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Gift giving and worker productivity: Evidence from a firm-level experiment ☆

Charles Bellemare [a,b,c,*], Bruce Shearer [a,b,c]

[a] Département d'économique, Université Laval, Canada
[b] CIRPÉE, Canada
[c] IZA, Germany

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ABSTRACT

We present results from a field experiment, designed to measure worker response to a monetary gift from their employer. The experiment took place inside a tree-planting firm paying its workforce incentive contracts. Firm managers told a crew of tree planters they would receive a pay raise for one day as a result of a surplus not attributable to past planting productivity. We compare planter productivity—the number of trees planted per day—on the day the gift was handed out with productivity on previous and subsequent days of planting on the same block, and thus under similar planting conditions. We find direct evidence that the gift had a significant and positive effect on daily planter productivity, controlling for planter-fixed effects, weather conditions and other random daily shocks.

1. Introduction

The modern economic theory of the firm emphasizes the role of labour as a unique factor of production. The recognition that workers can control their own productivity has led economic theorists to a detailed study of incentives, contracts and the internal worker-firm relationship; see, for example, Hart and Holmstrom (1987), Milgrom and Roberts (1992), Lazear (1998). One branch of this literature has concentrated on models of social interaction and gift exchange. The origins of these models can be traced to sociology and anthropology; see Mauss (1990) for a historical overview. Their theoretical foundations are based on the principle of reciprocity, stating that gifts received bring with them the obligation of returning gifts.[1] Economic interest in gift exchange derives from the possibility of its use as an effort-inducing device within firms (Akerlof, 1982). What is more, models of gift exchange have been shown to give rise to wage rigidity and involuntary unemployment (Akerlof, 1984), generating macroeconomic as well as microeconomic implications; see Fehr and Gächter (1998) for a review.

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* Corresponding author at: Université Laval, Département d'économique, Quebec, QC, Canada.
E-mail addresses: Charles.Bellemare@ecn.ulaval.ca (C. Bellemare), Bruce.Shearer@ecn.ulaval.ca (B. Shearer).

[1] An alternative interpretation is given by Carmichael and MacLeod (1997): gifts exchanged at the beginning of a long-term relationship may serve to support cooperation.

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Testing models of gift exchange is problematic using observational data. Many of the forcing variables that determine the response to the gift, such as effort costs and alternative wages, are unobservable. This has led many researchers to use laboratory experiments to evaluate these effects. The laboratory permits extensive control over the economic environment, allowing researchers to generate exogenous gifts and to observe participants' reaction to them. Many laboratory studies suggest that gifts in the form of increased wages are reciprocated by workers in the form of increased productivity (e.g., Fehr et al., 1993; Hannan et al., 2002; Charness, 2004).

One concern with laboratory experiments is generalizability. The laboratory may represent an artificial environment which affects participants' behaviour. An early example is the experiments conducted at the Hawthorne Works of the Western Electric Company (Gillespie, 1991). French (1953) suggested that field experiments would improve generalizability by allowing the observation of participants within a natural setting. Recent field experiments applied to (spot) labour markets have increased our understanding of the importance of gift-exchange in the real world. For example, Gneezy and List (2006) found that the effect of gifts on worker productivity quickly dissipated and was in some cases insignificant.[2]

However, the impact of gifts on worker productivity within real economic firms remains largely unknown. Firms often differ from spot markets by the presence of long-term employment relationships and repeated interaction (Simon, 1991) which can affect worker response to gifts. Akerlof (1982) emphasized the importance of repeated interaction in developing worker sentiment for the firm and utility from gift exchange.

In this paper, we present a first attempt to measure worker response to a monetary gift from their employer within a real economic firm. Our study is based on a field experiment, conducted within a tree-planting firm operating in British Columbia, Canada. Workers in this firm are typically paid piece rates and earn approximately $200 per day.

During the experiment workers received a surprise bonus of $80, in addition to their regular piece rate, for one day's planting. The bonus was formulated as a gift from the firm to the workers. Workers were told that extra money was available in the contract due to an exceptional event and that the firm had decided to distribute that money among the workers. We measure worker response in terms of their daily productivity—the number of trees planted.[3]

The experiment was conducted on a large homogeneous block of land permitting the observation of workers, with and without the bonus, under stable planting conditions. Eighteen planters took part in the experiment which took place in the early summer of 2006. The block was planted over a seven-day period and the bonus was paid on the second day of planting on the block. Each worker involved in the experiment is observed planting with and without the bonus. We use our panel data to estimate the effect of the gift on planter productivity, controlling for planter-fixed effects, weather conditions, and other random daily shocks. Our results show that workers responded positively to the gift by increasing their average daily production by 118 trees, approximately 10 percent.

To control for day-of-the-week effects (possibly due to fatigue), we expanded our data set to include information on the daily productivity of the experimental participants over a period of six weeks. This combined data set allowed us to identify the effect of the gift by comparing average productivity on the day of the gift with average productivity both on and off the experimental block, and within and outside of the experimental week. Again, we find that the gift significantly raised average daily planter productivity, by 132 trees, an estimate comparable to that obtained using information on the experimental block alone.

Our results also suggest that worker response is significantly correlated with tenure in the firm. High-tenure workers typically respond more to the gift than do low-tenure workers. Moreover, 14 of the 18 planters who participated in the experiment are predicted to respond significantly to the gift.

The rest of the paper is organized as follows. In the next section we present institutional details of the tree-planting industry and the firm in which the experiment took place. Section 3 presents the design of the experiment. Section 4 presents the data analysis. Section 5 presents our results and Section 6 concludes.

2. Tree planting in British Columbia

2.1. The industry

Tree planting is a simple, yet physically exhausting, task. It involves digging a hole with a special shovel, placing a seedling in this hole, and then covering its roots with soil, ensuring that the tree is upright and that the roots are fully covered. The amount of effort required to perform the task depends on the terrain on which the planting is done and weather conditions. Flat plateaux are much easier to plant than steep mountain sides and hard, rocky soil is more difficult to plant than soft terrain. British Columbia is a very mountainous region of Canada; the terrain can vary a great deal from site to site.

[2] See also Kube et al. (2006). Falk (2007) on the other hand finds significant field evidence of gift exchange in the context of charitable giving.

[3] These workers do not perform any other task apart from planting trees. Hence, the number of trees planted accurately summarizes worker daily productivity.

Planters are predominantly paid using piece-rate contracts, although fixed wages are used on occasion.[4] Under piece-rate contracts, planters are paid in proportion to their output. Generally, no explicit base wage or production standard exists, although firms are governed by minimum-wage laws.[5] Output is measured as the number of trees planted per day.[6]

2.2. The tree-planting firm

Our experiment was conducted within a medium sized tree-planting firm that employed approximately 70 planters in the 2006 planting season. The planters represent a very broad group of individuals, including returning seasonal workers and students working on their summer holidays. They range in age from 19 to 56.

This firm pays its planters piece rates; daily earnings for a planter are determined by the product of the piece rate and the number of trees the planter planted on that day. Blocks to be planted typically contain between 20 and 30 planter-days of work, with some lasting over 100 planter-days. For each block, the firm decides on a piece rate that applies to all planting done on the block. The piece rate for a particular block is set as a function of the planting conditions on that block.[7] Since planting conditions affect the number of trees that workers can plant, blocks for which average conditions are more difficult require higher piece rates to attract planters.

Contracts, comprising a number of blocks in the same geographic area, are planted by crews of workers under a supervisor. Each crew typically has from 10 to 20 planters. All workers planting on the same block receive the same piece rate; no matching of workers to planting conditions occurs. The planters usually access the planting blocks on logging roads. These roads, built by logging companies to transport loggers and logs, typically run along side the block to be planted. Upon arrival at the block, the supervisor drives along the access road stopping at each plot where the planter nearest the door of the truck disembarks. Thus, to a first approximation, planters were randomly assigned to plots. The planters have little contact with other workers during their work day. They are also largely left to their own devices during the day. The supervisor delivers trees to the planters, checks on the readiness of future blocks to be planted and performs quality checks on recently planted blocks.

3. Experimental design

The experiment took place on one homogeneous planting block which was planted over a seven-day period in June, 2006. This seven-day period was spread over two weeks. The first and second days of planting on the block took place on Thursday and Friday of the first week. The remaining 5 days of planting on the block took place from Monday to Friday of the following week. The piece rate paid to planters on this block was $0.20 per tree. Eighteen planters were involved in the experiment, each planting between two and seven days on the experimental block. All eighteen planters were present for the second and third days of planting on the experimental block.

Upon arrival at the experimental block for the second day of planting, planters were informed that they would receive a bonus of $80 for that day's work, in addition to the regular piece rate of twenty cents per tree. In order to avoid any effects of the experiment on participation, the bonus was presented to the planters after they had departed from the base camp. The bonus was added to the following bi-weekly pay of each worker.

An important aspect of our design is that workers were unaware that they were participating in an experiment.[8] This allowed us to formulate the bonus as a gift to the planters from the firm and to observe the workers' response to that gift in their natural work environment. To this end, planters were told that there was extra money in the contract since some of the previously-planted blocks had been expected to present access problems to the workers. This caused the firm to bid "walkin" compensation to the contract for those blocks.[9] In the end, the access problems did not materialize since the government unexpectedly opened an access road. In spite of this, the manager had decided to share the extra money with the planters. This represented a realistic explanation to the workers since access problems occur occasionally and "walkin-fees" are the typical solution of the firm when they occur.[10]

A second important feature of our design is that the workers were told that the gift was a one-time event that would not be repeated.[11] This was reinforced by attaching the gift to an extremely rare occurrence, minimizing any repeated-game

[4] See Paarsch and Shearer (2000) for a discussion of when firms use fixed wage contracts and the effects of these contracts on worker productivity.

[5] The minimum wage in British Columbia is 8$ per hour giving 64$ for an 8 hour workday. This is applied over a two week earnings period; i.e., the planter must average 64$ per day. Workers who are incapable of earning this amount typically leave since they can earn minimum wage, exerting much lower effort levels in other jobs. Nobody in our sample was affected by this law.

[6] Planted trees are subject to quality checks by the firm. These checks can result in fines to the worker if quality standards are not met. Discussions with the manager revealed that quality problems are very rare in this firm.

[7] The piece rate is not adjusted to take account of daily weather conditions.

[8] This is common practice in field experiments; see, for example, Gneezy and List (2006).

[9] "Walkin-fees" compensate planters for time spent walking to remote planting sites.

[10] None of the planters questioned this explanation. The reality of the explanation also kept the planters unaware of the fact that economists financed the experiment.

[11] Discussions with the firm manager revealed that he had never given such a bonus in the past. We are therefore confident that gift giving does not play a significant role in the personnel policy of the firm.

Table 1
Descriptive statistics for 18 planters on the experimental block only (second column) and on all blocks planted in proximity to the experimental block.

	I Experimental block	II Other blocks	III Difference
Avg. number of trees	1075.59	971.55	104.04
	(279.96)	(311.09)	(418.51)
Avg. daily earnings	215.12	218.48	−3.36
	(55.99)	(58.30)	(80.83)
Avg. minimum temperature	12.89	10.38	2.51
	(1.58)	(4.20)	(4.48)
Avg. maximum temperature	30.95	23.30	7.65
	(4.02)	(5.55)	(6.85)
Avg. precipitation (in millimeters)	–	2.64	−2.64
		(3.96)	(3.96)
Avg. piece-rate (dollar)	0.20	0.23	0.03
	–	(0.04)	(0.04)
Number of Mondays	1	10	
Number of Tuesdays	1	10	
Number of Wednesdays	1	10	
Number of Thursdays	2	8	
Number of Fridays	2	8	
Number of planter-day obs.	84	549	

effects whereby the workers might respond in the hopes of earning future gifts (or surpluses); see, for example, Shapiro and Stiglitz (1984) or MacLeod and Malcomson (1989).

Access problems requiring walkin fees occur on approximately 2–3% of all planting blocks. The firm plants approximately 300 blocks in a given year and most workers are affected only once or twice per year. That in itself is a rare event. Even more exceptional is the fact that the originally observed access problems did not materialize—the government unexpectedly opened an access road. Firm managers affirmed that, while this does occur (the government sometimes acts to open up areas to logging), it was an extremely rare event, occurring on perhaps 1% of the blocks for which walkin fees are bid.[12]

Finally, the manager was instructed to treat the day of the gift as a normal working day: planters worked the same number of hours as a regular workday and were monitored in the same way. What is more, the manager reported that nothing out of the ordinary (such as a truck breaking down or trees being delivered late) occurred on that day that would affect planting.

4. Data

Our primary data contain information on the number of trees planted and the payment received for each day of planting on the experimental block. We have supplemented these production data with information on the daily temperature to control for extraneous weather shocks that may affect productivity. We have 84 planter-day observations on the experimental block. We also created a second data set, combining data from our experimental block with planting data on the same workers, on 29 blocks planted in close geographical proximity to the experimental block during the months of May and June, 2006. To construct this extended data set we restricted ourselves to planting data for those 18 planters who were observed planting on the experimental block. This provides us with a sample of 633 planter/day observations over 53 planting days and 11 weeks.

Our empirical analysis will use both the experimental and the extended data sets. The extended data set will allow us to control for effects attributable to planting on different days of the week, which can reflect worker fatigue. This may be particularly important since the gift was given to planters on the last day of the week, a day where worker productivity could be possibly low. It will also allow us to control for daily weather effects with more precision.

Table 1 presents statistics on planting, earnings, minimal and maximal daily temperatures, and days of week on which planting occurred. We report statistics separately for the experimental block and for the non-experimental blocks. The first column presents statistics from the experimental block. Recall, all 18 planters were observed on the second and third days of planting on this block. A varying subset of planters were observed on the other days. The gift was offered to planters on the second day. Table 1 reveals that average planter productivity is approximately 1075 trees per day on the experimental block. Despite the fact that the soil and planting conditions were kept constant throughout the seven days, we find some variation in temperature across the planting days, with an average maximal temperature of 30.95 degrees Celsius and a standard deviation of 4.02. There was no rainfall during the experimental period. The piece rate paid to workers on this block was $0.20 per tree planted and average earnings (net of the bonus) were equal to $215, with a standard deviation of $56.

[12] This suggests that the event will occur approximately once in every 3000 blocks planted, implying a worker would have to work, on average, 10 years in the firm to experience it.

The second column of Table 1 presents the descriptive statistics for the non-experimental blocks. The average piece-rate across the non-experimental blocks is slightly higher than on the experimental block alone (0.23$ vs. 0.20$ per tree), indicating that the non-experimental blocks were somewhat more difficult to plant than the experimental block. This is reflected in the slightly lower average productivity per planter (971.55 trees per planter). Temperatures were considerably higher during planting on the experimental block: average maximal temperature was approximately 31 degrees centigrade on the experimental block and 23 degrees centigrade during planting on all blocks. Furthermore, the average precipitation in the extended sample is 2.64 millimeters per day. Notice, however, that the average daily earnings are practically identical between the experimental on non-experimental blocks ($218 for the non-experimental blocks vs. $215 in the experimental sample) suggesting that the piece rate is compensating workers for the differences in planting conditions.

The last column of Table 1 presents the differences between reported averages for the experimental block and those for the non-experimental blocks. We find that estimated differences are all substantially lower than their estimated standard deviations, indicating that differences are all individually insignificant.

5. A model of gifts and reciprocity in a piece rate setting

To fix ideas we present a simple, illustrative model of worker behaviour under piece rates and gifts. In our model, the worker's effort decision is governed by two key parameters: a cost of effort and a kindness parameter, measuring the worker's response to monetary gifts from the firm. Modelling worker utility as a function of kindness between the firm and the worker is in the spirit of Rabin's (1993) and Dufwenberg and Kirchsteiger's (2004) theoretical work on fairness and reciprocity.

We assume workers have a separable utility function defined over earnings, effort and gifts, that is given by

$$U(W, E, G) = W - C(E) + \beta Y G$$

where W represents daily earnings, $C(E)$ is the worker's cost of effort function and $\beta Y G$ represents the kindness function, capturing how workers respond to gifts from the firm. It specifies that the worker receives utility from returning value to the firm (in terms of output Y).[13] The utility gained is proportional to the size of the gift G (or kindness) received from the firm.

Effort affects output through the production function specified as $Y = ES$, where S denotes a non-negative productivity shock capturing variation in planting conditions beyond the worker's control; S is assumed to be observed by the planter before he/she chooses effort.[14] We specify the cost of effort as a power function

$$C(E) = \frac{E^\gamma}{\gamma}$$

where γ captures the curvature of the function. Earnings are given by $W = rY + G$, where r denotes the piece-rate.

The worker's optimal effort function is given by

$$e^G = (r + \beta G)^\theta S^\theta \tag{1}$$

with $\theta = 1/(\gamma - 1)$. In the absence of a gift, $G = 0$, the worker's effort is given by

$$e^{NG} = r^\theta S^\theta. \tag{2}$$

A natural definition of reciprocity in this setting is the increase in revenue due to a change in worker behaviour resulting from the gift. The gift received from the firm generates extra effort through the kindness parameter β which increases the worker's marginal value of effort. This extra effort generates an expected economic value of $P[(r+\beta G)^\theta - r^\theta]\mathbf{E}(S^{\theta+1})$, where P is the price of output (trees) that the firm receives and $\mathbf{E}$ denotes the expectations operator. The firm's net expected benefit (or reciprocal gift) from this extra effort is then

$$(P - r)\big[(r + \beta G)^\theta - r^\theta\big]\mathbf{E}\big(S^{\theta+1}\big). \tag{3}$$

Gift exchange within a piece-rate setting differs somewhat from a fixed-wage in that the worker benefits from his/her extra effort. Yet, the firm benefits from this extra effort as well as long as the price per unit of output that the firm receives, P, is higher than r.[15] Of course, whether or not the gift is profitable depends on the value of marginal effort being higher than the marginal cost (the gift). In our simple model profitability requires that (3) be greater than G, which occurs when

$$\beta > \frac{[G + (P - r)r^\theta \mathbf{E}(S^{\theta+1})]^{1/\theta}}{(P - r)G\mathbf{E}(S^{\theta+1})} - \frac{r}{G}.$$

We return to this point in our conclusion.[16]

[13] This model is also consistent with utility being defined over the monetary value returned to the firm by the worker, $\tilde{\beta}(P - r)YG$, where P denotes the output price and r the piece-rate paid to the worker. This can be seen by setting $\beta = \tilde{\beta}(P - r)$.

[14] See Shearer (2004) for a discussion of the observability of the shock by planters in the tree-planting industry.

[15] In the present case, the firm received $0.35 per planted tree and paid the worker $0.20.

[16] Gifts can also induce a reaction on other aspects of output, such as quality. The firm monitors quality very closely and problems are very rare (see footnote 6)—none were reported in our data set, with or without the gift.

Table 2
Parameter estimates of the productivity equation.

	I	II
Day of gift	118.313***	132.371***
	(13.160)	(33.904)
Minimum temperature	39.561**	7.713
	(13.702)	(4.737)
Maximum temperature	−14.585***	−1.451
	(1.665)	(2.581)
Rain		−60.137***
		(17.653)
Minimum temperature × Rain		−3.463
		(2.551)
Maximum temperature × Rain		4.292**
		(1.763)
Tuesday		46.922**
		(22.372)
Wednesday		54.237*
		(30.507)
Thursday		54.558***
		(20.369)
Friday		−25.784
		(26.652)
Constant	1159.627***	846.527***
	(124.655)	(74.754)
Experimental data only	Yes	No
F-test (H_0: No weekday effects)		4.050***

The first column presents estimates on the experimental block only using the 84 planter-day observations. Planter fixed effects included in the model are not reported in the table. The second column presents estimates obtained by combining data both on and off the experimental block for the 18 planters who participated in the experiment. Planter and block fixed effects included in the model are not reported in the table. All standard errors (in parentheses) are robust to daily random effects and arbitrary forms of heteroscedasticity.

* Significance at the 10% level.
** Significance at the 5% level.
*** Significance at the 1% level.

6. Results

In this section we use regression analysis to estimate the effect of the gift on average planter productivity on the day the gift was given. We use the number of trees planted on a given day by a planter as our dependent variable. This provides us with an unbalanced panel since not all 18 planters are observed planting on the experimental block each day.

To estimate the effect of the gift on productivity, we specify the following model of planter productivity on the experimental block

$$productivity_{it} = \beta_0 + \gamma Gift_{it} + \beta_1 Mintemp_t + \beta_2 Maxtemp_t + \mu_i + \lambda_t + \epsilon_{it} \tag{4}$$

where $Gift_{it}$ is a binary variable, indicating reception of the gift, $Mintemp_t$ and $Maxtemp_t$ denote the minimal and maximal temperatures on day t recorded in the area of planting,[17] μ_i represents a time-invariant, individual-specific effect capturing the intrinsic planting ability of worker i, λ_t represents a random daily effect with constant variance assumed to be mean independent from all the variables in the model, and ϵ_{it} denotes a, possibly, heteroscedastic mean-zero error term varying across individuals and time periods. The effect of the gift is identified by comparing productivity on the day of the gift relative to other days, taking account of the variance of daily shocks.

The first column of Table 2 presents results from estimating (4) based on the experimental sample, using ordinary least squares. Reported standard errors are corrected for clustering due to the presence of the random daily effect λ_t and for arbitrary forms of heteroscedasticity in ϵ_{it} (see Cameron and Trivedi, 2005, for details).[18] We find that the average productivity is higher on the day of the gift (in the order of 118 trees), and the difference is statistically significant (p-value $= 0.002$). Adding controls for weather appears to pick up a significant amount of variation in daily productivity on the experimental block. In particular, planter productivity significantly increases with the minimum temperature (p-value $=$ 0.033), and significantly decreases (p-value $= 0.001$) with the maximum temperature, reflecting the physical nature of tree planting. These results provide significant support for the use of gifts as effort-inducing devices, at least in the short run; workers in our sample have reacted positively to the gift received from the firm, increasing their productivity by an average of 118 trees.

[17] Quadratic terms in temperature are insignificant in our specifications and are omitted.
[18] We do not adjust the standard errors for clustering at the individual level since we include individual-specific effects which allow for autocorrelation of the composite error term. Below, we will consider autocorrelation in ϵ_{it} and λ_t.

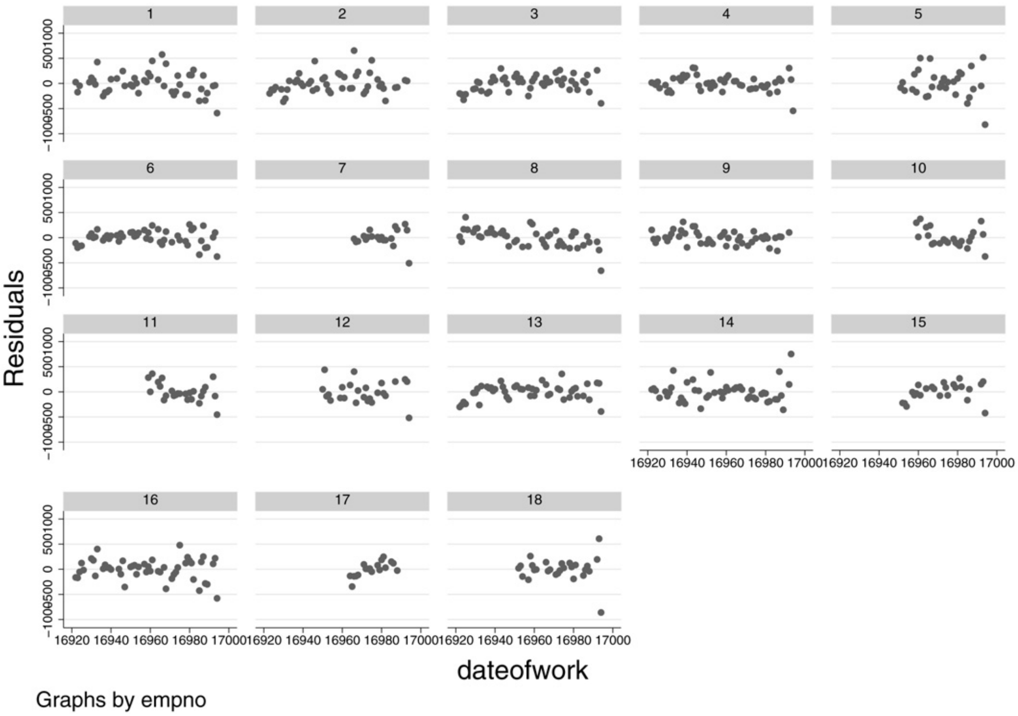

Fig. 1. Regression residuals for all 18 planters who participated in the experiment. Each graph plots the residuals for a given planter against the time period.

The second set of regressions measures the effect of the gift on productivity using planting data from the extended sample, combining data from the experimental block with planting data on the experimental participants, planting on non-experimental blocks in the same proximity. Adding these additional data allows us to consider day-of-the-week effects which may be caused by fatigue. It does, however, require that we control for differences in the difficulty of planting conditions across blocks. We do so by extending the model in (4) to account for differences in terrain as well as precipitation and day-of-the-week effects using the following model

$$\begin{aligned} productivity_{ijt} = {} & \beta_0 + \gamma Gift_{it} + \beta_1 Mintemp_t + \beta_2 Maxtemp_t \\ & + \beta_3 Rain_t + \beta_4 Mintemp_t \times Rain_t + \beta_5 Maxtemp_t \times Rain_t \\ & + \beta_6 Tuesday_t + \beta_7 Wednesday_t + \beta_8 Thursday_t + \beta_9 Friday_t \\ & + \delta_j + \mu_i + \lambda_t + \epsilon_{ijt} \end{aligned} \tag{5}$$

where $Rain_t$ denotes daily precipitation (measured in millimeters), and $Tuesday_t, \ldots, Friday_t$ represent binary variables, each taking a value of 1 if planting is done on the corresponding day, and 0 otherwise. Interactions between the minimal and maximal temperatures with rain are added to allow the effects of rain on productivity to depend on the temperature. Moreover, δ_j represents a block specific fixed effect introduced to capture ground conditions on block j.[19]

Results of the extended model are presented in the second column of Table 2. We find a significant negative relationship between average planter productivity and precipitation. We also find that the negative effect of rain is significantly smaller on days with higher maximal temperature. Moreover, an F-test easily rejects the null hypothesis of no day of the week effects (p-value $= 0.006$). Similarly, an F-test of the joint significance of the block fixed effects δ_j easily rejects the null hypothesis that differences in terrain across blocks does not affect planter productivity (p-value $= 0.000$). More importantly, we find that the estimated effect of the gift on average planter productivity is 132.371 and remains significant. These results suggest that the effect of the gift measured on the experimental block remains robust even when accounting for day-of-the-week effects.[20]

[19] Again, the standard errors of the estimated parameters in this model only need to be corrected for clustering due to the daily random shock λ_t as the model controls for planter and block specific fixed effects.

[20] We also tested whether the gift had any lasting effects on productivity by adding a dummy variable for the following Monday, that is the first day of work after the gift was given. We did not find evidence that average productivity of the crew was significantly different on the following Monday, suggesting that the bulk of the effect of the gift is observed only on the day it is given. Similar results were obtained in the field by Gneezy and List (2006).

The estimated standard errors reported in Table 2 are robust to daily random effects and arbitrary forms of heteroscedasticity. They do not, however, account for possible serial correlation in λ_t or ϵ_{it}. If these terms were serially correlated, then regression residuals should vary systematically across time for all planters. Fig. 1 presents plots of the regression residuals versus time, separately for each of the 18 planters. The residuals are based on the estimates presented in the second column of Table 2.[21] There is little in these graphs to suggest that serial correlation is a problem in our data. More formally, we estimated a planter specific correlation coefficient ρ_i by regressing residuals on their lagged value.[22] In all but one case we were unable to reject the null hypothesis that ρ_i is equal to zero. In light of these results, we are confident that we can ignore any possible serial correlation in the disturbances of our model.

6.1. Worker tenure and the response to gifts

The previous results suggest the presence of a significant response to the gift on the part of the workers. A distinctive feature of economic firms is the presence of ongoing relationships with its workers. Theoretical models of gift exchange have emphasized the effects of tenure on reciprocity. This can be due to workers developing sentiment for the firm (Akerlof, 1982) or repeated interaction reducing social distance.[23] It is of some interest then to consider the relationship between tenure and response within our experiment.[24] To do so, we extend (4) and (5) to allow for interaction terms between tenure, age and the $Gift_{it}$ variable; we estimate the following model

$$\begin{aligned} productivity_{ijt} = {} & \beta_0 + \gamma_0 Gift_{it} + \gamma_1 Gift_{it} \times Age_i + \gamma_2 Gift_{it} \times Tenure_i \\ & + \gamma_3 Gift_{it} \times Tenure_i \times Age_i + \beta_1 Mintemp_t + \beta_2 Maxtemp_t \\ & + \delta_j + \mu_i + \lambda_t + \epsilon_{ijt} \end{aligned} \tag{6}$$

where $Gift_{it}$ is now interacted with Age_i, the age (in years) of planter i, and $Tenure_i$, the number of completed years of work in the firm.

The regression results, using both the data from the experimental block (column 1) and the extended data set (column 2), are presented in the first two columns of Table 3. We focus initially on the estimates from the experimental block. The leading term in the gift variable captures the effect of the gift on planters with both age and tenure equal to zero, a parameter which has no clear economic interest. As might be expected, this parameter is imprecisely measured, and is only significant at the 10 percent level. The tenure term on the other hand is positive and precisely measured (p-value = 0.000), while the interaction of tenure with age is found to be negative and significant, suggesting that the effect of tenure on worker response diminishes with age. The results in the extended sample are, in general, qualitatively and statistically similar to the results in the experimental sample, although the leading gift term is now insignificant and the linear effect of age is now estimated to be positive and significant (at the 5 percent level). More importantly, the interaction between tenure and the gift remains positive and statistically significant and the interaction between age, tenure and the gift remains negative and significant.[25]

Given these results, tenure is clearly important in determining response, consistent with workers developing sentiment for the firm (or reducing social distance). Yet, these effects are not independent of age, suggesting that social interaction becomes more difficult as one gets older. The marginal effect of tenure on response is positive when evaluated at the average age in the sample (equal to 38.89 years) for both data sets. The individual marginal effects are also positive based on the results from the experimental block alone. Based on the results of the extended sample the tenure profile is predicted to be negative for 2 of the participants—aged 49 and 55.

To appreciate better the estimated heterogeneity in individual responses to the gift across age and tenure, we predicted each planter's response using the parameter estimates taken from the first column of Table 3.[26] Table 4 presents the results for each of the 18 planters, sorted by tenure. We find substantial heterogeneity in the predicted responses to the gift; the predicted responses are all positive and vary between 26 trees and 418 trees. Moreover, the predicted responses are significant (at the five percent level) for 14 of the 18 planters.

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21 Similar graphs are obtained for the other regressions.

22 We specified $\hat{r}_{it} = \rho_i \hat{r}_{it-1} + v_{it}$ for all i, where $\hat{r}_{it}$ denotes the residuals, and v_{it} is a white noise disturbance. Estimation of ρ_i was performed using the OLS estimator for all i.

23 Recent experimental evidence suggests that the importance of reciprocity may differ between long-term and short-term relationships (Gächter and Falk, 2002).

24 The 18 planters who participated in our experiment have different past histories with the firm: 8 of them are in their first year of planting with the firm, 3 are in their second year, 1 is in his fourth year, 3 are in their sixth year, and 3 are in their 15th year.

25 More flexible functional forms may pick up possible non-linear relationships between response and tenure. Including dummy variables for different tenure levels in (6) preserves the same general form of the response function (high-tenure workers react more than do low-tenure workers) although the response is not necessarily increasing for all levels of tenure. Given the small number of observations involved (eighteen) caution should be exercised in seeking and/or interpreting the exact form of the response function; we present the linear case as a first approximation to the actual function.

26 From (6), it follows that the response of a given planter to the gift is given by $\gamma_0 Gift_{it} + \gamma_1 Gift_{it} \times Age_i + \gamma_2 Gift_{it} \times Tenure_i + \gamma_3 Gift_{it} \times Tenure_i \times Age_i$. Setting $Gift_{it} = 1$, we calculate the predicted response of planter i by replacing unknown parameters with model estimates $\hat{\gamma}_0 + \hat{\gamma}_1 Age_i + \hat{\gamma}_2 Tenure_i + \hat{\gamma}_3 Tenure_i \times Age_i$.

Table 3
Results of the extended model with and without the non-experimental data.

Day of gift	109.677*	−28.350	158.106*	46.057
	(62.109)	(55.999)	(76.949)	(57.549)
Day of gift × Age	−1.675	2.639**	−4.188	−1.154
	(2.042)	(1.136)	(2.791)	(1.277)
Day of gift × Tenure	53.564***	94.586***	55.983***	97.555***
	(11.144)	(4.919)	(11.245)	(5.184)
Day of gift × Age × Tenure	−0.931**	−1.988***	−0.973**	−2.039***
	(0.355)	(0.132)	(0.361)	(0.137)
Day of gift × Return			63.963*	93.464***
			(32.422)	(18.795)
Minimum temperature	39.358**	7.753	39.150**	7.791
	(13.815)	(4.734)	(14.131)	(4.737)
Maximum temperature	−13.975***	−1.373	−13.804***	−1.360
	(1.536)	(2.577)	(1.641)	(2.577)
Rain		−60.089***		−60.126***
		(17.707)		(17.729)
Minimum temperature × Rain		−3.493		−3.496
		(2.558)		(2.561)
Maximum temperature × Rain		4.304**		4.307**
		(1.771)		(1.773)
Tuesday		46.444**		46.497**
		(22.324)		(22.331)
Wednesday		54.495*		54.629*
		(30.571)		(30.593)
Thursday		54.842**		54.918**
		(20.353)		(20.365)
Friday		−24.962		−24.907
		(26.604)		(26.567)
Constant	1128.270***	845.052***	1126.428***	845.049***
	(132.072)	(74.946)	(135.568)	(74.982)
Experimental data only	Yes	No	Yes	No
F-test (H_0: No weekday effects)		4.000***		3.990***

Planter fixed effects are not reported in the table. Standard errors (in parentheses) are robust to daily random effects and arbitrary forms of heteroscedasticity.
* Significance at the 10% level.
** Significance at the 5% level.
*** Significance at the 1% level.

A related question of economic interest concerns the profitability of the gift. We note that overall the gift was not profitable for the firm. The output price received by the firm for trees planted was $.35 per tree—the average increase in productivity of 118 trees therefore generated only $41.30 in revenue on the day of the gift, and no significant (average) response on the days following the gift. In the final column of Table 4 we present the predicted value of the response to the firm for each worker. We note that the response was not profitable for any of the planters.

One possible explanation for the positive relationship between the responses to the gift and tenure is that workers with higher tenure also have higher intrinsic planting ability, making it less costly for them to increase their effort in response to the gift. Investigating this issue requires obtaining a measure of planting ability for each worker which can be related to worker tenure. Here, we use estimated planter fixed effects μ_i obtained by estimating model (5) using only productivity data off the experimental block.[27] These fixed effects measure worker productivity net of differences in weather and planting conditions under which planters have worked.[28] We then regressed predicted planter ability $\hat{\mu}_i$ on Age_i, $Tenure_i$, and $Tenure_i^2$, the latter of which is added to capture possible non-linearities between ability and tenure. We find that the effect of age is insignificant, and that the linear and quadratic variables in tenure are jointly insignificant (p-value $= 0.133$).[29] This suggests that planters with higher tenure do not have significantly different planting abilities.

7. Discussion

These results highlight the importance of long-term relationships in determining the response to gifts. Long-term relationships lead to repeated interaction, allowing workers to develop sentiment for the firm. In the model we developed

[27] We removed the $Gift_{it}$ variable when estimating this model.
[28] Estimating planter fixed effects in (5) using only productivity off the experimental block helps to obtain more precise estimates of each μ_i than would otherwise be obtained using data on the experimental block alone. Moreover, excluding data from the experimental block prevents our estimates of μ_i from being contaminated by the experiment.
[29] All tests are based on robust standard errors. The linear and quadratic variables in tenure are also individually insignificant.

Table 4
Predicted productivity increase (in number of trees) in response to the gift for all 18 planters as a function of their age and years of completed tenure.

Age	Tenure	Predicted response	Value to the firm ($)
28	0	62.777***	9.415
23	0	71.152***	10.673
40	0	42.677*	6.401
38	0	46.027**	7.002
29	0	61.102***	9.165
42	0	39.327	5.899
20	0	76.177***	11.427
28	0	62.777***	9.415
31	1	82.455***	12.368
30	1	85.061***	12.759
23	1	103.300***	15.495
55	3	24.629	3.694
38	5	136.96***	20.544
24	5	225.58***	33.837
26	5	212.92***	31.938
38	14	300.63***	45.095
30	14	418.30***	62.745
49	14	138.83*	20.825

* Significance at the 10% level.
** Significance at the 5% level.
*** Significance at the 1% level.

in Section 5, this sentiment is captured by the worker's kindness function. Yet, long-term relationships can also lead to repeated-game effects—workers may supply effort in the hopes of receiving future gifts from the firm.

In general, it is difficult to distinguish repeated-game effects from repeated interaction within a real firm[30]; long-term relationships imply a past and a future. The fact that we attached the gift to an extremely rare event reduces the importance of repeated game effects but does not necessarily eliminate them—workers may respond in the hopes of receiving gifts in other contexts. However, some progress may be possible by considering individuals who are at the end of their tenure at the firm. Workers who know they will not be returning will gain little from future gifts. Consequently, their response to the gift should be smaller than that for returning workers if repeated game effects are important; they should show no response to the gift if repeated game effects are wholly responsible for the observed responses.

To consider the importance of repeated-game effects we collected data on whether or not workers returned to the firm in the year following the gift experiment. We found that 9 of the 18 planters did return in the following year. Based on this information we generated a dummy variable, $Return_i$, taking a value of 1 if individual i returned the following year, 0 otherwise. We then included $Return_i$ in the estimated gift-response function of each worker, re-estimating (6). The results are presented in the last two columns of Table 3, for both the experimental block (third column) and the extended data set (fourth column). We note that the coefficient on $Return_i$ is positive and statistically significant (at the 1% level in the extended data set and at the 10% level on the experimental block) suggesting that some repeated-game effects are present. Nevertheless, repeated game effects do not completely determine worker response—the predicted response is positive and significant (at the 5 percent level) for all nine planters who did not return in the following year.[31] What is more, the tenure coefficient is still positive and statistically significant implying that repeated interaction and worker sentiment remain important determinants of response. In fact, a comparison with the estimates without the *Return* variable (first two columns of Table 3) reveals that the coefficients on tenure and age are largely unchanged from the previous model both with and without the non-experimental data. This is because the *Return* is orthogonal to tenure and age in our data.[32]

Another issue that warrants discussion concerns the external validity of our results. In general, responses in other environments may differ from the observed experimental response. This may be due to differences in the importance of long-term relationships across firms or industries—recall that a large proportion of the workers in this firm had very low tenure levels and hence low predicted responses—but also due to variations in the personnel policies which affect effort levels. The workers in our experiment receive explicit incentives to provide high effort in the absence of gifts—they are paid piece rates. Empirical work repeatedly finds worker effort to be lower under fixed wages than piece rates; see, for example,

[30] Brown et al. (2004) overcome this problem by using controlled laboratory experiments. They report evidence suggesting that repeated game effects and repeated interaction are both significant determinants of worker response to gifts from their employers.

[31] The predicted responses for these nine planters range from 50 to 220 trees.

[32] A probit regression of *Return* on tenure, age and productivity has no explanatory power.

Lazear (2000), Paarsch and Shearer (2000) and Shearer (2004). If an agent's marginal cost of effort is increasing sufficiently quickly, one would expect larger responses to gifts in such low-effort environments.[33]

Reference dependent preferences and income targeting (Tversky and Kahneman, 2000) may also have reduced the observed experimental response. Broadly speaking, reference dependent models argue that large exogenous increases in income make it easier for workers to exceed their subjective daily income targets, or reference points. Since there is a diminishing marginal benefit to exerting effort beyond these reference points, the exogenous increase in income lowers incentives to exert effort and hence reduces daily productivity. Fehr and Goette (2007) have shown that income targeting may occur in piece-rate environments.[34] The positive response to the gift in our experiment suggests that any influences of reference-dependent preferences were not strong enough to offset the reciprocal behaviour triggered by the gift. However, if reference-dependent preferences have less effect on worker effort under fixed wages then the response to gifts may be larger in those environments than under piece rates.

8. Conclusions

We have presented results from a field experiment directly measuring worker response to a monetary gift from their employer. We have used payroll data on tree planters who were observed working on several blocks of land over several days. Each planter received a surprise bonus from the firm on one of the planting days. We estimated the effect of the gift on planter productivity, controlling for planter-fixed effects, weather conditions, and other random daily shocks. Our results suggest that the planters have responded to the gift from the firm by significantly raising their productivity. Moreover, we found that the response to the gift is heterogeneous, with 14 out of 18 planters predicted to respond significantly to the gift.

These results have a number of implications for the literature on gift giving and incentives. First, and perhaps most importantly, they suggest that workers do respond to monetary gifts within an actual firm—gifts can be used as an incentive mechanism, at least in the short run. This is consistent with laboratory evidence on worker response to gifts (see, for example, Fehr et al., 1993; Hannan et al., 2002; and Charness, 2004) and adds to a growing body of literature using field experiments to investigate incentive effects (Shearer, 2004; Bandiera et al., 2007; Paarsch and Shearer, forthcoming). The fact that the generated response is only evident in the short term—no significant effect was found on subsequent planting days—is consistent with Gneezy and List (2006). Yet Gneezy and List found that the response to the gift had dissipated by the end of the work day on which the gift was given. Future research seeking to measure the dynamic aspects of gifts within actual firms, particularly within the same day, would be useful.

These results also suggest that both repeated interaction and repeated-game effects play a role in determining the workers' response to gifts. More research will be helpful to characterize further their relative importance in real economic firms. One possibility comes from temporary, immigrant workers. Such workers may have little prospect of returning to the same firm, reducing the importance of repeated-game effects. Field experiments conducted on these workers would be a promising avenue of future research. Alternatively, these different explanations may imply different theoretical restrictions on equilibrium worker behaviour, providing a role for structural econometric models to distinguish between them.

These results also suggest that personal characteristics affect a worker's response to gifts. In general, the ability to identify this response function is limited by variation in the data and the sample size. We have provided evidence that the response function depends on worker tenure in the firm and age—high-tenure workers typically respond more to gifts than do low tenure workers and the effect of tenure diminishes with age. Fully characterizing this function with larger samples of workers, and linking its characteristics to theoretical models of gift exchange, is another important task for future research.

Finally, the worker's average reciprocal increase in productivity generated considerably less revenue than the original gift from the firm ($80). This raises questions as to the profitability of gift giving inside the firm. While our results might be interpreted as explaining why this firm does not normally use gifts to motivate its workforce, it may still be the case that optimal (possibly smaller) gifts are profitable. One approach to answering this question would be to use (experimental) data to estimate structural parameters (e.g. the cost of effort) which could be used to solve for the optimal gift-incentives combination for the firm.[35] We leave this task for future research.

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[33] This point can be illustrated using the model of Section 5. Recall that $\theta = \frac{1}{\gamma - 1}$ where γ captures the curvature of the cost of effort function. Assuming that $\gamma > 2$ (hence that $0 < \theta < 1$), we find that the marginal effect of the gift G on worker effort given in (1) is decreasing with r; i.e.,

$$\frac{\partial^2 e^G}{\partial r \partial G} = (\theta - 1)\theta\beta[r + \beta G]^{\theta - 2} S^{\theta} < 0. \tag{7}$$

Paarsch and Shearer (forthcoming) find that $\hat{\theta} = 0.390$ in the tree planting industry.

[34] Also see Camerer et al. (1997).

[35] See Paarsch and Shearer (forthcoming) for an example of this approach.

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