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## Social connections and incentives in the workplace: evidence from personnel data

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# **Social Connections and Incentives in the Workplace: Evidence from Personnel Data**

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## ABSTRACT

### **Social Connections and Incentives in the Workplace: Evidence from Personnel Data<sup>\*</sup>**

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 towards 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.

JEL Classification: J33, M52, M54

Keywords: favoritism, managerial incentives, natural field experiment

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# 1 Introduction

This paper explores the effects of social relationships between individuals within a firm, on the productivity of individuals, and 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 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.<sup>1</sup> However it is reasonable to 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).<sup>2</sup>

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 non-monetary incentives to workers, or help reduce informational asymmetries within the firm. On the other hand, managers may display favoritism towards workers they are socially connected with, and this might be detrimental to the firm's overall performance.<sup>3</sup>

In this paper, we present evidence on whether the existence of social connections between workers and managers affect 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

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<sup>1</sup>Lazear (1989), Kandel and Lazear (1992), and Rotemberg (1994) develop models incorporating social concerns into the analysis of behavior within firms. While they emphasize 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) offers 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.

<sup>2</sup>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).

<sup>3</sup>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 the firm influence within firm promotions (Podolny and Baron 1997).

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 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, to 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.<sup>4</sup>

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 towards 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

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<sup>4</sup>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).

performance pay increases the productivity of high ability workers, especially when they are not connected 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 *et al* 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 *et al* 2005), and how the demographic differences between managers and their subordinates affect the subordinates' rate of quits, dismissals and promotions (Giuliano *et al* 2005).<sup>5,6</sup> 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 exploit 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.

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

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<sup>5</sup>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 *et al* 2005, Kramarz and Thesmar 2005, Mian and Khwaja 2005). In non firm settings, Garicano *et al* (2005) present evidence from soccer matches on how referees favor home teams in order to satisfy the crowds in the stadium. Laband and Piette (1994) show 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.

<sup>6</sup>Fehr and Fischbacher (2002) provide 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 view 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).

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 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 UK 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.<sup>7</sup> 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 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.<sup>8</sup>

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 of the managerial effort targeted towards him.

Managers are each assigned a group of around twenty 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

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<sup>7</sup>Their work permit allows them to work on other UK 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.

<sup>8</sup>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 non-picking 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*.



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.<sup>9</sup>

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 to. 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 whom 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 whom 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 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.<sup>10</sup>

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 towards 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 five 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.<sup>11</sup>

We now discuss the two features of this work environment that allow us to assess whether

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<sup>9</sup>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.

<sup>10</sup>The disposition of plants in the field is such that it is not practical for workers to retain a stock of empty crates.

<sup>11</sup>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.

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 non-picking tasks such as planting and weeding.<sup>12</sup>

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 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, whom we refer to as the chief operating officer (COO).<sup>13</sup>

## 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.<sup>14</sup>

The bonus payment was awarded on field  $f$  and day  $t$  if the workers average productivity on the field-day,  $\bar{Y}_{ft}$ , exceeded an exogenously fixed threshold,  $Y^*$ . Conditional on reaching the threshold, the total monetary value of the bonus payment available to the managers,  $B(\bar{Y}_{ft})$  increases at an increasing rate in the average field-day productivity. The personnel software does not allow to record the exact match between workers and managers within the field-day, 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,

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<sup>12</sup>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

<sup>13</sup>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.

<sup>14</sup>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.

each obtains a payment of  $\frac{1}{M_{ft}}B(\bar{Y}_{ft})$ .<sup>15</sup>

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  $1.5 \sum_f \frac{1}{M_{ft}}B(\bar{Y}_{ft})$ .

The introduction of the bonus might affect managers' behavior through three channels – (i) because they now have a stake in 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 multi-tasking concerns (Holmstrom and Milgrom 1991), the performance bonus was not awarded if the quality of fruit picking declined.<sup>16</sup>

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.<sup>17,18</sup>

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, to his productivity on field-days in which he is not socially connected to his manager. We

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<sup>15</sup>The bonus payment schedule is piecewise linear;

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

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  $B(\bar{Y}_{ft})$  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.

<sup>16</sup>Quality is defined along two dimensions – (i) the quantity of damaged fruit; (ii) fruit has to be classified 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 pre-established norm, then the bonus was not awarded.

<sup>17</sup>Given that – (i) managers are from Eastern Europe; (ii) their base pay is 20% higher than the UK minimum wage; (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 UK 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.

<sup>18</sup>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.

exploit the exogenous variation in managerial incentives our research design provides to identify whether the effects of social connections depend on the managerial incentive 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 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 towards 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 towards worker  $i$  affects worker  $i$  alone. The output of worker  $i$  is then given by  $y_i = \theta_i k_i m_i$ , where  $\theta_i$  measures his innate ability,  $m_i$  is the managerial effort targeted towards 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  $\theta$  and 1, with  $\theta > 1$ , and index them with subscripts  $h$  and  $l$  for high and low ability respectively.<sup>19</sup>

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  $c > 0$  if effort is high.<sup>20</sup>

The productivity of worker  $i$ , measured as the kilograms of fruit picked per hour. As all workers in the field work for the same time, we normalize hours to one 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

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<sup>19</sup>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 non-targeted 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  $j$ .

<sup>20</sup>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 workers to reallocate does not depend on the ability of the worker that gets reallocated.

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  $p^M = f + b\bar{Y}$ , where  $f$  is a fixed wage and  $\bar{Y} = \sum_i y_i$  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,

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

where  $\sigma_i$  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 manager's altruism towards 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.<sup>21</sup>

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 ( $\sigma_i = 0$ ).

### 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,

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

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

**Proposition 1:** *Social connections weakly increase the level of managerial effort and might*

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<sup>21</sup>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 others. We also focus on the case in which  $\sigma \geq 0$ . A negative weight could be interpreted as the manager being spiteful towards the worker.

*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 that yields the highest marginal benefit.<sup>22</sup>

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 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 towards him.

In this second case, social connections distort the allocation of managerial effort towards low ability workers and might therefore be detrimental to the firm overall. Whether social connections are beneficial or detrimental for the 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 levels 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.<sup>23</sup>

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<sup>22</sup>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  $(\sigma_h, \sigma_l)$ . In a model with continuous managerial effort and convex costs, the effect of social connections on managerial effort would be strictly positive.

<sup>23</sup>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 firm's profits.

### 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 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 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 non-negative 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 identifies 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, 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 pre-bonus period and 51 days post-bonus. 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 that work at least one week either side of the change in managerial incentives. The final sample then contains 10148 worker-field-day productivity observations from 241 field-days. This covers 144 workers, 10 managers, 13 fields, and 94 days.<sup>24</sup>

### 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.<sup>25</sup>

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 programme with others that have arrived at a similar time. Hence the first group of

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<sup>24</sup>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.

<sup>25</sup>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.



people that each individual is exposed to, and may form social ties with, are those that arrive on a similar date. If two individuals have a worker number within the same ten 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 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.<sup>26</sup>

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 *et al* (2008) we find 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 one, 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 10148 worker-field-day observations in our sample, 8884 correspond to workers that 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.<sup>27</sup>

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,  $C_{ift} = \frac{\sum_j c_{ij}}{M_{ft}}$ , where the summation in the numerator is over all

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<sup>26</sup>There are no opportunities for workers to themselves choose their caravan or worker numbers.

<sup>27</sup>Unconnected workers are however not significantly different from connected workers on observables such as age, gender, and previous work experience.

managers  $j$  on field-day  $ft$ .<sup>28</sup>

### 4.3 Descriptives

Table 1 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 1 shows that, reassuringly, at least one third of the overall variation in social connections arises from variation within a worker over field-days. This is true under both managerial incentive schemes, and along each dimension that defines social connections.<sup>29</sup>

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 2 presents descriptive evidence on productivity by connection status, managerial incentive scheme, and workers' ability. For ease of exposition 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 0 otherwise. To analyze whether the effect of connections differ 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.<sup>30</sup>

Panel A of Table 2 pools all workers and illustrates that when managers are paid fixed wages, worker productivity is 7.21kg/hr when workers are unconnected and rises significantly to 8.98kg/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 1.59kg/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.<sup>31</sup>

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<sup>28</sup>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.

<sup>29</sup>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.

<sup>30</sup>The theoretical framework makes clear that the probability of social connections affecting the managers' allocation decision 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.

<sup>31</sup>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

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 towards 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 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, 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' effort is both higher, and more likely to be targeted towards them.

Overall, the evidence in Table 2 indicates that managers target connected workers irrespective of their ability when paid fixed wages, whereas they reallocate their effort 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.

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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.

# 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 following panel data regression,

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

where  $y_{ift}$  is worker  $i$ ’s log productivity on field  $f$  and day  $t$ . The worker fixed effects  $\alpha_i$  account for permanent productivity differences across workers, such as those arising from innate ability or motivation, and the field fixed effects  $\lambda_f$  capture permanent productivity differences across fields, such as those arising from soil quality.<sup>32</sup>

$C_{ift}$  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 0 otherwise. The parameters of interest throughout are  $\gamma_0$ , which measures the effect of social connections when managers are paid a fixed wage, and  $\gamma_1$ , 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,  $\gamma_0$  and  $\gamma_1$  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  $D_{id}^k = 1$  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,  $D_{id}^k = 1$  when the worker is of nationality  $d$ , and  $N_k$  is equal to eight 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

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<sup>32</sup>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.

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 0 otherwise, and  $M_{ft}$  is the set of managers that 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 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  $n$ th 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.<sup>33</sup>

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.<sup>34</sup>

The parameters of interest  $(\gamma_0, \gamma_1)$  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 3 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 0 otherwise. This is the variable used for the previous descriptive evidence in Table 2. The results show that the pattern of unconditional differences in worker

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<sup>33</sup>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.

<sup>34</sup>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,  $\gamma_0$  and  $\gamma_1$ , being considerably smaller than those we report.

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 socially connected to his managers ( $\hat{\gamma}_0 > 0$ ). 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 ( $\hat{\gamma}_1 = 0$ ).

The magnitude of  $\hat{\gamma}_0$  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  $\hat{\gamma}_0$  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 .642kg/hr higher, other things equal. Relative to a baseline average worker productivity of 7.21kg/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.<sup>35,36</sup>

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,  $(\hat{\gamma}_0 - \hat{\gamma}_1)$ . In line with the descriptive evidence, this is positive in both cases and significantly different 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

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<sup>35</sup>The difference between the estimated  $\hat{\gamma}_0$  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 is 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 whom they are connected to.

<sup>36</sup>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,  $\sum_k DC_{ift}^k$ . 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 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.

managers when productivity on the field is exogenously higher, connections should have the same positive effect under both schemes, i.e.  $\hat{\gamma}_0 = \hat{\gamma}_1 > 0$ . Second, if when they are on the field-day with managers they are socially connected to, workers prefer to socialize with their managers, connections should have the same negative effect under both schemes, i.e.  $\hat{\gamma}_0 = \hat{\gamma}_1 < 0$ . 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, i.e.  $\hat{\gamma}_0 = 0 < \hat{\gamma}_1$ .

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.<sup>37</sup>

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 *et al* (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.<sup>38</sup>

### 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.

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<sup>37</sup>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.

<sup>38</sup>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 that work at least one week 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 that have worked at least one day either side of the change in managerial incentives.

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 non-picking 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 of social connections changes *discontinuously* when the bonus is introduced.<sup>39</sup> 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.

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<sup>39</sup>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.



## 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 towards 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 test whether the manager reallocates effort from low to high ability workers 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,  $\theta$ . We therefore estimate the following specification,

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

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  $\theta$ th conditional quantile of log worker productivity is measured by  $\alpha_\theta$ . 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 are captured by  $\beta_\theta$  and  $\beta_\theta + \gamma_\theta$ , respectively.

The estimates of  $\alpha_\theta$  and  $(\alpha_\theta + \gamma_\theta C_{ift})$  at different conditional quantiles of worker productivity allows 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 non-negative 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  $\theta$ .

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  $\theta$ ; (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 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  $\theta$ .

Table 4 reports the estimates of  $\alpha_\theta$ ,  $\beta_\theta$ ,  $\gamma_\theta$ , and  $\alpha_\theta + \gamma_\theta \bar{C}_{ift}$  from specification (4) at various quantiles, and 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,  $\alpha_\theta$ , is zero at the bottom two quantiles and positive and increasing in  $\theta$  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 positive and significant in the last two quantiles.<sup>40</sup>

Taken together, these results provide evidence *against* the interpretation that after the introduction of the bonus, managers exert extra effort and target all workers regardless of their connection status. Rather the data suggests 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.<sup>41</sup>

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<sup>40</sup>As the effect of the bonus on both connected and unconnected field-days is increasing in  $\theta$ , 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.

<sup>41</sup>The results are qualitatively unchanged if we set the threshold  $\bar{C}_{ift}$  to – (i) the sample minimum of  $C_{ift}$ , so

### 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 following panel data specification,

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

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

$$\Lambda_{ift} = \alpha_i [DC_{ift} \times (1 - B_t)] + \beta_i [DC_{ift} \times B_t] + \gamma_i [(1 - B_t) \times (1 - DC_{ift})] + \delta_i [B_t \times (1 - DC_{ift})]. \quad (6)$$

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 ( $\alpha_i$ ); (ii) connected and managers are paid bonuses ( $\beta_i$ ); (iii) unconnected and managers are paid fixed wages ( $\gamma_i$ ); (iv) unconnected and managers are paid bonuses ( $\delta_i$ ). 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 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 manager's 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 targeted 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

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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.

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 towards all workers. This is consistent with the characteristics of the production technology in our setting. Indeed, as each manager is responsible for twenty workers distributed over one hectare, it is often impossible for her to target her effort towards *all* workers simultaneously. The technology is such that managerial effort is a rival good in that if the manager decides to target her effort towards 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 re-estimated 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, indicate 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),

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

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 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  $\kappa_0$ , which measures the effect of social connections on average productivity when managers are paid a fixed wage, and  $\kappa_1$ , which measures the effect of social connections when managers are paid performance bonuses. The findings, reported in Table 5, indicate that the overall effect of social connections is negative when managers are paid fixed wages, and zero when they are paid performance bonuses. An increase in average social connections by one standard deviation reduces average productivity by 8% unconditionally and by 5% in the full conditional specification (7) when managers 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 zero when they are paid bonuses, the results in Table 5 imply 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.

## 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 towards 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 impor-

tance of social relationships in the workplace. Our findings indicate that managerial behavior is shaped by both their social connections with their subordinates and their 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) present 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.<sup>42</sup>

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 towards such bonding exercises. Relatedly, 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.<sup>43</sup>

More generally, our findings provide support to 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.

## 8 Appendix

### 8.1 Proofs

**Proof of Proposition 1:** As the manager’s pay-off function  $(b + \sigma_h) \theta k(\sigma_h) m_h + (b + \sigma_l) k(\sigma_l) m_l - C(m_h + m_l)$  is linear in  $(m_h, m_l)$  the manager will target only the worker that yields the highest marginal benefit.<sup>44</sup> 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  $(\sigma_h, \sigma_l)$ , 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

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<sup>42</sup>Relatedly, Nagin *et al* (2002) present evidence from a field experiment in a call centre 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 has also been discussed in the sociology literature. These include potentially better hiring outcomes through the use of referrals by current employees (Fernandez *et al* 2000).

<sup>43</sup>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, Benabou and Tirole 2003).

<sup>44</sup>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*.

social connections alters the allocation of managerial effort in favor of the worker the manager is connected to. ■

**Proof of Proposition 2:** As  $m$  is weakly increasing in  $(\sigma_h, \sigma_l)$  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  $\theta km_h > \theta m_h$ . 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.<sup>45</sup> 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  $\theta$  when  $\sigma_h = 0, \sigma_l = 0$  and  $k\bar{m}$  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  $k < \frac{\theta}{\bar{m}}$ . ■

## 8.2 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 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.

### 8.2.1 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.

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<sup>45</sup>Total output is equal to  $\theta m$  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.



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,

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

$p_{it} = 1$  if worker  $i$  is selected by the COO to pick on day  $t$  on the main site, and 0 if they are assigned to non-picking tasks.  $B_t$  is the performance bonus dummy,  $C_i$  is a dummy variable equal to one if worker  $i$  is socially connected to any of the managers along any dimension of nationality, arrival cohort, and living site, and is zero otherwise.  $X_t^D$  and  $X_t^S$  proxy the demand and supply of labor on day  $t$ . To allow for a 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.<sup>46</sup>

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

Column 1 of Table A1 shows that, other things 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 one. 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 bears more fruit (namely, the coefficient of  $X_t^D$  is significantly larger than one) and on days in which they face less competition from other workers (namely, the coefficient of  $X_t^S$  is significantly smaller than one).

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 non-picking tasks varies differentially by socially connected and unconnected workers, when the performance bonus is introduced. The result in 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

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<sup>46</sup>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.

yields are higher and when the stock of available workers is lower.

## 8.2.2 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,

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

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  $\phi_1 = \varphi_1 = 0$ . Reassuringly, we fail to reject the null of zero coefficients in all cases.<sup>47</sup>

## 8.2.3 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 the composition of workers they are assigned differs after the change in managerial incentives. To begin with we note that Table 1 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,

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

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<sup>47</sup>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 that are socially connected to managers does not change significantly over the two halves of the season, nor 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),  $\hat{\alpha}_i$ , 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 post-bonus.

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.

### 8.2.4 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 A2 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 one standard deviation increase in each of the connectivity measures from its 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 one 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.<sup>48</sup>

## 8.3 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),  $\hat{\gamma}_0$  and  $\hat{\gamma}_1$  may simply

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<sup>48</sup>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 correlation among the three measures is very low. In line with this we find that their estimated effect on productivity to be the same, regardless of whether they are included together or one at the time.

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 A3 we analyze whether the effects of social connections on worker productivity naturally disappear over time. In Column 1 we split both the pre and post performance bonus periods into halves and allow the effect of connections to change within the pre and post bonus 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 pre-bonus period than in the second half, and again, higher in the first half of the post-bonus 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  $\hat{\gamma}_0$  and  $\hat{\gamma}_1$  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 non-classical 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.

Overall, the evidence in Columns 1 to 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 zero if the field is in the first half of its life cycle and equal to one 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 zero before the date bonuses were introduced in 2003 (June 27th) and equal to one thereafter. All variables are defined as in (3) and the sample is selected according to the same criteria.<sup>49</sup> Reassuringly, 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 towards connected workers throughout the season.

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<sup>49</sup>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.

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**Table 1: Descriptives on the Social Connectivity Between Workers and Managers, by Managerial Incentive Scheme (Worker-Field-Day Level)**

All observations are at the worker-field-day level

Means, standard deviation between workers in parentheses, and standard deviation within worker in brackets

|   | <u>Managerial Incentive Scheme</u> |                          |
|---|------------------------------------|--------------------------|
|   | Fixed Wages                        | Performance Bonus        |
| <b>Share of managers connected to <math>i</math> (<math>C_{ift}</math>)</b>     | .425<br>(.297)<br>[.196]           | .412<br>(.300)<br>[.154] |
| <b>Share of managers who are the same nationality as <math>i</math></b>         | .304<br>(.344)<br>[.145]           | .285<br>(.319)<br>[.111] |
| <b>Share of managers who are in the same living area as <math>i</math></b>      | .139<br>(.116)<br>[.167]           | .138<br>(.172)<br>[.138] |
| <b>Share of managers who are from the same arrival cohort as <math>i</math></b> | .038<br>(.076)<br>[.079]           | .056<br>(.101)<br>[.074] |

**Notes:** All variables are defined at the worker-field-day level. 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 ten 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.

**Table 2: Worker Productivity (kg/hr), by Social Connectivity to Managers and Managerial Incentive Scheme**

All observations are at the worker-field-day level  
Means, standard errors in parentheses

**PANEL A: All Workers**

| Managerial Incentive Scheme:              | Fixed Wages              | Performance Bonus     | Difference               |
|---|--------------------------|-----------------------|--------------------------|
| Unconnected on field-day ( $DC_{ift}=0$ ) | 7.21<br>(.211)           | 9.52<br>(.600)        | 2.30***<br>(.535)        |
| Connected on field-day ( $DC_{ift}=1$ )   | 8.98<br>(.345)           | 9.70<br>(.527)        | .712<br>(.272)           |
| <b>Difference</b>                         | <b>1.77***</b><br>(.352) | <b>.179</b><br>(.750) | <b>1.59***</b><br>(.609) |

**PANEL B: Low Ability Workers**

| Managerial Incentive Scheme:              | Fixed Wages              | Performance Bonus     | Difference              |
|---|--------------------------|-----------------------|-------------------------|
| Unconnected on field-day ( $DC_{ift}=0$ ) | 6.10<br>(.248)           | 6.60<br>(.342)        | .506<br>(.423)          |
| Connected on field-day ( $DC_{ift}=1$ )   | 7.37<br>(.173)           | 6.77<br>(.212)        | -.603**<br>(.211)       |
| <b>Difference</b>                         | <b>1.27***</b><br>(.287) | <b>.161</b><br>(.368) | <b>1.11**</b><br>(.435) |

**PANEL C: High Ability Workers**

| Managerial Incentive Scheme:              | Fixed Wages              | Performance Bonus     | Difference              |
|---|--------------------------|-----------------------|-------------------------|
| Unconnected on field-day ( $DC_{ift}=0$ ) | 7.76<br>(.259)           | 10.79<br>(.672)       | 3.03***<br>(.609)       |
| Connected on field-day ( $DC_{ift}=1$ )   | 10.32<br>(.519)          | 11.61<br>(.668)       | 1.28***<br>(.338)       |
| <b>Difference</b>                         | <b>2.56***</b><br>(.518) | <b>.815</b><br>(.899) | <b>1.75**</b><br>(.719) |

**Notes:** \*\*\* 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.

**Table 3: Social Connections and Managerial Incentives**

Dependent Variable = Log of worker's productivity (kilograms picked per hour on the field-day)

Standard errors reported in parentheses, allowing for clustering at worker level (Columns 1 to 3), clustering at the field-date level in Column 4

|  | (1) Any Managers<br>Connected To | (2) Share of Managers<br>Connected To | (3) Heterogeneous<br>Effects of the Bonus<br>on Workers | (4) Field-Date<br>Fixed Effects |
|--|----------------------------------|---------------------------------------|---|---------------------------------|
| Any managers connected to <i>i</i> , fixed wages for managers ( $DC_{ift}$ )           | .049**<br>(.019)                 |                                       |   |                                 |
| Any managers connected to <i>i</i> , performance bonus for managers ( $DC_{ift}$ )     | .016<br>(.032)                   |                                       |   |                                 |
| Share of managers connected to <i>i</i> , fixed wages for managers ( $C_{ift}$ )       |                                  | .158***<br>(.040)                     | .143***<br>(.040)                                       | .106**<br>(.045)                |
| Share of managers connected to <i>i</i> , performance bonus for managers ( $C_{ift}$ ) |                                  | -.083<br>(.088)                       | -.079<br>(.088)   | -.060<br>(.061)                 |
| Difference-in-difference estimate  | .033<br>(.034)                   | .241***<br>(.095)                     | .222**<br>(.096)  | .167**<br>(.075)                |
| Interactions of nationality x performance bonus dummy                                  | Yes [.147]                       | Yes [.042]                            | No  | No                              |
| Interactions of living site x performance bonus dummy                                  | Yes [.000]                       | Yes [.000]                            | No  | No                              |
| Interactions of arrival cohort x performance bonus dummy                               | Yes [.000]                       | Yes [.000]                            | No  | No                              |
| Interactions of worker fixed effect x 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                            |

**Notes:** \*\*\* 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 *n*th 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 the interaction terms with the performance bonus dummy.

**Table 4: Quantile Regression Estimates**

Dependent Variable = Log of worker's productivity (kilograms picked per hour on the field-day)  
Standard errors reported in parentheses

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

**Notes:** \*\*\* 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 include 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.

**Table 5: The Effect of Social Connections on Average Productivity**

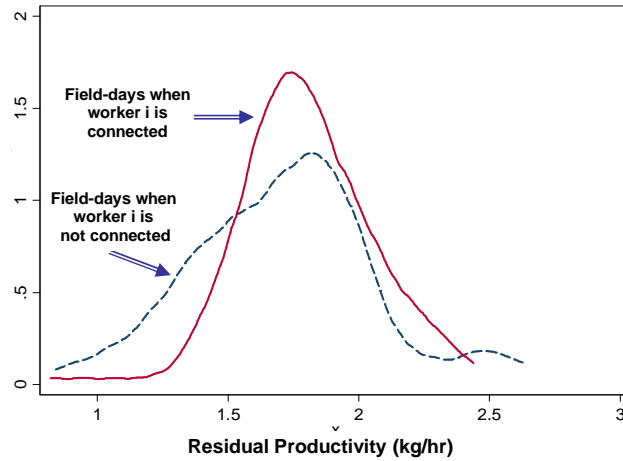
**Dependent Variable = Log of average field-day productivity (kilograms picked per hour on the field-day)**  
**Standard errors reported in parentheses, allowing for field specific AR(1)**

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

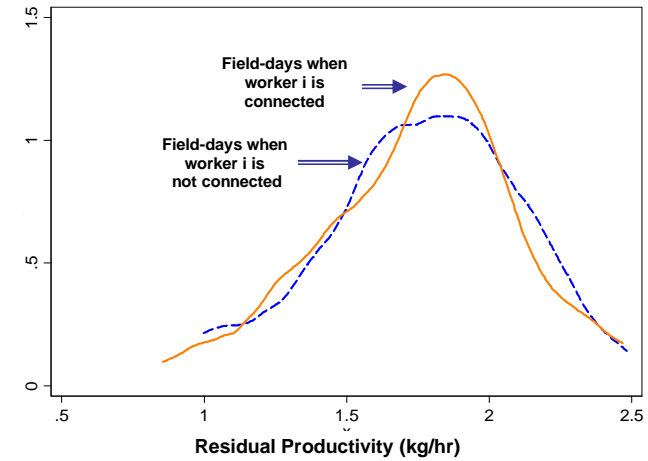
**Notes:** \*\*\* denotes significance at 1%, \*\* at 5%, and \* at 10%. AR(1) regression estimates are reported. Panel corrected standard errors are calculated using a Prais-Winsten regression, allowing the error terms to be field specific heteroskedastic, and contemporaneously correlated across fields. 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 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  $n$ th day the field is picked divided by the total number of days the field is picked over the season.

**Figure 1: Workers Fixed Effects, by Connection Status and Managerial Incentive Scheme**

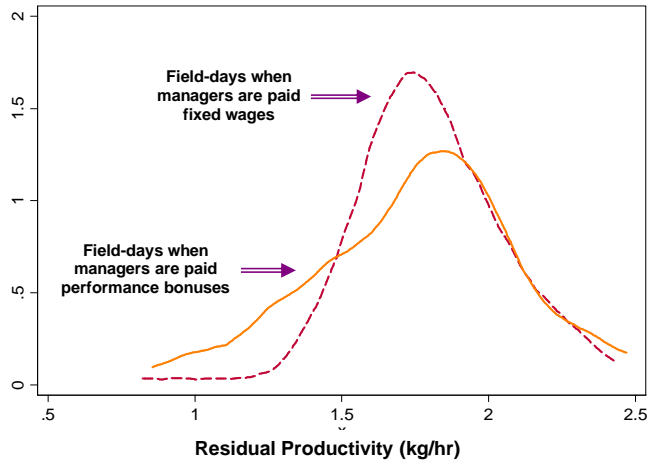
(a) Field-days when managers are paid fixed wages



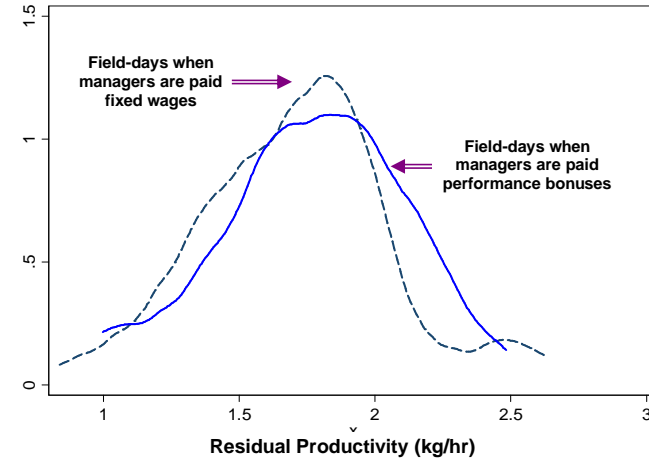
(b) Field-days when managers are paid performance bonuses



(c) Field-days when worker i is connected to his manager



(d) Field-days when worker i is not connected to his manager



**Notes:** 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.

**Table A1: Social Connections, Managerial Incentives, and the COO's Allocation Algorithm**

Conditional logit estimates

Column 1: Dependent Variable = 1 if worker  $i$  is chosen to pick on day  $t$  in main site, 0 if worker is assigned to non-picking tasks

Column 2: Dependent Variable = 1 if worker  $i$  is unemployed on day  $t$ , 0 if assigned to non-picking tasks

Odd ratios reported, standard errors in parentheses, clustered by worker

|   | Probability of Being Selected to Pick | Probability of Being Unemployed |
|---|---------------------------------------|---------------------------------|
| Performance bonus for managers                                    | 1.34<br>(.495)                        | 2.04*<br>(.764)                 |
| Performance bonus for managers x worker $i$ is socially connected | .524<br>(.214)                        | .605<br>(.253)                  |
| Total yield in site 1   | 2.24***<br>(.153)                     | .802***<br>(.057)               |
| Total yield in site 2   | .883***<br>(.036)                     | .800***<br>(.032)               |
| Number of workers available to pick fruit                         | .380***<br>(.037)                     | 1.83***<br>(.178)               |
| Worker $i$ 's previous deviation from mean productivity           | 1.16*<br>(.091)                       | 1.07<br>(.107)                  |
| <b>Log-likelihood</b>   | -5186.8                               | -3208.5                         |
| <b>Number of observations (worker-day)</b>                        | 15551                                 | 9808                            |

**Notes:** \*\*\* denotes that the log odds ratio is significantly different from one 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.

**Table A2: Social Connections and Managerial Incentives**

Dependent Variable = Log of worker's productivity (kilograms picked per hour on the field-day)

Standard errors reported in parentheses, allowing for clustering at worker level

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

**Notes:** \*\*\* denotes significance at 1%, \*\* at 5%, and \* at 10%. Standard errors 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 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. At the foot of the column we report the p-value on the F-test on the joint significance the interaction terms with the performance bonus dummy.



**Table A3: Robustness of Results to Time Effects**

Dependent Variable = Log of worker's productivity (kilograms picked per hour on the field-day)  
Standard errors reported in parentheses, allowing for clustering at worker level

|   | (1) Farm<br>Specific<br>Time Trend | (2) Field<br>Specific<br>Time Trend | (3) Worker<br>Specific<br>Time Trend | (4) Placebo Bonus<br>Based on Field<br>Life Cycle | (5) Placebo<br>Bonus Based on<br>2004 Season |
|---|------------------------------------|-------------------------------------|--------------------------------------|---|--|
| Share of managers connected to <i>i</i> , fixed wages for managers  | .165***<br>(.043)                  | .188***<br>(.067)                   | .269***<br>(.094)                    |   |  |
| Share of managers connected to <i>i</i> , performance bonus for managers                                    | -.037<br>(.092)                    | -.003<br>(.116)                     | .345<br>(.511)                       |   |  |
| Share of managers connected to <i>i</i> , fixed wages for managers x 2nd quarter dummy (31st May)           | -.018<br>(.076)                    |                                     |                                      |   |  |
| Share of managers connected to <i>i</i> , performance bonus for managers x 4th quarter dummy (29th July)    | -.133<br>(.099)                    |                                     |                                      |   |  |
| Share of managers connected to <i>i</i> , fixed wages for managers x field life cycle                       |                                    | -.089<br>(.141)                     |                                      |   |  |
| Share of managers connected to <i>i</i> , performance bonus for managers x field life cycle                 |                                    | -.249<br>(.200)                     |                                      |   |  |
| Share of managers connected to <i>i</i> , fixed wages for managers x days on farm for worker <i>i</i>       |                                    |                                     | -.047<br>(.035)                      |   |  |
| Share of managers connected to <i>i</i> , performance bonus for managers x days on farm for worker <i>i</i> |                                    |                                     | -.109<br>(.132)                      |   |  |
| Share of managers connected to <i>i</i> , placebo bonus based on field life cycle = 0                       |                                    |                                     |                                      | -.087<br>(.081)                                   |  |
| Share of managers connected to <i>i</i> , placebo bonus based on field life cycle = 1                       |                                    |                                     |                                      | -.033<br>(.138)                                   |  |
| Share of managers connected to <i>i</i> , placebo bonus 2004 = 0  |                                    |                                     |                                      |   | .201*<br>(.109)                              |
| Share of managers connected to <i>i</i> , placebo bonus 2004 = 1  |                                    |                                     |                                      |   | .215***<br>(.033)                            |
| <b>Interactions of nationality x performance bonus dummy</b>  | Yes                                | Yes                                 | Yes                                  | Yes   | Yes  |
| <b>Interactions of living site x performance bonus dummy</b>  | Yes                                | Yes                                 | Yes                                  | Yes   | Yes  |
| <b>Interactions of arrival cohort x performance bonus dummy</b>   | Yes                                | Yes                                 | Yes                                  | Yes   | Yes  |
| <b>Adjusted R-squared</b>   | .4374                              | .4524                               | .4368                                | .6260   | .4532  |
| <b>Number of observations (worker-field-day)</b>  | 8884                               | 8884                                | 8884                                 | 1584  | 2692   |

**Notes:** \*\*\* denotes significance at 1%, \*\* at 5%, and \* at 10%. Standard errors allow for clustering at the worker level. All specifications control for worker, field, and manager fixed effects. The other controls included in each specification include 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 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. 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 zero before May 31st and one thereafter. The 4th quarter dummy is defined to be equal to zero before July 29th and one thereafter. These dummy variables split the pre and post bonus 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 zero if the field is less than .53 of the way through its life cycle, and one 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.