might be that when managers are paid wages, they only devote effort to connected workers, whereas when they are paid bonuses they increase the overall level of effort and devote some to every worker. Second, it might be that when managers are paid wages, they only devote effort to connected workers, whereas when they are paid bonuses they reallocate their, possibly higher, effort toward high ability workers irrespective of whether they are socially connected to them or not.

Distinguishing between these interpretations is key to assess the effect of social connections on the firm's overall productivity. If the data support the first interpretation, the implication is that social connections do not distort the allocation of managerial effort and have a positive effect on firm's productivity because they increase managerial effort. To the contrary, if the data support the second interpretation, the interpretation is that social connections lead to a misallocation of managerial effort that decreases the firm's productivity. The theoretical framework makes clear that such an allocation effect might reduce the firm's productivity when the manager is connected to low ability workers and targets them instead of the high ability workers. To assess whether this is the case, we proceed in two stages. In Section 6.1 we assess whether the allocation effect is negative, namely we estimate the effect of social connections on connected workers of different ability by managerial incentive scheme and we test whether the manager reallocates effort from low to high ability workers

[40] A related concern is that the overall effect of social connections through time might mask heterogeneous effects for the three different components of the connection measure. Further specifications, not reported for reasons of space, reveal that the effect of each component does not vary with time and changes discontinuously when bonuses are introduced.

as a result of the increase in the strength of her incentives. In Section 6.2 we present evidence on the overall effect of social connections on the firm's performance, so as to assess whether the positive incentive effect prevails over the (possibly) negative allocation effect.

6.1. *The Allocation Effect*

6.1.1. *Quantile Regression Estimates*

To explore whether the effects of social connections are heterogeneous across workers, we use quantile regression methods to estimate the conditional distribution of the log of productivity of worker i on field f on day t, y_{ift}, at different quantiles, θ. We therefore estimate the specification

$$\text{Quant}_\theta(y_{ift}|\cdot) = \alpha_\theta B_t + \beta_\theta C_{ift} + \gamma_\theta (B_t \times C_{ift}) + \lambda_{\theta f} + \sum_{s \in M_{ft}} \mu_{\theta s} S_{sft} + \delta_\theta X_{ift} + \eta_\theta Z_{ft} + \varphi_\theta t, \tag{4}$$

where all variables are as previously defined and bootstrapped standard errors based on 1000 replications are calculated throughout. The effect of the managerial performance bonus on unconnected field-days at the θth conditional quantile of log worker productivity is measured by α_θ. The corresponding effect on connected field-days is given by $\alpha_\theta + \gamma_\theta C_{ift}$. Since the connection variable C_{ift} is continuous, we define worker i to be connected on field-day ft when the share of managers he is connected to is higher than a given threshold, $\bar{C}_{ift}$, and we experiment with alternative values of the threshold. The effect of social connections when managers are paid fixed wages and bonuses is captured by β_θ and $\beta_\theta + \gamma_\theta$, respectively.

The estimates of α_θ and $(\alpha_\theta + \gamma_\theta C_{ift})$ at different conditional quantiles of worker productivity allow us to distinguish between the two interpretations given above. Indeed, if social connections do not distort the allocation of effort but rather the manager targets connected workers before the bonus and exerts additional effort to target *all* workers after the bonus, we should observe the effect of the bonus to be nonnegative and stronger on field-days when the worker is not connected, that is, $\alpha_\theta > \alpha_\theta + \gamma_\theta \bar{C}_{ift} \geq 0$ for all θ.

In contrast, if social connections distort the allocation of effort and this is detrimental to the firm's productivity, we should observe that managers reallocate effort from low ability workers when connected to high ability workers regardless of their connection status. This implies (i) the introduction of the bonus strictly decreases the productivity of workers in the left tail of the productivity distribution on field-days in which they are connected and has no effect when they are not connected, namely $\alpha_\theta + \gamma_\theta \bar{C}_{ift} < 0$ and $\alpha_\theta = 0$ for low θ; (ii) the introduction of the bonus strictly increases the productivity of workers in the right tail of the productivity distribution on field-days in which they

TABLE IV

QUANTILE REGRESSION ESTIMATES[a]

	Quantile of Worker Productivity				
	10th	25th	50th	75th	90th
Performance bonus for managers (α_θ)	−.093	.001	.100**	.214***	.312***
	(.078)	(.037)	(.034)	(.040)	(.041)
Share of managers connected to i (β_θ)	.013	.074**	.144***	.272***	.392***
	(.067)	(.032)	(.030)	(.036)	(.037)
Performance bonus for managers × share of managers connected to i (γ_θ)	−.228**	−.175***	−.179***	−.168***	−.233***
	(.104)	(.050)	(.047)	(.057)	(.060)
Implied effect of performance bonus for managers on connected field-days ($\alpha_\theta + \gamma_\theta C_{ift}$) (evaluated at mean of C_{ift})	−.166**	−.055*	.042	.160***	.237***
	(.069)	(.033)	(.031)	(.035)	(.035)
Number of observations (worker-field-day)	8884	8884	8884	8884	8884

[a]Dependent variable = log of worker's productivity (kilograms picked per hour on the field-day). *** denotes significance at 1%, ** at 5%, and * at 10%. Standard errors are reported in parentheses. All specifications control for field and manager fixed effects. The other controls included in each specification are the worker's picking experience, the field life cycle, and a time trend. The field life cycle is defined as the nth day the field is picked divided by the total number of days the field is picked over the season. All continuous variables are in logarithms. A manager and given worker i are defined to be connected if they are either of the same nationality, live in the same area, or are in the same arrival cohort. The implied effect of the bonus on connected days is computed assuming that the share of managers the worker is connected to is at the sample mean.

are not connected and has a weakly positive effect when they are connected, namely $\alpha_\theta > \alpha_\theta + \gamma_\theta \bar{C}_{ift} \geq 0$ for high θ.

Table IV reports the estimates of α_θ, β_θ, γ_θ, and $\alpha_\theta + \gamma_\theta \bar{C}_{ift}$ from specification (4) at various quantiles, and is where $\bar{C}_{ift}$ is set at the sample mean. Two points are of note. First, the effect of the managerial bonus on unconnected field-days, α_θ, is zero at the bottom two quantiles, and is positive and increasing in θ for the top quantiles. Second, the effect of the managerial bonus on connected field-days, $\alpha_\theta + \gamma_\theta \bar{C}_{ift}$, is negative and significant in the first two quantiles, and is positive and significant in the last two quantiles.[41]

Taken together, these results provide evidence *against* the interpretation that after the introduction of the bonus, managers exert extra effort and target all

[41]As the effect of the bonus on both connected and unconnected field-days is increasing in θ, the evidence is not consistent with the hypothesis that workers work harder to increase the probability of being selected to pick once the bonus is introduced. If such "rat race" effects were responsible for the productivity increase, we should observe workers at the margin of being selected to be most affected.

workers regardless of their connection status. Rather the data suggest the introduction of the bonus strictly decreases the productivity of workers in the left tail of the productivity distribution on field-days in which they are connected and has no effect when they are not connected. The findings unambiguously provide support to the interpretation that social connections distort the allocation of effort when managers are paid fixed wages and that this allocation effect is detrimental for the firm's productivity.[42]

6.1.2. *Fixed Effects Estimates*

To complement the quantile regression evidence, we estimate the productivity effect of social connections, of the managerial bonus, and of their interaction, individually for each worker. To do so, we estimate the panel data specification

$$y_{ift} = \sum_{i=1}^{129} \Lambda_{ift} D_i + \lambda_f + \rho X_{ift} + \eta Z_{ft} + \varphi t + \sum_{s \in M_{ft}} \mu_s S_{sft} + u_{ift}, \tag{5}$$

where D_i equals 1 for worker i, and is 0 otherwise, and all other variables are as previously defined. To explore heterogeneous effects across workers, we define

$$\begin{aligned} \Lambda_{ift} = {} & \alpha_i [DC_{ift} \times (1 - B_t)] + \beta_i [DC_{ift} \times B_t] \\ & + \gamma_i [(1 - B_t) \times (1 - DC_{ift})] + \delta_i [B_t \times (1 - DC_{ift})]. \end{aligned} \tag{6}$$

For each worker we therefore estimate four parameters that capture his residual productivity on field-days when he is (i) connected and managers are paid wages (α_i); (ii) connected and managers are paid bonuses (β_i); (iii) unconnected and managers are paid fixed wages (γ_i); (iv) unconnected and managers are paid bonuses (δ_i). Figure 1 shows the kernel density estimates of the four estimates of residual productivity.

Panels (a) and (b) show the effect of being socially connected to managers for a given managerial compensation scheme. Panel (a) shows that when managers are paid fixed wages, the entire distribution of conditional productivity shifts to the right on field-days in which workers are connected compared to when they are not connected. The p-value of the Kolmogorov–Smirnov test for the null of equality of distributions is .01.

Panel (b) shows that when managers are paid performance bonuses, the distributions of conditional productivity on connected and unconnected field-days overlap. In this case, the Kolmogorov–Smirnov test fails to reject the null at

[42]The results are qualitatively unchanged if we set the threshold $\bar{C}_{ift}$ to (i) the sample minimum of C_{ift}, so that a worker is defined to be connected as long as he is connected to one of the managers; (ii) the sample maximum of C_{ift}, so that a worker is defined to be connected only if he is connected to all managers on the field-day.

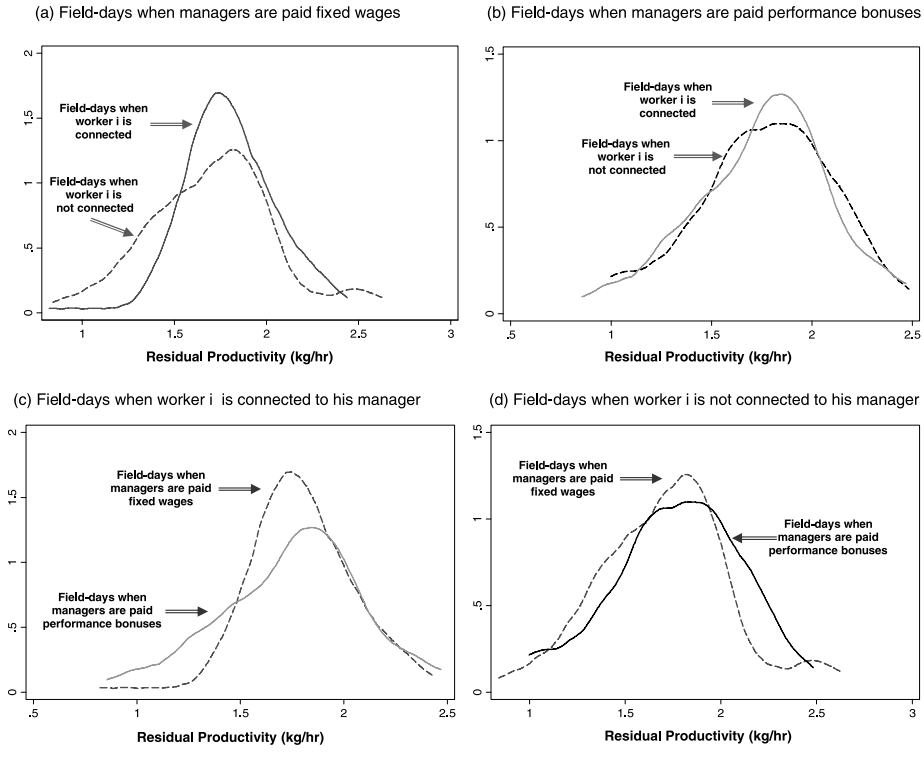

FIGURE 1.—Worker's fixed effects, by connection status and managerial incentive scheme. Residual productivity is the worker fixed effect in the regression of log productivity on worker experience, field life cycle, trend, field fixed effects, and manager fixed effects. For each worker we estimate a fixed effect in each of the four possible states: when managers are paid wages and the worker is connected, when managers are paid wages and the worker is not connected, when managers are paid bonuses and the worker is connected, and when managers are paid bonuses and the worker is not connected.

conventional levels of significance. Panels (a) and (b) together confirm the previous findings that being connected increases workers' conditional productivity when managers are paid a fixed wage, while it has no discernible effect when managers are paid performance bonuses.

To assess whether social connections distort the managers' allocation of effort and whether this is detrimental for productivity, we analyze whether managers reallocate effort from low ability workers on connected field-days to high ability workers on unconnected field-days after the introduction of the bonus. In line with the quantile regression estimates, panel (c) shows that on field-days when the worker is connected, the distribution of conditional productivity has a thicker left tail and the p-value of the Kolmogorov–Smirnov test is .04. Panel (c) thus indicates that the introduction of the managerial performance bonus *reduces* the productivity of low ability workers who were previously tar-

geted when managers were paid wages. Note also that on field-days when the worker is connected, the distribution of conditional productivity has a higher variance when managers are paid bonuses compared to when they are paid fixed wages. This illustrates that social connections reduce the variation in productivity naturally arising from differences in worker ability when managers are paid fixed wages but not when they are paid bonuses.

Finally, panel (d) illustrates the effect of the introduction of the bonus on unconnected field-days. In line with the previous estimates, on unconnected field-days the distribution of conditional productivity has a thicker right tail when managers are paid bonuses compared to when they are paid fixed wages—the p-value of the Kolmogorov–Smirnov test is .06. This is consistent with the introduction of the bonus *increasing* the productivity of high ability workers who were previously untargeted on field-days when they were unconnected and managers were paid wages.

Overall, panels (c) and (d) are in line with the quantile regressions results and provide support to the interpretation that when managers are paid fixed wages, they favor connected workers and that this allocation of managerial effort is detrimental for the firm's overall productivity.

6.1.3. *Further Evidence*

The balance of evidence indicates that following the introduction of the bonus, managers reallocate effort from low ability connected workers to high ability unconnected workers, rather than devoting more effort toward all workers. This is consistent with the characteristics of the production technology in our setting. Indeed, as each manager is responsible for 20 workers distributed over one hectare, it is often impossible for her to target her effort toward *all* workers simultaneously. The technology is such that managerial effort is a rival good in that if the manager decides to target her effort toward one worker, she necessarily does so at the expense of another worker.

A testable implication of this property is that if favors are rival, the effect of social connections on the productivity of worker i should be smaller when the share of his co-workers who are also connected to managers increases. In short, if few workers are connected, the manager can devote all of her time to favor them. If more workers are connected, the manager needs to spread her favors more thinly. To check for this, we reestimated our baseline specification (3), allowing the effect of social connections on the productivity of worker i on field-day ft to vary with the share of workers who are also connected to a manager on field-day ft. We find that when managers are paid fixed wages, social connections increase the productivity of a connected worker by 15% if one-quarter of the workers on the field are also connected, by 7% if half of the workers on the field are also connected, and have no effect if more than two-thirds of the workers on the field are also connected. In line with previous evidence, neither the connection status of worker i nor the share of connected

workers on the same field-day affect productivity after the introduction of managerial performance pay.

6.2. *The Overall Effect on Average Field-Day Productivity*

The evidence above indicates that when managers are paid fixed wages, social connections distort the allocation of managerial effort in favor of connected workers at the expense of high ability workers. This, together with the fact that when they are paid performance bonuses they allocate effort to high ability workers only, indicates that the allocation effect is detrimental for the firm's performance. We now present evidence on the overall effect of social connections, namely we investigate whether the extent to which social connection increase managerial effort is sufficient to overcome the negative allocation effect. To do so, we aggregate the data at the field-day level and estimate a specification analogous to (3):

$$\bar{y}_{ft} = \kappa_0(1 - B_t) \times \bar{C}_{ft} + \kappa_1(B_t \times \bar{C}_{ft}) + \rho B_t + \sum_{s \in M_{ft}} \mu_s S_{sft} + \eta Z_{ft} + \varphi t + \lambda_f + u_{ift}, \tag{7}$$

where $\bar{y}_{ft}$ is the log of the average productivity on field-day ft, $\bar{C}_{ft}$ is the share of managers worker i is socially connected to, averaged across all workers on field-day ft, B_t is a dummy variable equal to 1 after the performance bonus is introduced (June 27th) and equal to 0 otherwise, $\sum_{s \in M_{ft}} \mu_s S_{sft}$ is a full set of managers dummies, Z_{ft} is the field-life cycle, and t is a time trend, as in the baseline specification (3). The parameters of interest are κ_0, which measures the effect of social connections on average productivity when managers are paid a fixed wage, and κ_1, which measures the effect of social connections when managers are paid performance bonuses. The findings, reported in Table V, indicate that the overall effect of social connections is negative when managers are paid fixed wages and is zero when they are paid performance bonuses. An increase in average social connections by 1 standard deviation reduces average productivity by 8% unconditionally and by 5% in the full conditional specification (7) when mangers are paid fixed wages. The effect of social connections under the bonus is small and not significantly different than zero. Given our previous finding that the allocation effect is negative when managers are paid wages and is zero when they are paid bonuses, the results in Table V imply that the effect of social connections on managerial effort might be positive, albeit not very large, in the fixed wage regime only. The next section discusses how the finding that social connections are detrimental to the overall firm productivity might depend on specific features of the context we study.

TABLE V

THE EFFECT OF SOCIAL CONNECTIONS ON AVERAGE PRODUCTIVITY

	1. Unconditional	2. Managers FE	3. Time Controls	4. Field FE
Average connections ($\bar{C}_{ift}$), fixed wages for managers	−.779***	−.544**	−.675***	−.535**
	(.201)	(.255)	(.238)	(.250)
Average connections ($\bar{C}_{ift}$), performance bonus for managers	.206	.149	.122	.031
	(.509)	(.529)	(.484)	(.480)
Manager fixed effects	No	Yes	Yes	Yes
Time controls	No	No	Yes	Yes
Field fixed effects	No	No	No	Yes
Adjusted R-squared	.944	.943	.948	.909
Number of observations (field-day)	241	241	241	241

[a]Dependent variable = log of average field-day productivity (kilograms picked per hour on the field-day). *** denotes significance at 1%, ** at 5%, and * at 10%. AR(1) regression estimates are reported. Panel corrected standard errors are calculated using a Prais–Winsten (AR(1)) regression, allowing the error terms to be field specific heteroskedastic, and contemporaneously correlated across fields. The autocorrelation process is assumed to be specific to each field. Each field-day observation is weighted by the log of the number of workers present. All specifications control for the bonus dummy that is equal to 1 when the managerial performance bonus scheme is in place and equal to 0 otherwise. The dependent variable is the log of the average productivity at the field-day level. The average connection variable is computed as the average of the social connection measure for all workers on the field-day. A manager and given worker i are defined to be connected if they are either of the same nationality, live in the same area, or are in the same arrival cohort. Time controls included in columns 3 and 4 are a linear time trend and the field life cycle, defined as the nth day the field is picked divided by the total number of days the field is picked over the season.

7. DISCUSSION

We have provided evidence on the interplay between social connections, incentives, and productivity within a firm. We show that in a setting where managerial effort can be targeted to affect the productivity and earnings of individual workers, the existence of social connections between individuals at different tiers of the firm hierarchy affects individual and firm performance.

We find that managers target connected workers, but only when their monetary incentives are low powered. After the introduction of managerial performance pay, managers stop favoring low ability workers they are socially connected to and target their effort toward high ability workers instead. The results indicate that while social connections can increase the productivity of connected workers, their effect on the allocation of managerial effort is detrimental for the firm's productivity overall under the fixed wage regime.

Our results bring new evidence to the small but growing literature that highlights the importance of social relationships in the workplace. Our findings indicate that managerial behavior is shaped by both social connections with subordinates and monetary incentives. Both factors are key to explaining the success of existing incentive structures and to guide the design of optimal compensation schemes for both workers and managers.

The use of detailed personnel data combined with the purely exogenous variation created by our natural field experiment allows us to precisely identify the causal effect of social connections between workers and managers on the performance of individual workers and on the firm's performance overall. Precision, however, inevitably comes at the cost of a loss of generality, because the firm we study, as any other, has unique features that shape social connections between workers and managers, and their effect on productivity. The following features of this work environment are particularly noteworthy for the external validity of this study.

First, there are two characteristics of this firm that have opposite effects on the probability that social connections form and are strong enough to affect behavior. On the one hand, the fact that managers and workers are of similar ages and backgrounds, and live on the farm site for the entire duration of their stay increase the likelihood that they form strong social connections with one another. On the other hand, as managers and workers are employed on short term seasonal contracts, this might prevent the formation of meaningful long-run social ties relative to other settings.

Second, in our setting all the actions managers can take to help connected workers—allocating them to better rows, reallocating them quickly to new rows, providing them with new crates as soon as needed—are costlessly observed by others on the field. To the extent that favoritism is disapproved of by unconnected workers, the fact that these actions are observable by all workers reduce managers' ability to favor their friends. We thus expect the effect of social connections and favoritism to be stronger in settings where favoritism can be more easily disguised.

Third, the specific form that the effects of social connections take depends on the technology and incentive schemes in the workplace. In our context workers are paid piece rates and managers can undertake actions that improve the productivity and hence earnings of connected workers. In other contexts in which workers are paid fixed wages, social connections might be exploited to allow subordinates to slack, allocating subordinates to more desirable positions, or helping subordinates be promoted. Moreover, in our context workers' productivity is precisely measured, so there is also no scope for managers to show favoritism through subjective evaluations of workers. In general, managers will have more margins along which to favor workers and all such activities will affect the firm's overall performance.

Perhaps the most important consideration is that in other settings, the allocative effect of social connections on managerial effort might be beneficial. As emphasized throughout, social connections can reduce informational asymmetries, facilitate joint problem solving, and provide managers the ability to motivate workers through social rewards and punishments. In our context, the tasks workers undertake are relatively simple and so any potential benefits that social connections have for problem solving or improved communication more generally, are likely to be small. In other settings, the productivity enhancing

effects of social connections might dominate the inefficiency due to favoritism. For example Ichniowski and Shaw (2005) presented evidence from steel finishing lines—a relatively complex task that involves problem solving—of such positive effects of improved communication within and between tiers of the firm hierarchy.[43]

The fact that managers devote effort to increase the productivity of connected workers, even when they are paid fixed wages, suggests that social connections between managers and workers can provide an alternative, and possibly cheaper, mechanism to the provision of monetary incentives. It may thus be in a firm's best interests to foster social ties between management and workers. Indeed many firms are observed devoting resources toward such bonding exercises. On a related note, the fact that managers behave as if they derive utility from helping connected workers implies that being socially connected to their subordinates lowers the managers' participation constraint and thus the firm's wage bill may be reduced. However, this strategy may be suboptimal if it leads to the self-selection of lower quality managers to the firm over time.[44]

More generally, our findings provide support for the idea that interplays between social relationships and incentives within firms need to be taken into account in order to understand how individuals respond to a given set of incentives and to understand the optimal set of incentives within an organization. Differences in the social organization of the workplace might therefore explain part of the productivity differences among otherwise observationally similar firms.

APPENDIX

A.1. *Proofs*

PROOF OF PROPOSITION 1: As the manager's payoff function $(b + \sigma_h) \times \theta k(\sigma_h)m_h + (b + \sigma_l)k(\sigma_l)m_l - C(m_h + m_l)$ is linear in (m_h, m_l), the manager will target only the worker that yields the highest marginal benefit.[45] The

[43]Related work, Nagin, Rebitzer, Sanders, and Taylor (2002) presented evidence from a field experiment in a call center that exogenously varied the probability that employees would be monitored by managers. Their results suggest that management's "perceived empathy and fairness" in dealing with employees may play an important role in reducing workplace opportunism. Other beneficial effects of social capital within firms have also been discussed in the sociology literature. These include potentially better hiring outcomes through the use of referrals by current employees (Fernandez, Castillo, and Moore (2000)).

[44]Social connections within firms are just one alternative to using monetary incentives to solve agency problems. There is a growing theoretical and empirical literature on the relationship between intrinsic and extrinsic motivation (Frey and Oberholzer-Gee (1997), Kreps (1997), Bénabou and Tirole (2003)).

[45]This property would of course be retained if workers also chose their effort level. The analysis would however be more cumbersome as the worker's effort level would depend on the manager's and vice versa.

manager chooses $\bar{m}$ if and only if $\{\max[\theta k_h(b+\sigma_h), k_l(b+\sigma_l)]\}(\bar{m}-1) > c$. The right-hand side is increasing in (σ_h, σ_l), which proves the first part of the proposition, that the existence of social connections weakly increases the level of managerial effort.

The manager allocates her effort to worker i if and only if $(b+\sigma_i)\theta k(\sigma_i) \geq (b+\sigma_j)k(\sigma_j)$. There are two cases to consider. If $\sigma_h = \sigma$ and $\sigma_l \in \{\sigma, 0\}$, that is, if the manager is socially connected to both workers or only the high ability worker, she targets the high ability worker for all other parameter values. If $\sigma_h = 0 < \sigma_l = \sigma$, that is, if the manager is connected only to the low ability worker, she targets the high ability worker if and only if $k < \frac{b\theta}{b+\sigma}$. This proves the second part of the proposition, that there exists a part of the parameter space in which the existence of social connections alters the allocation of managerial effort in favor of the worker the manager is connected to. *Q.E.D.*

PROOF OF PROPOSITION 2: As m is weakly increasing in (σ_h, σ_l) and the firm's average productivity, $\frac{1}{2}(\theta k(\sigma_h)m_h + k(\sigma_l)m_l)$, is increasing in m, the levels effect of social connections is weakly positive.

For any given level of effort, if $\sigma_h = \sigma$ and $\sigma_l \in \{\sigma, 0\}$, then the manager targets the high ability worker only and the allocation effect is positive as productivity is equal to $\theta k m_h > \theta m_h$. This proves the first part of the proposition that if the manager is connected to the high ability worker, the effect of social connections on the firm's productivity is unambiguously positive.

If $\sigma_h = 0 < \sigma_l = \sigma$ and $\frac{b\theta}{b+\sigma} < k < \theta$, the allocation effect is negative, namely the manager targets the low ability worker although targeting the high ability worker would yield higher output.[46] The net effect of the existence of social connections on the firm's productivity then depends on the balance between the levels effect and the allocation effect. If $m(\sigma_h = 0, \sigma_l = 0) = m(\sigma_h = 0, \sigma_l = \sigma)$, namely if the manager chooses the same level of effort regardless of social connections, the allocation effect dominates and the effect of social connections is unambiguously negative. If $m(\sigma_h = 0, \sigma_l = 0) < m(\sigma_h = 0, \sigma_l = \sigma)$, the firm's productivity is equal to θ when $\sigma_h = 0$, $\sigma_l = 0$ and equal to $k\bar{m}$ when $\sigma_h = 0$, $\sigma_l = \sigma$. This proves the second part of the proposition that if the manager is connected only to the low ability worker and targets him, social connections reduce firm's productivity if $k < \frac{\theta}{\bar{m}}$. *Q.E.D.*

A.2. *Identification: The COO's Allocation Algorithm*

We present evidence in support of the first identifying assumption that the allocation algorithm used by the COO to assign workers to tasks and workers to managers does not change with the introduction of managerial performance bonuses. We proceed in four steps. First, we compare the allocation of

[46]Total output is equal to θm when the manager is not connected to either worker and is equal to km when she is connected to the low ability worker. Thus, for any level of m, output is lower when the manager is connected.

the connected workers we focus on for our main analysis to the allocation of unconnected workers. Second, we analyze the determinants of the level of social connections C_{ift} and test whether their effect changes after the change in incentive scheme. Third, we test whether the COO is more likely to assign connected workers to some managers rather than others and whether this changes after the change in incentive scheme. Finally, we exploit the fact that some dimensions of connectivity, such as nationality, are more easily observable to the COO than others, such as time of arrival. If such sorting biases the estimates, we should find the effect of social connections to be mostly driven by dimensions that are easier to observe.

A.2.1. *Connected versus Unconnected Workers*

We estimate the probability of a given worker being selected into employment by the COO while controlling for farm level variables that affect the probability of being hired independently of the incentive scheme in place. These farm level variables measure the supply and demand of labor.

We measure labor supply using personnel records on the number of workers available for hire on the farm on any given day. We measure the demand for labor using the total daily fruit yield on each site on the farm. The total yield is orthogonal to the incentive scheme as it is determined by planting decisions taken one or two years earlier. Fields are located on two sites, of which we use the largest for the analysis as fruit in the smaller site begins to ripen only after the introduction of the performance bonus scheme. However, as both sites hire workers from the same pool, we control for yields in each site separately. We then estimate the following conditional logit model, where observations are grouped by worker:

$$\Pr(p_{it} = 1) = \Lambda(B_t, B_t \times C_i, X_t^D, X_t^S, X_{it}). \tag{8}$$

$p_{it} = 1$ if worker i is selected by the COO to pick on day t on the main site and $= 0$ if they are assigned to nonpicking tasks. B_t is the performance bonus dummy, C_i is a dummy variable equal to 1 if worker i is socially connected to any of the managers along any dimension of nationality, arrival cohort, and living site, and equal to 0 otherwise. X_t^D and X_t^S proxy the demand and supply of labor on day t. To allow for workers' previous performance to affect their probability of being selected, X_{it} measures worker i's productivity on the last day she picked, in percentage deviation from the mean productivity on that day, to remove the effects of factors that determine the productivity of all workers and are beyond the worker's control.[47]

[47]We first take the deviation of the worker's productivity from the field average productivity on each field he picked on the day he was last selected to pick, and then calculate a weighted average of this across all fields he worked on where the weights are based on the number of pickers on the field.

TABLE A.I

SOCIAL CONNECTIONS, MANAGERIAL INCENTIVES, AND THE COO'S ALLOCATION ALGORITHM[a]

	Probability of Being Selected to Pick[b]	Probability of Being Unemployed[c]
Performance bonus for managers	1.34	2.04*
	(.495)	(.764)
Performance bonus for managers × worker *i* is socially connected	.524	.605
	(.214)	(.253)
Total yield in site 1	2.24***	.802***
	(.153)	(.057)
Total yield in site 2	.883***	.800***
	(.036)	(.032)
Number of workers available to pick fruit	.380***	1.83***
	(.037)	(.178)
Worker *i*'s previous deviation from mean productivity	1.16*	1.07
	(.091)	(.107)
Log-likelihood	−5186.8	−3208.5
Number of observations (worker-day)	15,551	9808

[a]Standard errors are given in parentheses, clustered by worker. *** denotes that the log odds ratio is significantly different from 1 at 1%, ** at 5%, and * at 10% levels. Conditional logit estimates are reported where observations are grouped by worker. All continuous variables are divided by their standard deviations so that one unit increase can be interpreted as increase by one standard deviation. A manager and given worker *i* are defined to be connected if they are either of the same nationality, live in the same area, or are in the same arrival cohort. "Total yield" on the site is the total kilograms of the fruit picked on the site-day. The "number of workers available to pick fruit" is the total number of individuals that are on the farm that day and are available for fruit picking. "Worker i's previous deviation from mean productivity" is defined on the last day the worker was selected to pick. We first take the deviation of the worker's productivity from the field average productivity on each field he picked on the day he was last selected to pick, and then calculate a weighted average of this across all fields he worked on where the weights are based on the number of pickers on the field. Worker *i* is defined to be unemployed on day *t* if she is present on the farm but is not assigned to any paid tasks.

[b]Dependent variable = 1 if worker *i* is chosen to pick on day *t* in main site, =0 if worker is assigned to nonpicking tasks.

[c]Dependent variable = 1 if worker *i* is unemployed on day *t*, =0 if assigned to nonpicking tasks.

All continuous variables are divided by their standard deviations so that one unit increase can be interpreted as an increase of 1 standard deviation. We report odds ratios throughout; standard errors are calculated using the delta method.

Data column 1 of Table A.I shows that, other things being equal, there is no differential effect on socially connected or unconnected workers of being selected to pick fruit after the introduction of the managerial performance bonus. Namely, the coefficient is not significantly different from 1. The other coefficients show that, as expected, workers are more likely to be assigned to fruit picking tasks on days in which the fields on the main site bear more fruit (namely, the coefficient of X_t^D is significantly larger than 1) and on days in which they face less competition from other workers (namely, the coefficient of X_t^S is significantly smaller than 1).

Conditional on not being selected to pick on the main site on a given day, a worker can either be assigned to other tasks on the main site, to work on the other site, or be left unemployed for the day. The next specification checks whether the assignment of workers to nonpicking tasks varies differentially by socially connected and unconnected workers when the performance bonus is introduced. The result in data column 2 again shows there to be no such differential effect of the COO's decision across workers based on their social connection to managers. The pattern of other coefficients confirms that the introduction of the bonus scheme significantly raises the probability of being unemployed. As expected, the probability of being unemployed for the day is lower when yields are higher and when the stock of available workers is lower.

A.2.2. *Determinants of Social Connections*

To provide evidence that field-day and worker-field-day specific determinants of productivity do not predict the level of social connections C_{ift} differently under the two managerial incentive schemes, we estimate regressions of the form

$$C_{ift} = \alpha_i + \lambda_f + \upsilon B_t + [(\phi_0 + \phi_1 B_t) \times X_{ift}] + [(\varphi_0 + \varphi_1 B_t) \times Z_{ft}] + \sum_{s \in M_{ft}} \mu_s S_{sft} + u_{ift}, \tag{9}$$

where B_t is the bonus dummy, X_{ift} captures worker i's time-varying characteristics, and Z_{ft} captures several time-varying field characteristics, such as the field life cycle, a time trend, worker's tenure on the farm, the number of workers on the field, the number of managers on the field, the total man hours worked on the field, and the total kilos of fruit picked. Our identifying assumption requires $\phi_1 = \varphi_1 = 0$. It is reassuring that we fail to reject the null of zero coefficients in all cases.[48]

A.2.3. *The Allocation of Workers to Managers*

Finally, we present evidence on whether managers can influence the composition of the group of workers they are allocated to and, in particular, whether

[48]Three other pieces of evidence also suggest that farm operations do not change over the two halves of the season. First, the ratio of workers to managers does not change significantly, remaining at 20 throughout. Second, at the field-day level, the average share of workers who are socially connected to managers does not change significantly over the two halves of the season, neither does the variation in this share between fields on the same day. This suggests workers do not become sorted into fields by social connections over time. Third, using the estimated worker fixed effect from (3), $\widehat{\alpha}_i$, as a measure of a worker's ability, we find that groups of workers on the field-day are equally heterogeneous before and after the change in managerial incentives. Hence there is no evidence the COO sorts workers differently by ability into fields postbonus.

the composition of workers they are assigned differs after the change in managerial incentives. To begin with we note that Table I indicates that workers are equally likely to be connected to managers under both schemes. This is inconsistent with the hypothesis that managers can affect the share of connected workers in their group and choose a different share after the introduction of the bonus. To provide further evidence on this point we test whether some managers are significantly more likely to be assigned connected workers and whether this changes after the introduction of the bonus. Note that since some nationalities are more numerous than others, some managers are mechanically connected to more workers. However, we are interested in establishing whether different managers are more or less likely to be assigned to workers they are connected to, regardless of the total number of workers they are connected to. To do so, we construct a data set at the manager-field-day level and estimate the following,

$$Z_{sft} = \sum_{s \in M_{ft}} \mu_s S_{sft} + \sum_{s \in M_{ft}} v_s (S_{sft} \times B_t) + \zeta_{sft}, \tag{10}$$

where Z_{mft} is the log of the ratio of the number of workers connected to manager m present on field-day ft over the total number of workers connected to manager m who are working on day t. The numerator thus represents the number of connected workers the manager is assigned to, whereas the denominator is the number of workers the managers could have potentially been assigned to on day t. All other controls are as previously defined.

We test two hypotheses: (i) $H_0 : \mu_s = 0$ for all s, namely all managers are equally likely to be assigned connected workers when they are paid fixed wages, and (ii) $H_0 : v_s = 0$ for all s, namely the allocation does not change after the introduction of the bonus. The p-values for these hypotheses are .64 and .94, respectively, so we cannot reject either hypothesis. Hence there is no evidence the COO treats managers differently before and after the bonus or that some managers are more able to be allocated to connected workers while others are not.

A.2.4. *Observability of Social Connections*

A final check on whether the COO intentionally sorts managers and workers into fields on the basis of their social connections is based on the intuition that some dimensions of connectivity, such as nationality, are more easily observable to the COO than others, such as time of arrival. If such sorting biases the estimates, we should find the effect of social connections to be mostly driven by dimensions that are easier to observe.

In Table A.II we estimate a specification analogous to (3) that separately controls for each dimension of social connectivity. To compare the magnitudes of the coefficients, we consider the implied effect on worker productivity of a 1 standard deviation increase in each of the connectivity measures from its

TABLE A.II

SOCIAL CONNECTIONS AND MANAGERIAL INCENTIVES

	Type of Social Connection
Share of managers of same nationality as *i*, fixed wages for managers	.162***
	(.045)
Share of managers of same nationality as *i*, performance bonus for managers	−.075
	(.134)
Share of managers living in same area as *i*, fixed wages for managers	.087*
	(.049)
Share of managers living in same area as *i*, performance bonus for managers	−.070
	(.071)
Share of managers of same arrival cohort as *i*, fixed wages for managers	.309***
	(.088)
Share of managers of same arrival cohort as *i*, performance bonus for managers	−.079
	(.142)
Interactions of nationality × performance bonus dummy	Yes [.068]
Interactions of living site × performance bonus dummy	Yes [.000]
Interactions of arrival cohort × performance bonus dummy	Yes [.000]
Interactions of worker fixed effect × performance bonus dummy	No
Field-date fixed effects	No
Adjusted *R*-squared	.4366
Number of observations (worker-field-day)	8884

[a]Dependent variable = log of worker's productivity (kilograms picked per hour on the field-day). *** denotes significance at 1%, ** at 5%, and * at 10%. Standard errors are reported in parentheses and allow for clustering at the worker level. All specifications control for worker, field, and manager fixed effects. The other controls include the managerial performance bonus dummy, the worker's picking experience, the field life cycle, a time trend, and interactions between the performance bonus dummy and the worker's nationality, arrival cohort, and living site. The field life cycle is defined as the *n*th day the field is picked divided by the total number of days the field is picked over the season. All continuous variables are in logarithms. At the foot of the column we report the *p*-value on the *F*-test on the joint significance on the interaction terms with the performance bonus dummy.

mean. We find that when managers are paid a fixed wage, the productivity of a given worker is 4.6%, 1.5%, and 3.3% higher when the share of managers he is connected to by nationality, living site, and arrival cohort, respectively, is 1 standard deviation higher. The magnitude of the effect is thus similar for dimensions that can be observed—nationality—and for dimensions that cannot be easily observed—arrival cohort. If we compare the effect of the same change across different connection measures, the magnitude of the effect is actually the largest for the dimension that is least observable—arrival cohort. This provides further evidence against the hypothesis that the COO sorts managers and workers into fields on the basis of their social connections. Finally, social connections along any dimension do not affect worker productivity when managers are paid a performance bonus.[49]

[49]We chose to measure social connections along the dimensions of nationality, living site, and time of arrival in order to capture social links that form for different reasons and, indeed, the

A.3. *Identification: Time Effects*

We now present evidence in support of the second identifying assumption that any effect of social connections on individual productivity unrelated to the managerial incentive scheme in place remains unchanged over time. If not, then in the baseline specification (3), $\widehat{\gamma}_0$ and $\widehat{\gamma}_1$ may simply pick up that the effect of social connections naturally dies out over time, rather than because managers change their behavior when they are paid performance bonuses. For example, managers may initially favor some workers in order to befriend them. Similarly workers may initially work hard under some managers in order to befriend them. This would explain the pattern of coefficients we find in the data and then suggest social connections do not distort managerial effort in the long run.

In Table A.III we analyze whether the effects of social connections on worker productivity naturally disappear over time. In column 1 we split both the pre- and postperformance bonus periods into halves and allow the effect of connections to change within the pre- and postbonus periods. Intuitively, if the effect of social connections were naturally declining over time, we would expect it to be higher in the first half of the prebonus period than in the second half, and again higher in the first half of the postbonus period than in the second half. Column 1 shows that, in contrast, there is no change in the effect of social connections within each period. Rather, the effect of social connections on worker productivity disappears discontinuously with the introduction of the performance bonus for managers.

A second concern is that $\widehat{\gamma}_0$ and $\widehat{\gamma}_1$ might pick up that later in the field life cycle there is less variation in the fruit available across different rows and so managers have no means by which to favor connected workers, even though they prefer to do so. To check for this, in column 2 we allow the effect of social connections to vary with a field specific time trend—the field life cycle. We do not find statistically significant evidence that the effect of social connections diminishes within a field over time.

A third time related concern is that the true social ties between a worker and his managers are measured with error using C_{ift} which is based on three particular dimensions. This measurement error is nonclassical because it increases over time if workers learn they are better off being socially connected to managers and so invest more into forming social ties with managers over time, irrespective of whether they are of the same nationality, living site, and arrival cohort. If so, we should find the effect of C_{ift} to diminish with the time the worker has spent on the farm. In column 3 we allow the effect of social connections to vary with a worker specific time trend—the number of days the worker has been present on the farm. There is no significant evidence of such effects, although the interaction terms are not precisely estimated.

---

correlation among the three measures is very low. In line with this we find their estimated effect on productivity to be the same, regardless of whether they are included together or one at a time.

TABLE A.III

ROBUSTNESS OF RESULTS TO TIME EFFECTS[a]

	1. Farm Specific Time Trend	2. Field Specific Time Trend	3. Worker Specific Time Trend	4. Placebo Bonus Based on Field Life Cycle	5. Placebo Bonus Based on 2004 Season
Share of managers connected to *i*, fixed wages for managers	.165***	.188***	.269***		
	(.043)	(.067)	(.094)		
Share of managers connected to *i*, performance bonus for managers	−.037	−.003	.345		
	(.092)	(.116)	(.511)		
Share of managers connected to *i*, fixed wages for managers × 2nd quarter dummy (31st May)	−.018				
	(.076)				
Share of managers connected to *i*, performance bonus for managers × 4th quarter dummy (29th July)	−.133				
	(.099)				
Share of managers connected to *i*, fixed wages for managers × field life cycle		−.089			
		(.141)			
Share of managers connected to *i*, performance bonus for managers × field life cycle		−.249			
		(.200)			
Share of managers connected to *i*, fixed wages for managers × days on farm for worker *i*			−.047		
			(.035)		
Share of managers connected to *i*, performance bonus for managers × days on farm for worker *i*			−.109		
			(.132)		
Share of managers connected to *i*, placebo bonus based on field life cycle = 0				−.087	
				(.081)	
Share of managers connected to *i*, placebo bonus based on field life cycle = 1				−.033	
				(.138)	

(*Continues*)

TABLE A.III—*Continued*

	1. Farm Specific Time Trend	2. Field Specific Time Trend	3. Worker Specific Time Trend	4. Placebo Bonus Based on Field Life Cycle	5. Placebo Bonus Based on 2004 Season
Share of managers connected to *i*, placebo bonus 2004 = 0					.201*
					(.109)
Share of managers connected to *i*, placebo bonus 2004 = 1					.215***
					(.033)
Interactions of nationality × performance bonus dummy	Yes	Yes	Yes	Yes	Yes
Interactions of living site × performance bonus dummy	Yes	Yes	Yes	Yes	Yes
Interactions of arrival cohort × performance bonus dummy	Yes	Yes	Yes	Yes	Yes
Adjusted *R*-squared	.4374	.4524	.4368	.6260	.4532
Number of observations (worker-field-day)	8884	8884	8884	1584	2692

[a]Dependent variable = log of worker's productivity (kilograms picked per hour on the field-day). *** denotes significance at 1%, ** at 5%, and * at 10%. Standard errors are reported in parentheses and allow for clustering at the worker level. All specifications control for worker, field, and manager fixed effects. The other controls included in each specification are the managerial performance bonus dummy, the worker's picking experience, the field life cycle, and a time trend. The field life cycle is defined as the *n*th day the field is picked divided by the total number of days the field is picked over the season. All continuous variables are in logarithms. A manager and given worker *i* are defined to be connected if they are either of the same nationality, live in the same area, or are in the same arrival cohort. All sample workers are connected to at least one manager on at least one field-day and work at least one week under each incentive scheme. In column 1 the 2nd quarter dummy is defined to be equal to 0 before May 31st and equal to 1 thereafter. The 4th quarter dummy is defined to be equal to 0 before July 29th and equal to 1 thereafter. These dummy variables split the pre- and postbonus periods equally into two halves. In column 3 the days on the farm for a worker are defined as the number of days elapsed since the worker first arrived on the farm. In column 4 the placebo bonus dummy based on the field life cycle is defined to be 0 if the field is less than .53 of the way though its life cycle, and 1 otherwise. In this column the sample is restricted to fields that are only operated in the period when managers are paid a performance bonus (after June 27th). In column 5, the sample covers the same period of time (May 1st to Aug 31st) in the following year—2004—when managers were paid wages throughout. The placebo bonus is equal to 1 after June 27, 2004. The interaction terms at the foot of the table are defined with respect to the placebo bonus dummy variable in columns 4 and 5.

Overall, the evidence in columns 1–3 indicates that the effect of social connections does not decline smoothly with time, field specific trends, or worker specific trends. Rather there is a discontinuous effect of social connections on worker performance at the time when managerial performance bonuses were introduced. Given that we had full control over the timing of this change, our experimental research design ensures that the exact date on which the managerial incentive schemes changed is uncorrelated with any determinants of individual productivity.

To provide further support, columns 4 and 5 report the results of two placebo tests. Column 4 uses fields that were picked only after the introduction of the bonus and are therefore excluded from our main sample. Given that in our sample the bonus is introduced when the average (and median) field is half the way through its life cycle, we define a placebo bonus dummy to be equal to 0 if the field is in the first half of its life cycle and equal to 1 if it is in the second half. The results in column 4 indicate that social connections have no effect on worker productivity either side of the placebo dummy, thus ruling out that our previous results were due to the effect of social connections naturally disappearing once fields have reached half of their life cycle.

Column 5 uses data from the same tasks in the same farm one year later, namely in 2004, when the managers were paid fixed wages throughout the season. We define the placebo bonus dummy to be equal to 0 before the date bonuses were introduced in 2003 (June 27th) and equal to 1 thereafter. All variables are defined as in (3) and the sample is selected according to the same criteria.[50] It is reassuring that column 5 shows that the effect of social connections during the entire 2004 season is of similar magnitude to the effect before the introduction of the bonus in 2003. In other words, in 2004 when managers are paid fixed wages throughout the season, they appear to allocate more effort toward connected workers throughout the season.

REFERENCES

AKERLOF, G. A. (1982): "Labor Contracts as a Partial Gift Exchange," *Quarterly Journal of Economics*, 97, 543–569. [1050]

AKERLOF, G. A., AND J. L. YELLEN (1988): "Fairness and Unemployment," *American Economic Review Papers and Proceedings*, 78, 44–49. [1050]

BANDIERA, O., I. BARANKAY, AND I. RASUL (2005): "Social Preferences and the Response to Incentives: Evidence From Personnel Data," *Quarterly Journal of Economics*, 120, 917–962. [1050]

——— (2007): "Incentives for Managers and Inequality Among Workers: Evidence From a Firm Level Experiment," *Quarterly Journal of Economics*, 122, 729–774. [1050,1071]

——— (2008): "Social Capital in the Workplace: Evidence on Its Formation and Consequences," *Labor Economics*, 15, 724–748. [1062]

[50]Namely, we select workers that work at least one week on either side of the placebo bonus and fields that are operated for at least one week either side. We restrict the sample to the peak picking season (May 1 to August 31) and to the main site.

BARNARD, C. (1938): *The Functions of the Executive*. Cambridge, MA: Harvard University Press. [1047]

BECKER, G. S. (1957): *The Economics of Discrimination*. Chicago: University of Chicago Press. [1050]

BÉNABOU, R., AND J. TIROLE (2003): "Intrinsic and Extrinsic Motivation," *Review of Economic Studies*, 70, 489–520. [1082]

BERTRAND, M., AND A. SCHOAR (2003): "Managing With Style: The Effect of Managers on Firm Policies," *Quarterly Journal of Economics*, 118, 1169–1208. [1049]

BERTRAND, M., F. KRAMARZ, A. SCHOAR, AND D. THESMAR (2005): "Politically Connected CEOs and Corporate Outcomes: Evidence From France," Mimeo, University of Chicago. [1050]

BEWLEY, T. F. (1999): *Why Wages Don't Fall During a Recession*. Cambridge, MA: Harvard University Press. [1047]

BLACK, S. E., AND P. STRAHAN (2001): "The Division of Spoils: Rent Sharing and Discrimination in a Regulated Industry," *American Economic Review*, 91, 814–831. [1050]

CHARNESS, G., AND P. KUHN (2005): "Pay Inequality, Pay Secrecy, and Effort: Theory and Evidence," Mimeo, University of California, Santa Barbara. [1050]

FEHR, E., AND U. FISCHBACHER (2002): "Why Social Preferences Matter—The Impact of Non-Selfish Motives on Competition, Cooperation and Incentives," *Economic Journal*, 112, C1–C33. [1050]

FERNANDEZ, R. M., E. J. CASTILLO, AND P. MOORE (2000): "Social Capital at Work: Networks and Employment at a Phone Center," *American Journal of Sociology*, 105, 1288–1356. [1082]

FREY, B. S., AND F. OBERHOLZER-GEE (1997): "The Cost of Price Incentives: An Empirical Analysis of Motivation Crowding-Out," *American Economic Review*, 87, 746–755. [1082]

GARICANO, L., I. PALACIOS, AND C. PRENDERGAST (2005): "Favoritism Under Social Pressure," *Review of Economics and Statistics*, 87, 208–216. [1050]

GIULIANO, L., D. I. LEVINE, AND J. LEONARD (2005): "Do Race, Gender, and Age Differences Affect Manager-Employee Relations? An Analysis of Quits, Dismissals, and Promotions at a Large Retail Firm," Mimeo, University of California, Berkeley. [1050]

HARRISON, G., AND J. LIST (2004): "Field Experiments," *Journal of Economic Literature*, 152, 1009–1055. [1055]

HOLMSTROM, B., AND P. MILGROM (1991): "Multitask Principal–Agent Analyses: Incentive Contracts, Asset Ownership, and Job Design," *Journal of Law, Economics and Organization*, 7, 24–52. [1055]

ICHNIOWSKI, C., AND K. L. SHAW (2005): "Connective Capital: Building Problem-Solving Networks Within Firms," Mimeo, Stanford University. [1082]

KANDEL, E., AND E. LAZEAR (1992): "Peer Pressure and Partnerships," *Journal of Political Economy*, 100, 801–813. [1047]

KOFMAN, F., AND J. LAWARREE (1993): "Collusion in Hierarchical Agency," *Econometrica*, 61, 629–656. [1048]

KRAMARZ, F., AND D. THESMAR (2005): "Social Networks in the Boardroom," Discussion Paper 5496, CEPR. [1050]

KREPS, D. M. (1997): "The Interaction Between Norms and Economic Incentives: Intrinsic Motivation and Extrinsic Incentives," *American Economic Review Papers and Proceedings*, 87, 359–364. [1082]

LABAND, D. N., AND M. J. PIETTE (1994): "Favoritism versus Search for Good Papers: Empirical Evidence Regarding the Behavior of Journal Editors," *Journal of Political Economy*, 102, 194–203. [1050]

LAZEAR, E. P. (1989): "Pay Equality and Industrial Politics," *Journal of Political Economy*, 97, 561–580. [1047]

MALMENDIER, U., AND G. TATE (2005): "CEO Overconfidence and Corporate Investment," *Journal of Finance*, 60, 2661–2700. [1049]

MAYO, E. (1933): *The Human Problems of an Industrial Civilization*. New York: Macmillan. [1047]

MIAN, A. R., AND A. I. KHWAJA (2005): "Do Lenders Favor Politically Connected Firms? Rent Provision in an Emerging Financial Market," *Quarterly Journal of Economics*, 120, 1371–1411. [1050]

MILGROM, P. R. (1988): "Employment Contracts, Influence Activities, and Efficient Organization Design," *Journal of Political Economy*, 96, 42–60. [1048]

MILGROM, P. R., AND J. ROBERTS (1990): "The Efficiency of Equity in Organizational Decision Processes," *American Economic Review Papers and Proceedings*, 80, 154–159. [1048]

NAGIN, D., J. B. REBITZER, S. SANDERS, AND L. J. TAYLOR (2002): "Monitoring, Motivation, and Management: The Determinants of Opportunistic Behavior in a Field Experiment," *American Economic Review*, 92, 850–873. [1082]

PODOLNY, J. M., AND J. N. BARON (1997): "Resources and Relationships: Social Networks and Mobility in the Workplace," *American Sociological Review*, 62, 673–693. [1048]

PRENDERGAST, C., AND R. H. TOPEL (1996): "Favoritism in Organizations," *Journal of Political Economy*, 104, 958–978. [1048,1057]

ROETHLISBERGER, F. J., AND W. DICKSON (1939): *Management and the Worker*. Cambridge: Harvard University Press. [1047]

ROTEMBERG, J. J. (1994): "Human Relations in the Workplace," *Journal of Political Economy*, 102, 684–717. [1047]

ROY, D. (1952): "Quota Restriction and Goldbricking in a Machine Shop," *American Journal of Sociology*, 57, 427–442. [1047]

TIROLE, J. (1986): "Hierarchies and Bureaucracies: On the Role of Collusion in Organizations," *Journal of Law, Economics and Organizations*, 2, 181–214. [1048]

THOMAS, D. A. (1990): "The Impact of Race on Managers' Experiences of Developmental Relationships," *Journal of Organizational Behavior*, 11, 479–492. [1048]

TSUI, A. S., AND C. A. OREILLY (1989): "Beyond Simple Demographic Effects: The Importance of Relational Demography in Superior-Subordinate Dyads," *Academy of Management Journal*, 32, 402–423. [1048]

WESOLOWSKI, M. A., AND K. W. MOSSHOLDER (1997): "Relational Demography in Supervisor-Subordinate Dyads: Impact on Subordinate Job Satisfaction, Burnout, and Perceived Procedural Justice," *Journal of Organizational Behavior*, 18, 351–362. [1048]

Dept. of Economics, London School of Economics and Political Science, Houghton Street, London WC2A 2AE, U.K.; o.bandiera@lse.ac.uk,

The Wharton School, University of Pennsylvania, 3620 Locust Walk, Philadelphia, PA 19104, U.S.A.; barankay@wharton.upenn.edu,

and

Dept. of Economics, University College London, Drayton House, 30 Gordon Street, London WC1E 6BT, U.K.; i.rasul@ucl.ac.uk.

Manuscript received May, 2006; final revision received December, 2008.