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Gift-exchange vs. repeated interaction as a source of reciprocal behavior: The optimal provision of incentives over the course of careers*

Preliminary Version - do not cite or circulate

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Humans reciprocate. We want to return favors we have received, but also respond appropriately to behavior that we regard as unfair against us. Whereas previous research has typically tried to isolate the most prominent explanations for reciprocal behavior - inherent preferences for reciprocity and repeated interaction - the present paper addresses the question if and how those interact. Developing a theoretical model of a long-term employment relationship, we first show that reciprocal preferences are more important when an employee is close to retirement. At earlier stages, repeated interaction is more important because more future rents (which increase players' commitment in this case) can be used to provide incentives. Preferences for reciprocity still affect the structure of an employment relationship early on, though, because of two reasons. First, preferences for reciprocity effectively reduce the employee's effort costs. Second, they allow to relax the enforceability constraint that determines the principal's commitment in

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the repeated interaction. We test our main predictions using data from the German Socio-Economic Panel (SOEP) and find cross-sectional evidence for a stronger positive effect of positive reciprocity on effort and wages for older workers.

Keywords: reciprocity; relational contracts, dynamic incentives

JEL Classification Numbers: C73, D003, D21, D22, D86

1 Motivation

Humans reciprocate. They repay kindness with kindness and hostility with hostility. Several possible explanations exist for why individuals display reciprocal behavior, where the most prominent ones are inherent preferences for reciprocity and repeated interaction (see Sobel, 2005, for an excellent overview of mechanisms). Whereas inherent preferences for reciprocity reflect the idea that an individual can enjoy additional utility when returning favors one has received (based on Akerlof (1982)’s conceptual idea of gift exchange), repeated interaction can give rise to reciprocal behavior even if individuals only care about their own material payoffs. A vast amount of evidence supports both channels for reciprocal behavior, however mostly trying to isolate one from the other.

In this paper, we address the questions whether inherent preferences for reciprocity are also relevant in long-term employment relationships, and if and how they affect incentives generated by repeated interaction. We show that both kinds of incentives optimally do interact with each other, and that their relative importance depends on the phase of a long-term employment relationship. At early stages, incentives generated by repeated interaction are more important because more future rents can be used to provide incentives. At later stages, reciprocity-based incentives become more and more important and gradually replace repeated-game incentives. However, preferences for reciprocity are still important for the structure of the employment relationship early on: First, they reduce an employee’s effective effort costs. Second, they relax the employer’s enforceability constraint which determines their commitment in the long-run relationship. After deriving these – and other – results within a theoretical model, we test its implications using data from the German Socio-Economic Panel (SOEP). As predicted, we find evidence for a positive effect of reciprocity on effort and wages, and that this effect is stronger for older workers.

There is a plethora of evidence showing that a substantial fraction of individuals behave in accordance with the norm of reciprocity, even when present or future material benefits are ruled out (Fehr and Gächter, 2000, see the literature section for additional evidence). This is important for organizations because the existence of reciprocal agents has the potential to influence the employment relationship in fundamental ways. Especially in firms where contracts are often incomplete by nature, and usage of high-powered explicit incentives comes with the caveat of being restricted by the limited measurability of effort, reciprocal behavior of employees has the potential to alleviate contractual inefficiencies. But employment relationships are inherently dynamic, and most of the approaches identifying reciprocal preferences have been careful in muting

all incentives potentially stemming from repeated interaction.

Some recent experimental studies have started to address this issue by disentangling strategic (i.e., generated by repeated interaction) and intrinsic motives for cooperation. Reuben and Suetens (2012) use an infinitely-repeated prisoner's dilemma¹ to assess the relative importance of strategic motives and intrinsic reciprocity and find that cooperation is mostly driven by strategic concerns. Similarly, Dreber et al. (2014) find that strategic motives seem to be more important than social preferences in an infinitely repeated prisoner's dilemma. Cabral et al. (2014) conduct an infinitely repeated veto game to distinguish between different explanations for generous behavior. They find strategic motives to be the predominant motivation, however also present some evidence for the importance of intrinsic reciprocity. Johnsen and Kvaløy (2014) use a two-period trust game where some subjects know that they meet twice and others do not, therefore either allowing for strategic behavior or ruling it out. They find that cooperation increases if strategic behavior is ruled out and conclude that strategic considerations crowd out intrinsic reciprocity.

Hence, experimental evidence suggests that strategic motives are not only relevant in situations of repeated interaction, but rather seem to be the dominant mode to support cooperation. However, to understand how cooperation is achieved in long-term employment relationships and not only in standard experimental games, real-world evidence is needed. This is problematic, though, because of the difficulties involved with observing worker characteristics and effort. As a potential solution Dohmen et al. (2009) apply data on direct, individual-level survey measures for reciprocity from the German Socio-Economic Panel (SOEP) (where individuals are asked for their reciprocal inclinations). Using an individual's decision to work overtime as a proxy for non-verifiable effort, they show that reciprocal inclinations are linked to high effort, high wages, and general life success. Whereas their results support the notion that reciprocal preferences help to enforce effort, they do not explore the role of repeated-game incentives in supporting cooperation. Hence, the starting point of this paper is to further explore the association of reciprocity, wages and effort using the real-world data also used by Dohmen et al. (2009) – with the aim to detect differences depending on the stage of employees' careers. The idea behind this distinction is driven by the fact that repeated-game incentives can only be applied if the *future* value of a relationship is sufficiently high. Therefore, one would expect repeated-game incentives to be relatively more important in early, and incentives making use of intrinsic reciprocity to be relatively more important in the final stages of careers. Indeed, we are able to refine the findings of the original study by Dohmen

¹More precisely, the continuation probability after each round is 0.6.

et al. (2009): when dividing our sample by age and by proximity to retirement, we find that the positive effect of positive reciprocity on discretionary effort exerted is driven by older employees / employees that are relatively close to retirement.

Inspired by these findings, we develop a dynamic principal-agent model with a finite time horizon, where the agent is protected by limited liability. Effort is observable but not verifiable and yields a verifiable output measure. Hence, standard bonus contracts based on output are feasible but necessarily associated with a rent going to the agent. Furthermore, the agent reacts reciprocally towards any *voluntary* rent, i.e. any unconditional wage payment. Therefore, our notion of reciprocity is a hybrid between intention- and outcome-based models. This takes into account empirical evidence that individuals respond to outcomes, however that intentions often matter as well. Now, effort incentives are also generated by a fixed wage payment. We first find that in a static spot contract, the principal either uses a standard bonus contract (with a zero wage) or a “reciprocity contract” (with no bonuses), but not combination of the two. A reciprocity contract is naturally optimal if the agent’s preferences for reciprocity are sufficiently strong; furthermore, the principal’s profits, effort, and the agent’s utility are increasing in the degree of the agent’s preferences for reciprocity.

But the principal is also able to provide repeated-game incentives based on effort – using so-called relational contracts. There, we assume that once the principal reneged on promises made in the relational contract, the agent’s preferences for reciprocity towards the principal disappear. Therefore, relational contracts are potentially feasible in all periods beside the last, despite the existence of this predetermined last period: A relational contract can only work if the principal’s behavior affects her future profits, in a sense that paying a promised effort-based bonus triggers higher continuation profits than refusing to pay it. Now, the principal can be punished for reneging on a bonus if a reciprocity contract is optimal in a spot relationship – because afterwards she only has the option to use (less profitable) bonus spot contracts.

Since relational contracts work better if total future rents on the equilibrium path are higher, they are more efficient in early stages of the relationship (i.e., with more periods to come) – but also if the agent’s preferences for reciprocity are more pronounced: Then, the principal has more to lose when reneging, because the difference between profits generated by a reciprocity contract and the profits generated by a bonus contract in the last period is larger. This is the first source of complementarity between relational and reciprocity contracts.

Moreover, there exist two additional channels how the agent’s reciprocal inclinations affect the relational contract. First, giving the agent an extra rent effectively reduces his

effort costs. Therefore, it is optimal for the principal to give the agent an extra rent, even though this is not necessary because a relational contract is based on effort. Second, the enforceability of effort in the relational contract is determined by a so-called dynamic enforcement constraint, which states that the effort-based bonus must not exceed the difference between future discounted profits on and off the equilibrium path. If this constraint binds (which is more likely in later stages of the employment relationship), granting the agent an extra rent relaxes this constraint and allows to enforce higher effort.

Therefore, incentives triggered by reciprocal preferences and relational contracts are *complements* if a given point in time is considered. They are dynamic *substitutes* in a sense that – as time proceeds – relational contracts incentives are gradually replaced by reciprocal incentives.

This yields the following dynamics: At the beginning of the relationship, effort is at its highest level. It remains at this highest level as long as the dynamic enforcement constraint does not bind. As soon as it becomes binding, effort gradually goes down and reaches its lowest level in the last period of the game. The same holds for the agent's total compensation, where his fixed wage, is increasing over time. Furthermore, stronger reciprocal preferences on the agent's side increase effort and payments, and this effect gradually becomes stronger as soon as the dynamic enforcement constraint has become binding.

We explore the empirical validity of our outcomes using data from the German Socio-Economic Panel (SOEP), which is a representative panel survey containing ~12,000 households (~21,000 individuals). For our analysis, we restrict attention to employees, yielding a sample of ~8,000 individuals. The survey contains questions regarding the personal and socioeconomic situation of the individuals and also includes questions on labor market status and income as well as on attitudes on assorted topics. In the 2005 wave of the survey, the SOEP included measures of positive reciprocity, which each consisted of three self-report questions asking individuals to rate their reciprocal inclinations on a seven-point Likert scale. Following Dohmen et al. (2009), we use monthly and annual gross labor income as proxies for wages, and overtime as a proxy for non-contractible effort.

Our calculations largely confirm our model's predictions. In a logit regression, we regress a dummy variable taking a value of one if the respondent indicates that (s)he has worked overtime the month preceding the interview on the measures of reciprocity as well as on the controls. This regression reveals a positive significant effect of positive reciprocity. Thus, our results largely correspond to those reported by Dohmen et al.

(2009).

Furthermore, we find that the likelihood to work overtime goes down over time, as does the total income of an individual. Both of these results are in line with our theoretical model. To further explore its implications, we split our sample into two sub-samples consisting of individuals above and below the age of 60 to account for the fact that reciprocal inclinations in our model are much more important in later stages of the employment relationship. Remarkably, the effect of positive reciprocity on unpaid overtime is positive for young as well as for old workers, but *only significant for older workers* who are relatively close to retirement.

Furthermore, we include an interaction of positive reciprocity and retirement expectations to account for the fact that in our model, it is the proximity to the final period that determines the type of employment contract. We find that positive reciprocity only has a significant positive impact on overtime work if employees expect to retire within the next two years.

To further assess the robustness of our theoretical results, we make use of some additional survey measures which indicate how satisfied employees are with their jobs. In our model, employee satisfaction might be captured by the agent's utility. There, we find that an agent's utility increases with his reciprocal inclinations and that this effect becomes stronger over time. Empirically we find that an individual's degree of reciprocity is associated with a higher satisfaction, which is more pronounced for individual's above 60 – supporting our theoretical predictions.

Related Literature

The fundamental deviation from the assumptions of self-interest and greed is one of the most robust, thoroughly researched fundamentals in the field of behavioral economics (DellaVigna, 2009). There, inference on intrinsic reciprocity is based on Akerlof (1982)'s conceptual idea of gift exchange, i.e., that employees exert voluntary effort if they feel well treated by firms. Seminal work by Fehr et al. (1993, 1998) introduces the gift-exchange paradigm to experimentally test this concept has inspired a plethora of research that establishes the prevalence of gift exchange (see, e.g., Camerer and Weber, 2013, for an overview over existing experimental research).

Concerning real-world evidence, existing papers have linked firm-level proxies for reciprocity like screening for work ethic or personality to management practices and outcomes such as monitoring, teamwork, wage levels, and firm productivity, providing at least suggestive evidence for the importance of reciprocity in employment relationships

(Huang and Cappelli, 2010; Englmaier et al., 2015). Others use more direct, individual-level survey measures for reciprocity: for example, Leuven et al. (2005) link them to investment in training by firms. Based on a double moral-hazard problem that can be overcome with promotion incentives for reciprocal agents, Dur et al. (2010) use data from the German Socio-Economic Panel (SOEP) to show that reciprocal preferences are linked to performance appraisals, which serve as a proxy for promotion incentives. Using the same data set, Dohmen et al. (2009) show that reciprocal inclinations are linked to high wages, high effort, and general life success.

In sum, there is vast evidence pointing to the fact that reciprocity matters in employment relationships, theoretically as well as in the lab and in the field. However, existing research in this area does not explicitly distinguish between possible mechanisms but rather tries to capture each of them separately, for instance by explicitly ruling out future interaction. Exceptions are papers that demonstrate the endogenous formation of long-term relationships in the presence of instrumental reciprocity in the lab (e.g., Brown et al., 2004; Bartling et al., 2012). Hence, a comprehensive approach to the underlying mechanism capturing the role of reciprocal behavior for employment relationships is lacking.

Conceptually, several contracting papers exist that theoretically investigate the effects of intrinsic reciprocity and relational contracts employment relationships. Relational contracts have been characterized by Bull (1987) and MacLeod and Malcomson (1989), who observed that a possible payment scheme in repeated interaction with observable, but non-verifiable effort would be to pay a bonus conditional on effort exerted in addition to a performance-independent base wage (see Malcomson, 1999, for an overview). A decade later, Levin (2003) revived the literature by formalizing relational contracts.

Due to its behavioral foundation, the literature on intrinsic reciprocity is younger. For instance, Englmaier and Leider (2012) incorporate intrinsic reciprocity in a principal-agent model with moral hazard.

Our paper makes several contributions to the literature: To our knowledge, we are the first to explicitly combine both intrinsic preferences for reciprocity and repeated interaction in a contracting model. This allows us to derive specific predictions with respect to the interaction and relative importance of the two mechanisms. In light of the somewhat conflicting evidence on the interaction of the two mechanisms, we deliver new support for the complementarity of intrinsic and instrumental reciprocity. In contrast to early supporters of this view, our argument does not rely on signaling.

The remainder of this paper proceeds as follows: in section 2, we give a short overview of the general pattern we find in the data which serves as basis for the development of

our basic contracting model in section 3. Then, in section 4, we explore how the relationship between intrinsic reciprocity and effort is influenced by career advancement. In section 5, we explore some extensions, and section 6 concludes.

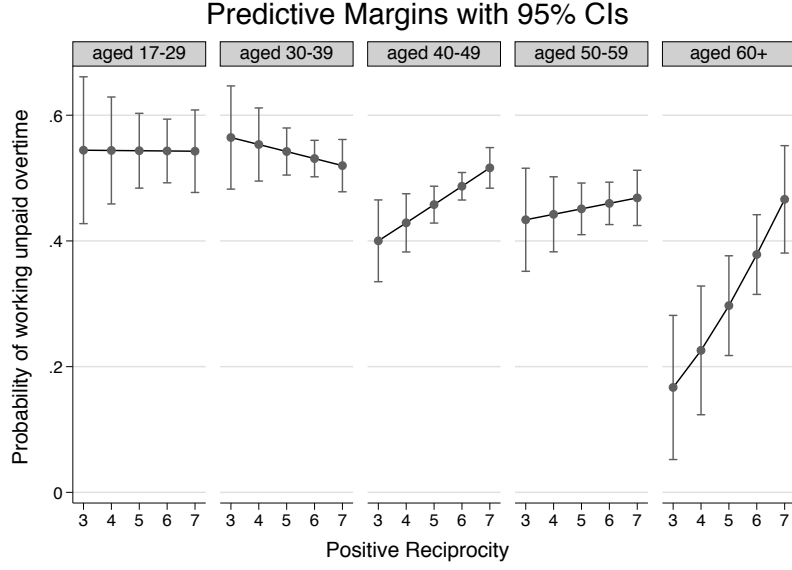
2 Reciprocity and Effort over the Course of Careers

We want to explore the extent to which an employee's reciprocal inclinations are optimally reflected in dynamic incentive systems. To develop a first idea, we use data from the German Socio-Economic Panel (SOEP), which is a representative panel survey containing $\sim 12,000$ households ($\sim 21,000$ individuals). A detailed description of the data and our empirical approach can be found below, in section 4. For now, note that the survey contains questions regarding the personal and socioeconomic situation of the individuals, as well as on their labor market status and income. In the 2005 wave of the survey, the SOEP also included measures of positive reciprocity, which each consisted of three self-reported questions asking individuals to rate their reciprocal inclinations on a seven-point Likert scale. The SOEP (unfortunately) does not contain information on the actual incentive systems respondents face, though, but there is a notion of exerted effort: Respondents can indicate whether they worked (paid as well as unpaid) overtime the month preceding the interview. Hence, we use this measure as a proxy for a respondent's (non-contractible) effort level.

The idea behind using effort as an indicator for the role of reciprocal inclinations in incentive systems is that a more pronounced role should be associated with a greater responsiveness of effort to reciprocity. This approach has initially been applied by Dohmen et al. (2009), who indeed find that a larger degree of (positive) reciprocity increases a respondent's likelihood of working overtime. We are able to confirm their results with a logit regression, regressing a dummy variable – which takes the value one if the respondent indicates that (s)he has worked overtime the month preceding the interview – on the measures of reciprocity as well as on controls.

In order to explore the dynamic aspects of this interaction, we investigate whether the responsiveness of effort to reciprocal preferences is different across different stages of a career. Thereby, we split our sample into different age groups and generally find a positive interaction between reciprocity and effort, which however is particularly pronounced for respondents who are at least 60 years old.

Figure 1 indicates that reciprocity is a less important factor to motivate employees at early stages of their careers. At these early stages, one might rather expect repeated-game incentives to matter more. Those only work if the future value of a relationship is



Notes: The figure plots predicted marginal changes of the propensity to work overtime at different levels of positive reciprocity depending on age group, holding all other factors constant.

Figure 1: Predictive marginal effects of positive reciprocity on effort by age group

large enough which requires a sufficiently long remaining time horizon.

We hence conjecture that repeated-game incentives are applied at early stages of employment relationships and gradually replaced by reciprocity-based incentives once retirement is approaching. This conjecture is supported by our next figure, where we split the full sample into two sub-samples consisting of individuals above and below the age of 60. Remarkably, the effect of positive reciprocity on (unpaid) overtime is positive for young as well as for old workers, but *only significant for older workers* who are relatively close to retirement.

In order to formally rationalize our conjecture regarding the relative importance of repeated-game versus reciprocity-based incentive over the course of careers and to develop further testable predictions, we proceed with developing a theoretical principal-agent model – where players interact repeatedly where the agent has inherent preferences for reciprocity.

3 Theoretical Model

3.1 Model Setup

3.1.1 Technology

There is one risk-neutral principal (“she”) and one risk-neutral agent (“he”). At the beginning of every period $t \in \{1, \dots, T\}$, with $1 < T < \infty$, the principal makes an employment offer to the agent. If the agent accepts the offer, he chooses an effort level $e_t \geq 0$, which is associated with effort costs $c(e) = e^3/3$. Furthermore, effort determines the probability with which a positive output – that is subsequently consumed by the principal – is realized. More precisely, the output is $y_t \in \{0, \theta\}$, with $\text{Prob}(y_t = \theta) = e_t$. Below, we will impose further assumptions to always guarantee an interior solution. If the agent rejects the offer, both players consume their exogenous outside options which for simplicity are set to zero.

3.1.2 Payments, Information & Contracts

The employment offer also includes a prospective compensation package. It consists of a fixed wage w_t and discretionary bonus payments. An *output-based* bonus b_t is supposed to be paid if $y_t = \theta$ (it is without loss of generality to assume that no output-based bonus is paid if $y_t = 0$), an *effort-based* bonus B_t is supposed to be paid if the principal’s requested effort level is chosen by the agent.

The output realization y_t is verifiable, and formal spot contracts can be used to enforce payment of b_t . Effort can be observed by both parties, however is not verifiable. Therefore, payment of B_t can only be enforced within a self-enforcing dynamic arrangement, a so-called relational contract. The agent is protected by limited liability, hence $w_t, b_t \geq 0$.

3.1.3 Preferences and Equilibrium

Given the agent has accepted the principal’s employment offer at the beginning of a period t , and denoting the on-path effort level e_t^* , the principal’s per-period profits on the equilibrium path are

$$\pi_t = e_t^* (\theta - b_t) - B_t - w_t.$$

The agent is also risk-neutral and in addition has preferences for reciprocity. Those are activated by any *non-contingent* payment he receives and thus potentially by fixed wages. However, note that a dynamic arrangement can either use current payments (in the form of bonuses) or future rents to motivate current effort – and the agent’s

preferences for reciprocity are not triggered by wages paid as a reward for past effort. It turns out though, that in our setting it is without loss of generality to assume that only current bonus payments are used to incentivize the agent. Taking this into account, we can assume that the agent's preferences for reciprocity are indeed activated by fixed wage payments. Then, upon accepting the principal's offer, the agent's per-period utility on the equilibrium path is

$$u_t = e_t^* b_t + B_t + w_t - \frac{e_t^3}{3} + \eta w_t e_t^* \theta,$$

The parameter $\eta \in [0, \infty)$ captures the agent's inherent preferences for reciprocity and lets the principal's output (potentially) enter his utility. Note that the agent's preferences for reciprocity in period t are only activated by wage payments received in period t – and not by received past or expected future payments.

Furthermore, η remains constant across periods, with one exception. If the principal has promised to pay a bonus B_t but reneges on that promise even though the agent has exerted the desired effort level, η drops to zero in all subsequent periods.

Finally, principal and agent share the discount factor $\delta \leq 1$, and we can use the following recursive formulations for players' discounted payoff streams:

$$\begin{aligned} \Pi_t &= e_t^* (\theta - b_t) - B_t - w_t + \delta \Pi_{t+1} \text{ and} \\ U_t &= e_t^* b_t + B_t + w_t - c(e_t^*) + \eta w_t e_t^* \theta + \delta U_{t+1}. \end{aligned}$$

In order to always guarantee an interior solution, we impose the technical assumptions $\theta < 3$ and $\frac{\eta \theta^2}{2} < 1$.

We apply subgame perfect equilibrium as the equilibrium concept. We are interested in a subgame perfect equilibrium that maximizes the principal's profits at the beginning of the game, Π_1 .

3.2 Formal Spot Contracts

We first derive a profit-maximizing spot contract. Besides serving as a benchmark, this contract will also be offered in period T , the last period of the game. In a spot contract, it is not possible to enforce a bonus based on non-verifiable effort, hence $B = 0$. Therefore, the only means to provide *direct* incentives is an output-based bonus b . Indirectly, though, the agent will also be incentivized by a positive fixed wage w . Recall that the agent's per-period utility equals $u = eb + w - e^3/3 + \eta we\theta$ (in this section we omit the time subscript). Because of his inherent preferences for reciprocity, a positive wage lets the output value also enter the agent's utility. Then, the agent's and principal's

interests become partially aligned. Taking a slightly different perspective, one can also regard positive values of w and η as triggering a reduction of the agent's effective effort to $(e^*)^3/3 - \eta w e^* \theta$.

Given b and w , and presuming he decides to work for the principal, the agent chooses effort e^* in order to maximize his per-period utility u . The conditions for using the first order approach hold, hence the agent's incentive compatibility (IC) constraint gives

$$e^* = \sqrt{b + \eta w \theta}. \quad (\text{IC})$$

The principal sets b and w to maximize her per-period profits $\pi = e(\theta - b) - w$. However, she has to take into account that it must be optimal for the agent to accept the contract in the first place. The latter is captured by the agent's individual rationality (IR) constraint,

$$e^* b + w - \frac{(e^*)^3}{3} + \eta w e^* \theta \geq 0. \quad (\text{IR})$$

Furthermore, because of limited liability, payments must be non-negative.

Concluding, the principal's problem is to

$$\max_{w, b} e^* (\theta - b) - w,$$

subject to (IR) and (IC) constraints, and $w, b \geq 0$.

As a first result, we show that either only wages or bonus payments are used, not a combination of both.

Lemma 3.1. *Either bonus or wage payments are used to give incentives in a profit-maximizing spot contract. More precisely, there exists a threshold $\bar{\eta} > 0$ such that $b > 0$ and $w = 0$ for $\eta < \bar{\eta}$, and $b = 0$ and $w > 0$ for $\eta \geq \bar{\eta}$.*

The proof of this Lemma as well as all other omitted proofs can be found in the Appendix.

Intuitively, bonus and wage payments are never used together because they are substitutes in the principal's profit function: Plugging $e^* = \sqrt{b + \eta w \theta}$ into per-period profits $\pi = e^* (\theta - b) - w$, the cross derivative with respect to w and b is negative. Put differently, for any bonus level the marginal profitability of using a bonus is decreasing in the wage. Therefore, either a pure *bonus contract* ($b > 0$ and $w = 0$) or a pure *reciprocity contract* ($b = 0$ and $w > 0$) is implemented by the principal.² When a reciprocity contract is used,

²Note that because the principal's outside option is zero, profits under the bonus contract ($\pi = \frac{2\theta}{3} \sqrt{\frac{\theta}{3}}$) are strictly positive. Therefore, the principal will in any case make an employment offer to the agent.

a higher value of η is associated with lower effective effort costs and consequently also larger profits. Since the profitability of a bonus contract with a zero-wage is naturally unaffected by the size of η , a reciprocity contract is optimal given that η is sufficiently high.

The positive relationship between intrinsic reciprocity η and outcomes in the reciprocity contract is summarized in the following Corollary:

Corollary 3.1. *Given $\eta \geq \bar{\eta}$ and hence a reciprocity contract is used, $\frac{de^*}{d\eta} > 0$, $\frac{d\pi}{d\eta} > 0$, $\frac{dw}{d\eta} > 0$, and $\frac{du}{d\eta} > 0$.*

Proof. [Proof of Corollary 3.1.] Using a reciprocity contract, outcomes are $e^* = \eta\theta^2/2$, $\pi = \frac{\eta\theta^3}{4}$, $w = \eta\theta^3/4$ and $u = \frac{\eta\theta^3}{4} + \frac{\eta^3\theta^6}{12}$, which all are increasing in η . \square

Finally, note that the agent always gets a rent, that is, $u > 0$ under both types of contracts. This is straightforward for the reciprocity, but also for the bonus contract because of the agent's limited liability constraint. However, note that even without a limited liability constraint (implying that when using a bonus contract, the principal could extract the whole rent), a reciprocity contract would eventually be optimal because of the associated reduction of effective effort costs. Then, only the threshold $\bar{\eta}$ would be larger.

3.3 Relational Contracts

Now, we will analyze how self-enforcing relational contracts can be used to motivate the agent. Different from both kinds of spot contracts, those can be based on effort. The principal would also prefer an effort-based over an output-based contract because – as derived in the previous section – limited liability requires to grant the agent a rent in the latter case. With reciprocal preferences, the agent is also granted a rent, which however makes it cheaper to provide incentives.

Two aspects are of particular interest, namely the enforceability of relational contracts and if and how they are affected by the agent's preferences for reciprocity. We will explore these aspects in the next subsections and furthermore derive the properties of a profit-maximizing relational contract.

3.3.1 Preliminaries

Relational contracts are self-enforcing implicit arrangements between economic agents. They work if the future surplus of continuing a cooperative relationship is sufficiently large compared to the future surplus without cooperation. Informally speaking, a

relational contract in our setting involves a request from the principal to the agent to exert an effort level e_t^* (recall that effort can be observed by the principal), combined with a promise to pay the reward B_t in return. However, it must be in the principal's interest to pay the bonus when supposed to do so, which is specified by a dynamic enforcement (DE) constraint for every period t ,

$$-B_t + \delta \Pi_{t+1} \geq \delta \tilde{\Pi}_{t+1}. \quad (\text{DE})$$

Π_{t+1} describes the principal's on-path and $\tilde{\Pi}_{t+1}$ her off-path continuation profits. The (DE) constraint captures the requirement that future on-path profits must be sufficiently high compared to future off-path profits so that they offset today's costs of paying the bonus. Note that since the period- t output has already been realized and consumed, it is not included in the (DE) constraint and hence considered as sunk by the principal when making the decision whether or not to pay B_t . (DE) indicates that a bonus payment is only feasible if $\Pi_{t+1} > \tilde{\Pi}_{t+1}$, i.e., if future equilibrium play can be made contingent on the principal's current behavior.

Generally, relational contracts require a (potentially) infinite time horizon because of a standard unravelling argument that can be applied once a predetermined last period exists. Then, the equilibrium outcome in the last period is unique, implying the same for all subsequent periods. In our case, however, the situation is different if the spot reciprocity contract is (strictly) more profitable than the spot bonus contract, i.e., if $\eta > \bar{\eta}$. In this case the principal's behavior in a period $t < T$ affects her future profits because A) the optimal spot contract is implemented (at least) in period T , and B) refusing to pay a promised bonus B_t lets η drop to zero. Therefore, the spot reciprocity contract is not feasible anymore once the principal reneged on a promise, and reneging is costly if $\eta > \bar{\eta}$.

In addition, relational contracts are not feasible anymore once the principal refused to pay a promised bonus. (e.g., Abreu, 1988, shows that an observable deviation should be punished by a reversion to a player's minmax-payoff) Hence, after a deviation by the principal, spot bonus contracts are implemented in every subsequent period,³ and off-path continuation profits are $\tilde{\Pi}_t = \sum_{\tau=t}^T \delta^{\tau-t} \frac{2\theta}{3} \sqrt{\frac{\theta}{3}} = \frac{1-\delta^{T-t+1}}{1-\delta} \frac{2\theta}{3} \sqrt{\frac{\theta}{3}}$.

For $\eta \leq \bar{\eta}$, equilibrium profits in period T are unique, hence no relational contracts are feasible, and the profit-maximizing spot bonus contract will be implemented in every

³Because those are profitable, subgame perfection implies that the relationship is not terminated after a deviation.

period.⁴ To keep the analysis interesting, we will from now on assume that

$$\eta > \bar{\eta}.$$

This assumption is backed by the data we use for our empirical analysis, where the variable measuring positive reciprocity is relatively high for most individuals. The assumption also implies that a relational contract does not involve an output-based bonus b_t because it is dominated by using a fixed wage. Therefore, incentives are potentially given by a non-discretionary fixed wage w_t and an effort-based bonus payment B_t .

As mentioned above, we also assume that in a given period t , the agent is only motivated by period- t payments. This assumption is without loss of generality, for the following reasons: Generally, incentives in relational contracts can be provided via contingent current or future payments. In a setting like ours, though, replacing contingent future payments with the equivalent and appropriately discounted current amount does neither affect today's profits nor any constraints. Furthermore, sticking to current discretionary payments simplifies our analysis because the agent's reciprocal preferences are triggered only by unconditional payments. If a future wage were paid as a compensation for previous effort, we would have to differentiate between wages that are paid as a compensation for past effort and those that are not (if *any* fixed-wage payment triggered reciprocal behavior, using wages would be effectively cheaper than bonus payments, making it optimal to backload wages as much as possible).

3.3.2 Incentive Compatibility

The relational contract specifies an effort level e_t^* that the agent is supposed to exert on the equilibrium path. He will do so if his (IC) constraint is satisfied. Before stating this constraint, we have to specify what happens if he deviates in a period t . First, he does not receive the period- t bonus B_t . Second, we assume that after a deviation by the agent, the reciprocity parameter is *not* reduced but remains at η , and third, that continuation play is not affected by the agent's behavior. The second assumption is not crucial for our results, but it seems more realistic to presume that the degree of the agent's reciprocal

⁴We assume that no formal long-term contracts based on output realizations are feasible. This can be endogenized by assuming that the principal is not able to commit to fire the agent. If she were able to do so, a long-term contract involving a positive termination probability following a number of low output realizations would yield higher profits than a series of spot contracts (see Ohlendorf and Schmitz; Fong and Li). Still, the possibility to write such a long-term contract would have no qualitative effect on our results, in particular with respect to the impact of the agent's reciprocal preferences on a profit-maximizing agreement.

preferences only depends on the principal's behavior. It implies that if the agent deviates, he does not necessarily deviate to an effort level of zero. The third assumption, however, is crucial for our results because the agent's rent under a reciprocity contract might be higher than under a relational contract (see below). Therefore, if the agent's behavior affected continuation play, and in particular if a deviation triggered a breakdown of the relational contract, the agent might be tempted to deviate in order to enjoy the higher rent of a reciprocity contract in the future.

Concluding, for any off-path effort level \tilde{e}_t , the (IC) constraint equals

$$B_t + w_t - \frac{(e_t^*)^3}{3} + \eta w_t e_t^* \theta \geq w_t - \frac{(\tilde{e}_t)^3}{3} + \eta w_t \tilde{e}_t \theta.$$

Subgame perfection implies that if the agent deviates, he will select an effort level $\tilde{e}_t = \arg\max (-e^3/3 + \eta w_t e \theta)$, i.e., $\tilde{e}_t = \sqrt{\eta w_t \theta}$. Hence, the (IC) constraint becomes

$$B_t - \frac{(e_t^*)^3}{3} + \eta w_t e_t^* \theta \geq 2/3 \left(\sqrt{\eta w_t \theta} \right)^3. \quad (\text{IC})$$

This implies that an (IR) constraint for the agent is automatically satisfied because his per-period rent, $B_t + w_t - (e_t^*)^3/3 + \eta w_t e_t^* \theta$, is non-negative given the (IC) constraint. Also note that $e_t^* \geq \tilde{e}_t$ (because $B_t \geq 0$).

3.3.3 The Complementarity of Relational and Reciprocity-Based Incentives

In this section, we will derive some first results and show that reciprocity-based incentives also make the relational contract work better.

To simplify the principal's problem, note that the (IC) constraint must bind in any profit-maximizing equilibrium. If it did not bind, the bonus B_t could be slightly reduced, which would increase profits and relax the (DE) constraint without violating the (IC) constraint. This allows us to plug $B_t = (e_t^*)^3/3 - \eta w_t e_t^* \theta + 2/3 \left(\sqrt{\eta w_t \theta} \right)^3$ into the (DE) constraint, which yields

$$\frac{(e_t^*)^3}{3} - \eta w_t \theta e_t^* \leq \delta \left(\Pi_{t+1} - \tilde{\Pi}_{t+1} \right) - \frac{2}{3} \left(\sqrt{\eta w_t \theta} \right)^3. \quad (\text{DE})$$

The enforceability of relational contracts is generally determined by a comparison of today's effort costs with discounted future payoffs (compared to future deviation payoffs). Only if the latter are large enough, they are sufficient to cover today's costs of exerting effort. Here, two additional terms enter which are implied by the agent's preferences for reciprocity (those reduce the necessary bonus payment to achieve a certain

effort level e_t^*) and the fact that if he deviates, he still selects a positive effort level given the wage is positive.

Concluding, for $\eta > \bar{\eta}$, the principal's problem is to maximize

$$\Pi_1 = \sum_{t=1}^T \delta^{t-1} \pi_t,$$

subject to a (DE) constraint for every period t^5 , and subject to $w_t \geq 0 \forall t$.

The equilibrium is sequentially efficient, hence the problem is equivalent to maximizing

$\pi_t = e_t \theta - B_t - w_t = e_t \theta - \left((e_t^*)^3 / 3 - \eta w_t e_t^* \theta + 2/3 (\sqrt{\eta w_t \theta})^3 \right) - w_t$ in every period t , subject to the relevant constraints.

After generally addressing the enforceability of a relational contract, we will now analyze the relationship between reciprocal and effort-based incentives. To do so, we first abstract from issues of enforceability. Put differently, we assume that the (DE) constraint does not bind, i.e., is satisfied for the principal's preferred effort level and derive respective effort and wage levels. Note that this situation is equivalent to one where formal contracts based on effort are feasible.

Lemma 3.2. *Assume the (DE) constraint does not bind in a period $t < T$. Then, setting a strictly positive wage is optimal.*

Lemma 3.2 implies that even if the principal is not restricted in setting her preferred effort-based bonus B_t , she still decides to pay a strictly positive fixed wage (which amounts to $w_t = (\eta^2 \theta^3 - 1)^2 / 4\eta^3 \theta^3$), and the agent receives a rent. This is because the agent's concern for reciprocity reduces his effective effort costs, *but only in combination with a strictly positive wage w_t* . The agent's effective effort costs are $(e^*)^3 / 3 - \eta w e^* \theta$, and implemented effort $e_t^* = (1 + \eta^2 \theta^3) / 2\eta \theta$ is also strictly larger than the "standard" first best without reciprocal preferences, $\sqrt{\theta}$.⁶ In the following, we will refer to the implemented effort and wage levels for a non-binding (DE) constraint as *first-best* levels. At these first-best levels, the costs for the principal to implement one additional unit of effort are the same when using relational as when using reciprocity-based incentives, and those costs are equal to the principal's marginal benefits.

⁵Note that in period T , the (DE) constraint equals $\frac{(e_T^*)^3}{3} - \eta w_T \theta e_T^* \leq -\frac{2}{3} (\sqrt{\eta w_T \theta})^3$, which for $e_T^* = \sqrt{\eta w \theta}$ (the agent's effort in a spot reciprocity contract) is trivially satisfied.

⁶The condition $(1 + \eta^2 \theta^3) / 2\eta \theta > \sqrt{\theta}$ is equivalent to $(1 - \sqrt{\eta^2 \theta^3})^2 > 0$, which holds since $\eta > \bar{\eta}$ also implies $\eta^2 \theta^3 > 1$.

In a next step, we explicitly take the enforceability of relational contracts into account and assess how the agent's preferences for reciprocity affect outcomes with a *binding* (DE) constraint.

Lemma 3.3. *Assume the (DE) constraint binds in a period $t < T$. Compared to the situation with a non-binding (DE) constraint, the fixed wage is larger and implemented effort smaller.*

Besides reducing effective effort costs, a fixed wage also relaxes the principal's (DE) constraint – by reducing the bonus that must be paid to implement a given effort level. Therefore, if the (DE) constraint binds (i.e., it does not hold for first-best effort), the fixed wage is larger than when it does not bind.

This implies that relational and reciprocity-based incentives are complements *at a given point in time*. Reciprocity-based incentives relax the (DE) constraint and therefore allow to enforce more effort within the relational contract. In the following, we will explore how this interaction develops over time.

3.3.4 Relational and Reciprocity-Based Incentives as Dynamic Substitutes

When using an effort-based relational contract, the principal also sets a positive wage in any case. This wage is higher (and implemented effort lower) if the principal is restricted in paying her preferred bonus B_t , i.e., if the (DE) constraint binds. Now, we derive conditions for when the (DE) constraint actually binds, and in particular how this relates to the tenure of the employment relationship. This allows us to characterize how the optimal use of relational and reciprocity-based incentives evolves dynamically.

Generally, the (DE) constraint might or might not bind in any period $t < T$, depending on discount factor δ , reciprocity parameter η and productivity θ . Furthermore, the (DE) constraint becomes tighter in later periods.

Lemma 3.4. *The principal's dynamic enforcement constraint might or might not bind in period $T-1$. More precisely, for any discount factor δ , the (DE) constraint holds for first-best effort and wage levels if η is sufficiently large. For any values η and θ , the (DE) constraint does not hold for first-best effort and wage levels if the discount factor is sufficiently small.*

Furthermore, $\Pi_{t-1} - \tilde{\Pi}_{t-1} > \Pi_t - \tilde{\Pi}_t$ for all $t \leq T$.

The principal's commitment in a relational contracts is given by what she has to lose given she deviates. If the discount factor is small, she cares less about a potential reduction of future profits and is therefore less willing to compensate the agent for his effort.

Furthermore, a larger reciprocity parameter η increases future profits on the equilibrium path (by more than future off-path profits), and furthermore reduces today's effective effort costs (by more than first-best effort goes up). The second part of Lemma 3.4 states that the difference between on- and off-path continuation profits goes down over time. The intuition is driven by two aspects. First, the remaining time horizon and therefore the periods in which profits can be generated is reduced as time elapses. Second, this triggers a re-enforcing effect because implementable effort in a period is increasing in the difference between on- and off-path continuation profits. Since $\Pi_T - \tilde{\Pi}_T > 0$, the (DE) constraint allows to implement a larger effort level in period $T - 1$ than in period T . Therefore, per-period on-path profits in period $T - 1$ are larger than in period T (whereas per-period off-path profits are the same in every period), and implementable effort in period $T - 2$ is even larger than in period $T - 1$. Hence, the (DE) constraint in earlier periods is less tight than later on.

Lemma 3.4 implies that if the (DE) constraint *binds* in a given period \tilde{t} , it will also bind in all subsequent periods $t > \tilde{t}$. If it is *slack* in a given period \hat{t} , it will also be slack in all previous periods $t < \hat{t}$. This allows us to derive the following effort- and (fixed) wage-dynamics.

Proposition 3.1. *Equilibrium effort is weakly decreasing over time and equilibrium wage weakly increasing, i.e., $e_t^* \leq e_{t-1}^*$ and $w_t \geq w_{t-1}$. Both inequalities hold strictly if and only if the (DE) constraint binds in period t .*

Furthermore, $e_t^ < e_{t-1}^*$ and $w_t > w_{t-1}$ imply $e_{t+1}^* < e_t^*$ and $w_{t+1} > w_t$, whereas $e_{t+1}^* = e_t^*$ and $w_{t+1} = w_t$ imply $e_t^* = e_{t-1}^*$ and $w_t = w_{t-1}$*

Proposition 3.1 states that the profit-maximizing equilibrium is characterized by a downward sloping effort and an upward sloping wage profile. As long as the future is sufficiently valuable for the (DE) constraint to not bind, both are time-invariant. Once the (DE) constraint binds, the principal cannot credibly promise her preferred bonus payment anymore. On the one hand, this reduces equilibrium effort. On the other hand, the principal responds with a wage increase which increases equilibrium effort – directly due to the agent's preferences for reciprocity, and indirectly because it relaxes the principal's (DE) constraint and allows her to request more effort from the agent. However, the effort increase caused by the higher wage does not fully compensate for the effort reduction caused by the binding (DE) constraint because the costs of implementing an additional unit of effort now are larger with reciprocity-based than with relational incentives. As time proceeds, the (DE) constraint becomes tighter and tighter (Lemma 3.4). Hence, relational incentives are gradually substituted by reciprocity-based incen-

tives (fixed wage \uparrow), with the substitution however being incomplete (effort \downarrow).

3.4 Comparative Statics and Main Predictions

In the previous sections, we derived the properties a profit-maximizing long-term arrangement for an agent with given reciprocal preferences. Now, we will explore to what extent the agent's preferences for reciprocity affect the source of incentives he faces over the course of his career. This generates comparative statics with respect to outcomes and therefore allows us to derive a number of testable predictions.

The first prediction picks up the results stated in Proposition 3.1 and refers to the dynamics with respect to effort and payments.

Prediction 1. *Effort decreases with age/proximity to retirement. This decrease becomes larger over the course of the employment relationship.*

Fixed wages increase with age/ proximity to retirement. This increase becomes larger over the course of the employment relationship.

Proof. The first part follows from Lemma 3.1. The second part follows from the fact that the (DE) constraint becomes more likely to bind over time. Therefore, in a population with heterogenous individuals, the share for whom the (DE) constraint does not bind (and for whom the effort/wage profile is constant in our model) is larger for younger workers. \square

Note that Prediction 3 only relates to fixed wages, not to bonus payments. The latter are decreasing over time, since $b_t^* = \frac{3\eta^2\theta^3(1+\lambda_{DEt})-1}{6\eta^3\theta^3(1+\lambda_{DEt})^3}$, i.e., $\frac{\partial b_t^*}{\partial \lambda_{DEt}} = \frac{1-2\eta^2\theta^3(1+\lambda_{DEt})}{2\eta^3\theta^3(1+\lambda_{DEt})^4} < 0$.

Now, we focus explicitly on the role of the degree of an individual's reciprocity on outcomes. There, our model provides the general result that irrespective of an individual's career stage, the effect of a larger η on effort and payments is unambiguously positive.

Prediction 2. *More reciprocal individuals should on average exert more effort and receive higher fixed and total wages.*

Proof. This relationship holds in any period: For periods $t < T$ and $\eta > \bar{\eta}$, $\frac{\partial e_t^*}{\partial \eta} = \frac{\eta^2\theta^3(1+\lambda_{DEt})-1}{2\eta^2\theta(1+\lambda_{DEt})} > 0$ and $\frac{\partial w_t}{\partial \eta} = \frac{(\eta^2\theta^3(1+\lambda_{DEt})-1)[\eta^2\theta^3(1+\lambda_{DEt})+3]}{4\eta^4\theta^3(1+\lambda_{DEt})^2} > 0$. For period T and $\eta > \bar{\eta}$, $\frac{\partial e_T^*}{\partial \eta} = \frac{\theta^2}{2} > 0$ and $\frac{\partial w_T}{\partial \eta} = \frac{\theta^3}{4} > 0$. Finally, for $\eta \leq \bar{\eta}$, $\frac{\partial e_t^*}{\partial \eta} = 0$ and $\frac{\partial w_t}{\partial \eta} = 0$ in all periods t . \square

This prediction has already been tested and confirmed by Dohmen et al. (2009). It follows from our result that reciprocal and relational incentives are complements at a

given point in time. There, providing incentives becomes cheaper if η goes up, hence more effort will be implemented. Next, we explore how η affects incentive schemes and consequently outcomes at different stages of an individual's career.

Prediction 3. *The positive effect of reciprocal preferences on effort becomes stronger over the course of the employment relationship.*

Proof. This follows from Lemma 3.4, where we show that λ_{DEt} increases over time, and $\frac{\partial e_t^*}{\partial \lambda_{DEt} \partial \eta} = \frac{1}{2\eta^2 \theta (1 + \lambda_{DEt})^2} > 0$. \square

Prediction 3 follows from reciprocal and relational incentives being dynamic substitutes. When an individual approaches the end of their employment relationship, the incentive system puts more weight on reciprocal incentives, hence the role of η is intensified. Therefore, the reduction of incentive costs caused by a higher η is more pronounced and equilibrium effort reacts more strongly.

Prediction 4. *Total compensation (sum of bonus and wage payments) goes down over time. Total compensation is increasing in reciprocity. This effect becomes stronger over the course of the employment relationship.*

Proof. $w_t + b_t^* = \frac{3\eta^4 \theta^6 (1 + \lambda_{DEt})^2 + 1}{12\eta^3 \theta^3 (1 + \lambda_{DEt})^2}$, $\frac{\partial(w_t + b_t^*)}{\partial \lambda_{DEt}} = -\frac{1}{6\eta^3 \theta^3 (1 + \lambda_{DEt})^3} < 0$, $\frac{\partial(w_t + b_t^*)}{\partial \eta} = \frac{\eta^4 \theta^6 (1 + \lambda_{DEt})^2 - 1}{4\eta^4 \theta^3 (1 + \lambda_{DEt})^2} > 0$, $\frac{\partial^2(w_t + b_t^*)}{\partial \eta \partial \lambda_{DEt}} = \frac{2}{4\eta^4 \theta^3 (1 + \lambda_{DEt})^3} > 0$. \square

Note that the bonus in the relational contract is paid with certainty on the equilibrium path, therefore could be assessed as a fixed wage component by many individuals.

4 Empirical Analysis

As already briefly introduced above, the approach utilized by Dohmen et al. (2009) allows to detect associations between preferences for reciprocity and real-world labor market outcomes, thus illustrating the impact of the presence of reciprocal agents in employment relationships. More specifically, the authors look at cross-sectional evidence for a relationship between reciprocal inclinations and effort as well as wages. However, while we use the same data set and largely keep their empirical specification for the sake of comparability, we are particularly interested in demonstrating how the influence of intrinsic reciprocity on labor market outcomes changes over the course of careers.

We use data from the German Socio-Economic Panel Study (SOEP). The SOEP is a yearly panel survey that is representative of the German population and goes back to 1984. It contains a wide range of questions on the personal and socioeconomic situation

as well as labor market status and income of respondents. For our purposes, the 2005 wave of the survey is of particular interest as it contains a total of six questions that are designed to capture individual reciprocal inclinations. The items developed by Perugini et al. (2003) capture what they define as the personal norm of reciprocity, that is, to what extent an individual has internalized the norm of reciprocal behavior, ask participants to rate how well six statements (three for positive, three for negative reciprocity) apply to themselves on a seven-point Likert scale.⁷ The item average then determines each person's strength of reciprocity. Figure 2 shows the distribution of positive and negative reciprocity among survey participants, revealing that while there is quite some variation in negative reciprocity among the SOEP population, positive reciprocity is strongly pronounced.

It is important to note that positive and negative reciprocity constitute different traits. This is supported by the observations that the correlation between the two is rather low ($p=.025$), that the traits have different determinants (Dohmen et al., 2008), and that the six items can be represented by two distinct orthogonal principal components (Dohmen et al., 2009).

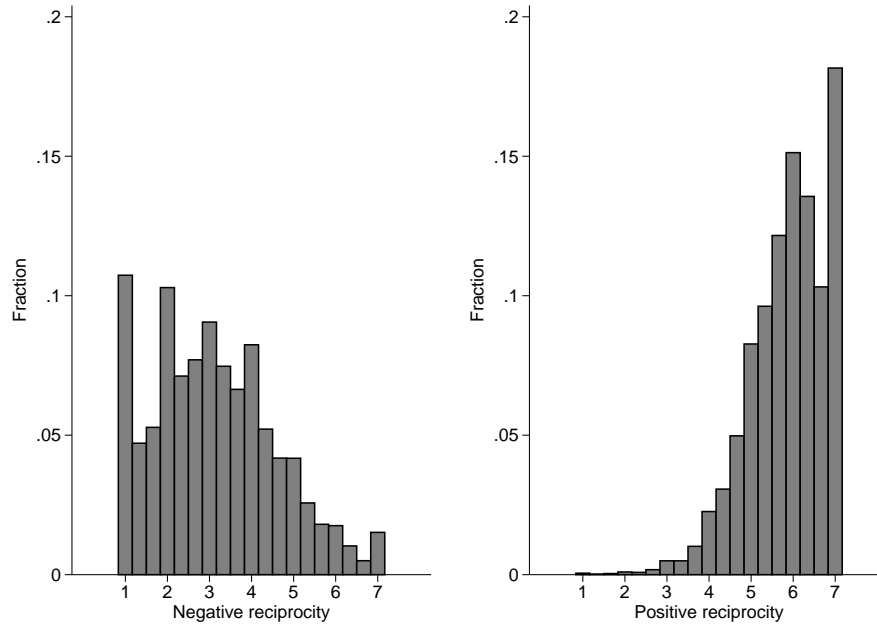
We restrict attention to a subsample of all SOEP respondents: because we focus on the role of intrinsic reciprocity in employment relationships, we only consider employees in our analyses, thus excluding individuals who are unemployed, retired, self-employed, in compulsory military or community service, or in training and education, leaving us with a sample of 9,176 individuals.⁸

We utilize several dependent variables that allow us to study the effect of reciprocity on effort as well as on compensation. First, we use overtime work as proxy for effort. Overtime is a binary variable indicating whether the employee has worked overtime hours in the month preceding the interview. Deviating from Dohmen et al. (2009), we only focus on respondents who are not paid for working overtime because paid overtime work cannot readily be seen as exceptional high effort.⁹ Second, for wages, we use two variables. The first, gross annual income, is a constructed measure that represents total

⁷Specifically, the items measuring positive reciprocity are “If someone does me a favor, I am prepared to return it”, “I go out of my way to help somebody who has been kind to me before”, and “I am ready to undergo personal costs to help somebody who helped me before”, while the items “If I suffer a serious wrong, I will take revenge as soon as possible, no matter what the cost”, “If somebody puts me in a difficult position, I will do the same to him/her”, and “If somebody offends me, I will offend him/her back” are meant to capture negative reciprocity.

⁸While Figure 2 depicts the distribution of negative and positive reciprocity among the 20,774 individuals who answered all six questions on the questionnaire, the same pattern can also be found when restricting attention only to individuals in the subsample used for our estimations later on.

⁹While we restrict our attention to unpaid overtime for our analysis due to content-related arguments, we also run our analyses using overtime work in general and find no differences in results.



Notes: The figure plots the distribution of negative and positive reciprocity for the 20,774 respondents of the 2005 SOEP wave who answered all six reciprocity questions. The individual inclination for negative and positive reciprocity are calculated by taking the average of the three questions that are targeted at the respective dimension.

Figure 2: Distribution of negative and positive reciprocity in the SOEP population

compensation received in the previous year (i.e., fixed income as well as boni). The second, gross monthly income, is a measure of employees' gross wages in the month previous to the interview, excluding special payments. Thus, it can rather be seen as a proxy for employees' fixed base wages.

Taking the main analysis in Dohmen et al. (2009) as a starting point, we first examine the effect of reciprocity on effort and wages. We do so by estimating cross-sectional regressions and controlling for several other influence factors. Specifically, our controls include gender, age, years of education, full-time and part-time work experience, tenure in the recent position (all included in a Mincer-type fashion), a dummy variable for part-time employment, and indicator variables for industry sector, firm size, and occupational status.¹⁰

¹⁰Note that we make a few small adjustments in the specification compared to Dohmen et al. (2009): since we are interested in interactions between intrinsic reciprocity and employee age, we include the latter in

	(1) Overtime	(2) Annual income	(3) Monthly income
Positive reciprocity	0.0155** (0.00739)	0.0159** (0.00720)	0.00902 (0.00674)
Age (in years)	-0.00718*** (0.00169)	-0.00773*** (0.00181)	-0.00535*** (0.00176)
Controls	Yes	Yes	Yes
Observations	7,011	6,820	6,285
R^2	0.0830	0.619	0.665

Notes: Robust standard errors in parentheses clustered at household level. Column (1) reports marginal effects at the mean after logit regression, while columns (2) and (3) report coefficients of OLS regressions with log income as dependent variable. Controls include negative reciprocity, years of education, gender, years of full time and part time work experience (linear and squared terms), a dummy for part-time employment, job tenure in current position (linear and squared), indicator variables for industry sector (services, agriculture, energy or mining, manufacturing, construction, trade, transport, bank or insurance) and firm size (less than 100, 100-199, 200-1999, more than 1000 employees), and an indicator variable for occupation status (white collar, blue collar, public sector). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 1: Overall effect of reciprocity on effort and wages

Table 1 reports regressions of our three main dependent variables on reciprocity and controls. More specifically, in column (1), the dependent variable is a binary variable indicating whether the employee has worked unpaid overtime in the month preceding the interview. To estimate the effect of reciprocity on the propensity for unpaid overtime work, we employ a logit regression and report marginal effects at the mean. Standard errors are clustered at household level and reported in parentheses. The results we obtain are similar to those of Dohmen et al. (2009) – the propensity of working unpaid overtime depends positively on positive reciprocity. Columns (2) and (3) address the relationship of reciprocity and wages. In column (2), log annual labor income is regressed on reciprocity scores and our set of controls in an OLS regression, partly replicating the patterns found by Dohmen et al. (2009).¹¹ In particular, we find a significant, positive coefficient for positive reciprocity. As can be seen in column (3), when using log gross monthly labor income instead, the reciprocity effects are not found. Thus, in our data, reciprocity is only significantly related to total compensation, but not to our proxy of the base wage.

Next, we examine the relationship between effort, fixed wages and age to get a first impression of how our outcomes depend on employee age when controlling for other influences. Looking at the net relationship in the regressions from Table 1, the coefficient in the effort regression is negative and significant, indicating that the propensity of working overtime is decreasing with employee age. In the monthly and annual income regressions, the same relationship can be found, as the age coefficient is negative and significant in both cases; thus, income is on average decreasing with employee age. Figure 3 further explores the relationship between employee age and effort as well as income by depicting a local polynomial regression of the residual variance of unpaid overtime (left panel), monthly income (middle panel), and annual income (right panel) on the residual variance of age, thus illustrating the adjusted, non-linear relationship between the two variables. Regarding overtime, it can be seen that the pattern largely overlaps with the linear regression line with a few small exceptions at the lower and upper end of the age continuum. For fixed wages, the downward slope is also visible, but slightly more variable, showing an increase for young and a steep decrease for old workers.¹²

all regressions, while Dohmen et al. (2009) only include age in overtime, but not in income regressions.

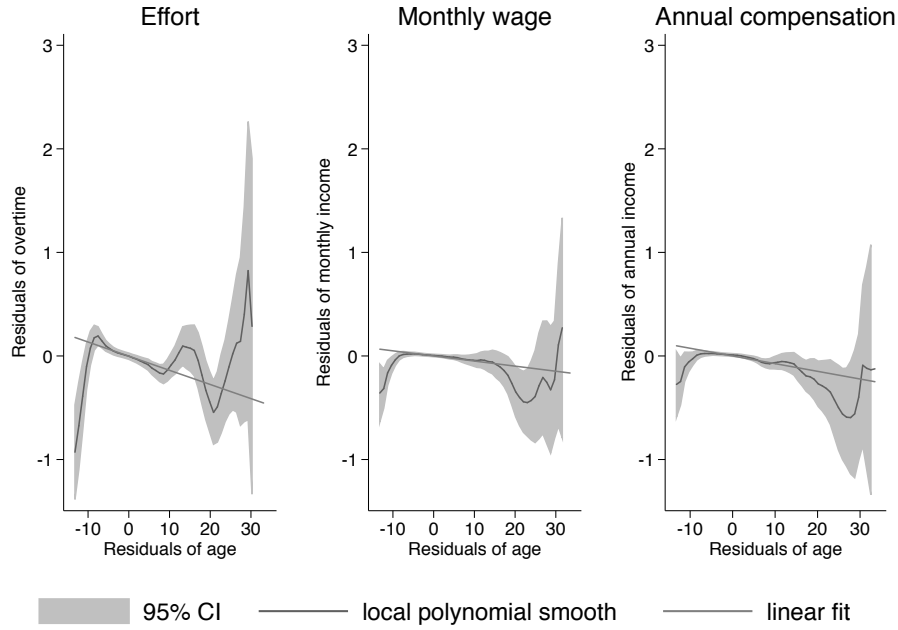
¹¹Note that for annual wages, we use data from the 2006 data for our dependent variable. This is due to the fact that we utilize generated wage data that are constructed retrospectively for the year prior to the respective survey wave.

¹²Due to the fact that the relationship between age and our outcome variables seems to be a non-linear, we additionally estimate our main specification including a quadratic term for employee age. While the quadratic term indeed turns out to be significant for all three outcomes, predictive power does not

	(1) Overtime	(2) Young	(3) Old	(4) No retire	(5) Retire
Positive reciprocity	0.0155** (0.00739)	0.0111 (0.00762)	0.106*** (0.0374)	0.0117 (0.00768)	0.0708** (0.0288)
Age (in years)	-0.00718*** (0.00169)	-0.00705*** (0.00177)	-0.0435** (0.0208)	-0.00730*** (0.00177)	-0.00248 (0.00582)
Controls	Yes	Yes	Yes	Yes	Yes
Observations	7,011	6,618	393	6,597	414
Pseudo R^2	0.0830	0.0780	0.2243	0.0828	0.1053

Notes: Robust standard errors in parentheses clustered at household level. Table reports marginal effects at the mean after logit regression. Controls include years of education, gender, years of full time and part time work experience (linear and squared terms), a dummy for part-time employment, job tenure in current position (linear and squared), indicator variables for industry sector (services, agriculture, energy or mining, manufacturing, construction, trade, transport, bank or insurance) and firm size (less than 100, 100-199, 200-1999, more than 1000 employees), and an indicator variable for occupation status (white collar, blue collar, public sector). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 2: Effect of reciprocity on effort by age and likelihood of retirement



Notes: The figure plots a linear fit as well as a local polynomial smooth of the residual variance of the propensity to work overtime (left panel), the residual variance of log monthly income (middle panel), and the residual variance of log annual income (right panel) on the residual variance of age.

Figure 3: Local polynomial smooth

Having looked at the impact of positive reciprocity and age on overtime propensity in our sample, we now turn to the question that is central to us: do we see that the positive effect of positive reciprocity on effort is changing over the course of the employment relationship? To examine the predicted pattern in our data, we first split our sample into young and old workers, where old workers are all employees who are at least 60 years old. We argue that for these subgroup, proximity to retirement is sufficiently close to approximate the "last periods" of employment that resemble one-shot interactions more closely, thus making intrinsic reciprocity relatively more important.¹³ Based on this sample split, we conduct the regression of overtime on reciprocity and our set of controls separately for both subgroups to explore potential differences. Table 2 depicts the overall

substantially increase and our main effects of interest remain the same.

¹³Note that our results are qualitatively robust to splitting the sample at other age cutoffs. More specifically, we tested this by splitting our sample at ages 50 and 55. Detailed results can be obtained from the authors upon request.

logit regression in column (1) as well as the separate estimations in columns (2) and (3). Indeed, the coefficient of positive reciprocity turns out to be significantly positive only for the old subsample. Testing for equality with seemingly unrelated estimation reveals that the positive influence of positive reciprocity on the propensity to work overtime is indeed significantly stronger among employees who are at least 60 years old compared to younger employees ($\chi^2 = 6.72$, $p = .010$). Thus, it seems like the positive effect of positive reciprocity on the probability of working overtime in the whole sample of employees is mostly driven by older workers.

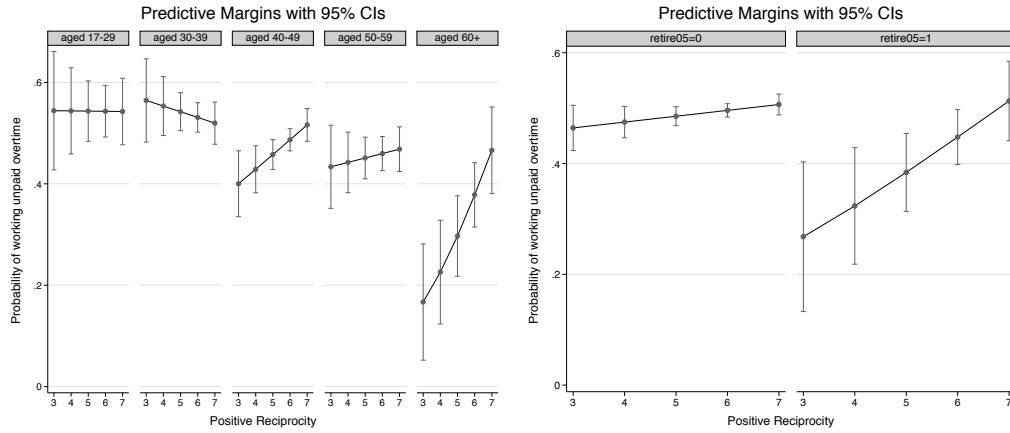
To further illustrate this, we employ an alternative specification: instead of dividing our sample and running separate regressions, we include age in 10-year categories and interact these categories with positive reciprocity.¹⁴ Interestingly, when utilizing this specification, the main effect of positive reciprocity is no longer a significant predictor for overtime; instead, the interacted term of positive reciprocity and being at least 60 years of age is significant and positive. To illustrate this relationship, the resulting predictive margins of positive reciprocity by age group are depicted in the left panel of Figure 4. As can be seen clearly, while the overall propensity of working unpaid overtime is lower for the subgroup of workers that are at least 60 years old, the probability of working unpaid overtime increases in reciprocity scores only for this group when holding all other factors fixed. This also confirms the main intuition of our model, namely that intrinsic reciprocity mostly matters near the end of employment relationships.

However, one might wonder whether there are systematic differences in positive reciprocity between age groups that influence the relationship that we find. To address this, we take a closer look at the distribution of positive reciprocity depending on age in Figure 5. Plotting average scores of positive reciprocity by age in years reveals a slightly positive trend, but quite some variation.¹⁵ The same relationship can be seen when plotting average reciprocity in the five age categories (right panel of Figure 5).

Additionally, one might argue that, even though there is an officially regulated age for retirement in Germany, there might still be differences in individual retirement ages and thus that age is a noisy proxy for the stage of employees' careers. To address this concern, we utilize an additional question from the SOEP that asks employees how likely it is that they are going to retire within the following two years. This results in a binary variable that takes on the value of 1 if the respondent indicates that his/her probability of retiring within the following two years is at least 50 percent. We use this variable to split our sample and again estimate the effect of reciprocity on the propensity to work overtime

¹⁴Results of this and other interaction specifications can be found in Table 6 in the Appendix.

¹⁵Note that the associated coefficient for the linear trend is significant, but rather small ($\beta = 0.00309$)



Notes: The figure plots predicted marginal changes of the propensity to work overtime at different levels of positive reciprocity depending on age group (left panel) and a high vs. low propensity to retire within the next two years (right panel), holding all other factors constant.

Figure 4: Predictive marginal effects of positive reciprocity on effort

separately for both groups. The estimation results can be found in columns (4) and (5) in Table 2. It is evident that this alternative specification produces similar results than splitting the sample based on age: the coefficient for positive reciprocity is only significant among employees with a high likelihood for retirement within the following two years. Utilizing a post estimation test after seemingly unrelated estimation of the two models reveals that the two coefficients are significantly different from each other ($\chi^2 = 3.99, p = .046$).

Again, we further illustrate our finding by additionally implementing a specification on the whole sample where positive reciprocity and the retirement likelihood indicator are interacted. As expected, the interaction term turns out to be positive and significant, while the main effect of being likely to retire within the following two years is significant and negative. In this specification, the main effect of positive reciprocity is still positive, but not significant. In the right panel of Figure 4, the interaction effect is clarified by plotting the predicted marginal effects of positive reciprocity on the probability of working unpaid overtime separately for the subsamples split according to their propensity to retire within the next two years. Again, it can be seen clearly that while the slope of both curves is positive, the slope is much steeper for employees with a high likelihood of retirement. This also supports our intuition that the influence of positive reciprocity

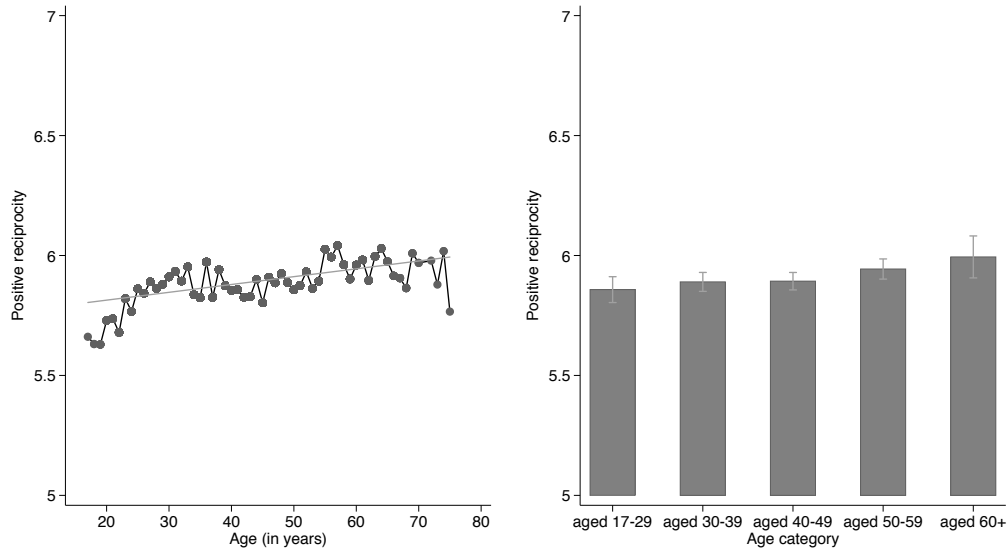


Figure 5: Average positive reciprocity scores by age

on effort should be stronger towards the end of careers.

To sum up, looking at influence factors on propensity of unpaid overtime among our sample of German employees, we find that positive reciprocity is positively related to overtime. While unpaid overtime decreases with age (the level of overtime goes down), the positive effect of reciprocity on overtime is strengthened for older employees (the slope becomes steeper). A qualitatively similar pattern can be found when comparing employees who indicate that they are likely to retire compared to those who are not: again, while likelihood of retirement has a negative influence on the propensity to work overtime, positive reciprocity has a stronger positive influence on overtime for those employees.

Having identified these patterns, we next take a closer look at wages. As the results in Table 1 and Figure 3 described above already indicated, results are more mixed for those outcomes: while positive reciprocity is at least marginally significantly related to higher annual earnings, it has no significant predictive value for monthly income. For the following analyses, we thus focus on annual earnings as a proxy for total compensation. As a first indicator, the age coefficient in the regression of log annual earnings on reciprocity, age and controls (column (2) in Table 1) is negative and significant. Again, we further explore the relationship between annual earnings and age by plotting re-

sults of a local polynomial regression of the residual variance of annual income on the residual variance of age in Figure 4. It can be seen that while the overall linear fit has a negative slope, there is some variation in the local fit pattern: for young employees, total compensation increases with age, while it is relatively stable afterwards. For higher ages, there is a steeper downward slope and some variation.

Regarding the influence of reciprocal inclinations on annual earnings dependent on age, we again split our sample and estimate separately for employees below the age of 60 and those above. The results are depicted in Table 3. While the marginally significant positive influence of positive reciprocity on annual income that can be identified in the full sample is also present for employees below the age of 60, it disappears when only older employees are considered. Looking at the regressions where we split the sample depending on whether they indicate a high or low propensity to retire within the following two years (columns (4) and (5)), positive reciprocity does only have a marginally significant positive influence on total compensation for those indicating a low propensity for retirement. Thus, contrary from our expectations, we cannot find evidence for a stronger influence of positive reciprocity on total compensation towards the end of careers in our sample. In contrast to overtime as a proxy for effort, where we find clear results, this is not the case for wages.¹⁶

Summing up, when taking a closer look at the patterns first described by Dohmen et al. (2009), we find that interestingly, the positive effect of positive reciprocity on discretionary effort they discover is mostly driven by older employees who are relatively close to retirement. In terms of intrinsic versus instrumental reciprocity as possible mechanisms leading to high discretionary effort, we interpret this as suggestive evidence that while instrumental reciprocity, working through repeated interaction and thus in need of future periods of the employment relationship, plays a relatively important role in the beginning, intrinsic reciprocity is mostly important towards the end of careers.

5 Extensions and Robustness

After having examined the core predictions of our model and corresponding patterns in the data, we next turn to further exploring some additional aspects.

¹⁶This could partly be due to the fact that both monthly as well as annual labor income are self-reported measures that are likely subject to reporting errors. Individuals might not remember their exact gross monthly or annual income, for instance, or, more importantly, might not be able to perfectly distinguish between fixed and variable parts of their compensation.

DV: log annual income	(1) Full sample	(2) Young	(3) Old	(4) No retire	(5) Retire
Positive reciprocity	0.0146** (0.00729)	0.0161** (0.00728)	0.00982 (0.0391)	0.0128* (0.00746)	0.0466 (0.0377)
Age (in years)	-0.00773*** (0.00181)	-0.00428** (0.00187)	-0.0969*** (0.0158)	-0.00608*** (0.00191)	-0.0197*** (0.00742)
Controls	Yes	Yes	Yes	Yes	Yes
Observations	6,820	6,454	366	6,291	388
R^2	0.619	0.622	0.711	0.622	0.608

Notes: Robust standard errors reported in parentheses. Standard errors are clustered at household level. Table reports coefficients of OLS regressions. Estimation in column (1) is based on the whole sample, while estimations in columns (2) and (3) are based on employees who are younger than 60 and those at least 60 years of age, respectively. Controls include years of education, gender, years of work experience, a dummy for part-time employment, job tenure in current position, a indicator for children living in the employee's household, and an indicator variable for occupation status (white collar, blue collar, public sector). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 3: Effect of reciprocity on total compensation by age and likelihood of retirement

5.1 Job Satisfaction

We further have survey measures on employee satisfaction. In our model, this might capture that unsatisfied employees have had a bad experience with their employer, indicating that the latter reneged on the relational contract. Probably more intuitively, employees simply might be more satisfied with their job if they get a higher utility out of it.

The first aspect gives an additional empirical prediction,

Prediction 5. *The effect of reciprocity on wages and effort is larger for more satisfied employees.*

Proof. On the hand, having unsatisfied employees could indicate that the employer reneged on the relational contract. In this case, only the spot bonus contract is feasible, indicating that for those agents, there is no effect of general reciprocal inclinations on effort and wages. \square

The second aspect allows to make a couple of further predictions considering different satisfaction levels of employees:

Prediction 6. *More reciprocal employees are more satisfied; older employees (or those closer to retirement) are more satisfied; the positive effect of reciprocal preferences on satisfaction becomes stronger over time.*

Proof. An agent's utility in a period $t < T$ is

$$u_t = w_t + b_t - \frac{e_t^3}{3} + \eta w_t e_t^* \theta$$

$$= \frac{(2 + \lambda_{DEt}) + 3\eta^4 \theta^6 (1 + \lambda_{DEt})^3 - 3\eta^4 \theta^6 (1 + \lambda_{DEt})^2 + \eta^6 \theta^9 (1 + \lambda_{DEt})^3 - 3\eta^2 \theta^3 (1 + \lambda_{DEt})}{12\eta^3 \theta^3 (1 + \lambda_{DEt})^3}$$

$$\frac{\partial u_t}{\partial \lambda_{DEt}} = \frac{3(\eta^4 \theta^6 (1 + \lambda_{DEt})^2 - 1) + 2(1 + \lambda_{DEt})(3\eta^2 \theta^3 - 1)}{12\eta^3 \theta^3 (1 + \lambda_{DEt})^4} > 0 \text{ because } \eta > \bar{\eta} \text{ implies } \eta^2 \theta^3 > 1.$$

$$\frac{\partial u_t}{\partial \eta} = \frac{3\eta^4 \theta^6 (1 + \lambda_{DEt})^2 \lambda_{DEt} + 3(\eta^6 \theta^9 (1 + \lambda_{DEt})^3 - 1) + 3(1 + \lambda_{DEt})(\eta^2 \theta^3 - 1)}{12\eta^4 \theta^3 (1 + \lambda_{DEt})^3} > 0$$

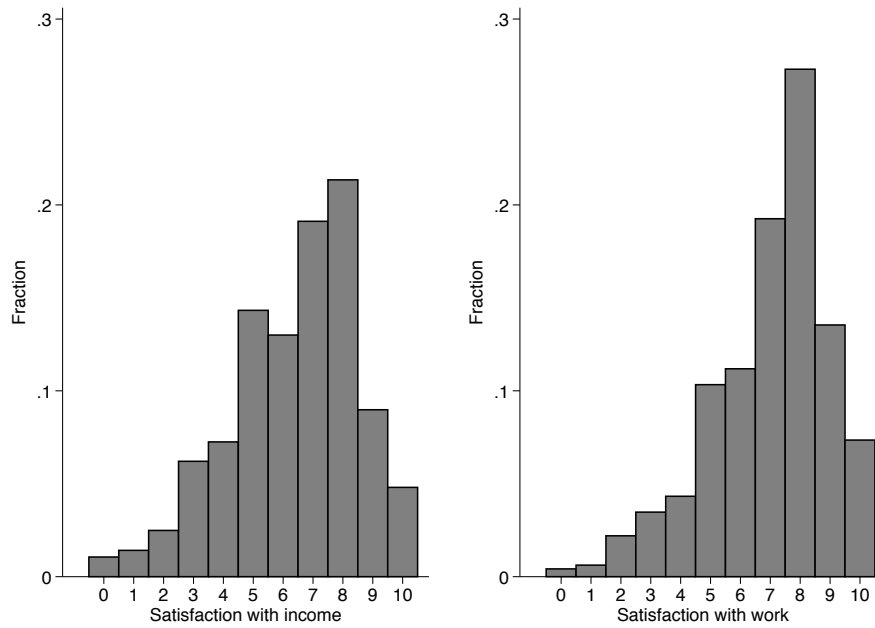
$$\frac{\partial^2 u_t}{\partial \lambda_{DEt} \partial \eta} = \frac{(1 + \lambda_{DEt})(\eta^2 \theta^3 - 1)^2 + \eta^4 \theta^6 (1 + \lambda_{DEt}) \lambda_{DEt} + (4 + \lambda_{DEt})}{4\eta^4 \theta^3 (1 + \lambda_{DEt})^4} > 0$$

Recall that in a spot reciprocity contract, $u = \frac{\eta \theta^3}{4} + \frac{\eta^3 \theta^6}{12}$.

This is larger than the utility in previous periods if

$$(1 + \lambda_{DEt}) (3\eta^2 \theta^3 - 1) > 1 - 3\eta^4 \theta^6 (1 + \lambda_{DEt})^2$$

which always holds. \square



Notes: The figure plots the distribution of satisfaction with income and with work in general for the 7,011 individuals included in the main analysis.

Figure 6: Distribution of income and job satisfaction in the study population

Empirically, in a next step, we further explore the influence of positive reciprocity on effort by following the argument made by Dohmen et al. (2009) that fairness perceptions are likely to influence the strength of the influence of reciprocity on effort. Note, however, that Dohmen et al. (2009) only use one question asking employees whether they think their wage is fair¹⁷ while at the same time raising the point that job satisfaction does in fact comprise of many other factors as well. We certainly agree, which is why we utilize not only the binary fairness indicator, but also two other questions that ask participants to rate their satisfaction with their personal income¹⁸ as well as their overall job satisfaction¹⁹. Figure 6 depicts the distribution of satisfaction with personal income and job for the employees included in our main analysis. It can be seen that, while the full range of answers is given, the distributions are left-skewed in both cases.

¹⁷The precise question asked is “Is the income you earn at your current job just, from your point of view?”.

¹⁸The question employees are asked is “How satisfied are you with your personal income?” and is to be rated on a scale from 0 (totally unsatisfied) to 10 (totally satisfied).

¹⁹The question employees are asked is “How satisfied are you with your job?” and is to be rated on a scale from 0 (totally unsatisfied) to 10 (totally satisfied).

	(1)	(2)	(3)	(4)	(5)	(6)
DV: unpaid overtime	Wage unfair	Wage fair	Low wage satisfaction	High wage satisfaction	Low job satisfaction	High job satisfaction
Pos. reciprocity	-0.0222* (0.0127)	0.0354*** (0.00917)	0.00192 (0.0104)	0.0305*** (0.0103)	0.0101 (0.0101)	0.0263** (0.0110)
Age (in years)	-0.00915*** (0.00299)	-0.00603*** (0.00208)	-0.00893*** (0.00248)	-0.00522** (0.00232)	-0.00493** (0.00244)	-0.00965*** (0.00232)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,198	4,790	3,251	3,760	3,356	3,655
Pseudo R^2	0.0839	0.0930	0.0891	0.0785	0.0838	0.0888

Notes: Robust standard errors reported in parentheses. Standard errors are clustered at household level. Table reports marginal effects at the mean after logit regression. Estimation in column (1) is based on employees thinking their wage is unfair, while estimations in column (2) is based on employees who think their wage is fair. Columns (3) and (4) show estimation results on a split sample based on wage satisfaction, while columns (5) and (6) are based on a split by job satisfaction, both estimated in the wave. Controls include negative reciprocity, years of education, gender, years of full time and part time work experience (linear and squared terms), a dummy for part-time employment, job tenure in current position (linear and squared), indicator variables for industry sector (services, agriculture, energy or mining, manufacturing, construction, trade, transport, bank or insurance) and firm size (less than 100, 100-199, 200-1999, more than 1000 employees), and an indicator variable for occupation status (white collar, blue collar, public sector). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 4: Effect of reciprocity on effort by fairness and satisfaction perceptions

For these two variables, we split our sample at the median values and run the main specification separately for the resulting subgroups. Results from all subgroup estimations based on the fairness and satisfaction judgments are shown in Table 4. Again, the results for positive reciprocity provide a clear picture: for all three fairness and satisfaction measures, we find that the propensity to work overtime is only positively influenced by reciprocal inclinations for those employees who perceive their wage as fair, are satisfied with their wage and their job, respectively. Thus, our data reveal an extreme form of Prediction 6: the effect of reciprocity on effort is not only larger for more satisfied employees, but in this case the effect seems to be driven entirely by those employees who feel treated fairly by their employer and are satisfied with their wage and job, respectively.

To explore the effect reciprocity has on employee's job satisfaction as reflected in

DV: job satisfaction	(1) 2005	(2) 2006	(3) young	(4) old	(5) no retire	(6) retire
Positive reciprocity	0.177*** (0.0270)	0.205*** (0.0296)	0.198*** (0.0301)	0.362** (0.163)	0.186*** (0.0301)	0.402** (0.169)
Age (in years)	-0.0108* (0.00590)	-0.00732 (0.00635)	-0.0121* (0.00674)	0.116* (0.0691)	-0.00604 (0.00657)	-0.0131 (0.0303)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,443	6,475	6,206	269	6,051	288
R^2	0.030	0.033	0.032	0.150	0.030	0.132

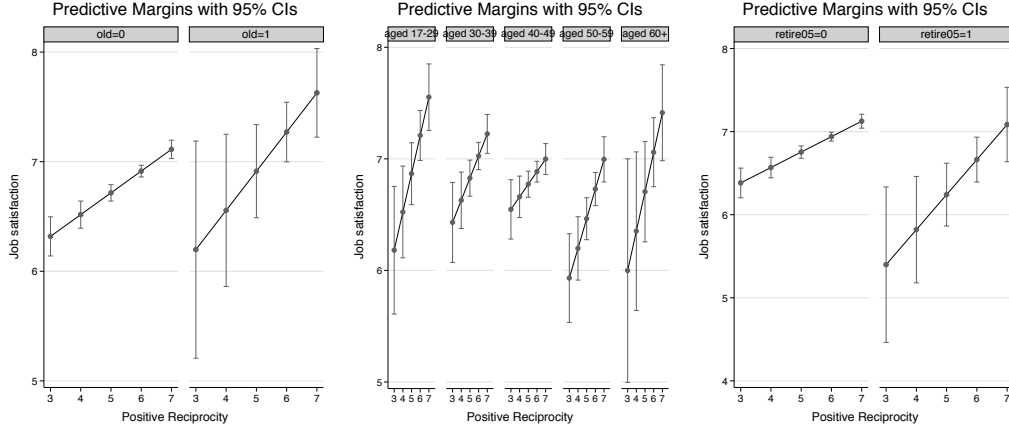
Notes: Robust standard errors reported in parentheses. Standard errors are clustered at household level. Table reports coefficients of OLS regressions. Estimation in column (1) utilizes job satisfaction in 2005, while estimations in column (2) uses job satisfaction in 2006. Controls include negative reciprocity, years of education, gender, years of full time and part time work experience (linear and squared terms), a dummy for part-time employment, job tenure in current position (linear and squared), indicator variables for industry sector (services, agriculture, energy or mining, manufacturing, construction, trade, transport, bank or insurance) and firm size (less than 100, 100-199, 200-1999, more than 1000 employees), and an indicator variable for occupation status (white collar, blue collar, public sector). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 5: Effect of reciprocity on job satisfaction

Prediction 7, we estimate an additional specification where we regress job satisfaction measures on reciprocity from the survey waves of 2005 and 2006 while controlling for age and our usual control variables. Note that we do not control for income, as this is part of the agent's utility. The results shown in columns (1) and (2) of Table 5 indicate that reciprocity indeed influences job satisfaction of employees as the coefficient for positive reciprocity is positive and significant for both outcomes. When splitting the sample into young and old workers (columns (3) and (4)) or into employees close to retirement and those further away (columns (5) and (6)), one can see that the coefficient is significant for all subsamples. While the coefficients seem to be larger in size for those employees who are at least 60 years old compared to younger employees and for those employees with a high probability of retirement, tests for significance of differences between the coefficients using similar unrelated regressions reveal that the coefficients are not significantly different from each other.

This result is also illustrated in Figure 7, which is the result of several regressions with interaction terms of positive reciprocity and age groups (left panel), a dummy

variable indicating if the employee is at least 60 years of age (middle panel), and the retirement indicator (right panel). Here, it can also be seen that the positive relationship between positive reciprocity and job satisfaction is present for all subsamples alike when controlling for other factors.



Notes: The figure depicts predicted marginal changes of job satisfaction at different levels of positive reciprocity depending on being below vs. at least 60 years of age (left panel), age group (middle panel) and a low vs. high propensity to retire within the next two years (right panel), holding all other factors constant.

Figure 7: Predictive marginal effects of positive reciprocity on job satisfaction

6 Conclusion

We have shown that in optimal dynamic incentive schemes, repeated-game incentives and reciprocal preferences interact in interesting ways. They are dynamic substitutes but complements once a specific point in time is considered.

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Appendix

Proofs

Proof. [Proof of Lemma 3.1.] Plugging the agent's optimal effort choice, $e^* = \sqrt{b + \eta w \theta}$, into the principal's profits gives the Lagrange function $\mathcal{L} = \sqrt{b + \eta w \theta} (\theta - b) - w + \lambda_b b + \lambda_w w$ and first order conditions

$$\begin{aligned}\frac{\partial \mathcal{L}}{\partial b} &= \frac{1}{2\sqrt{b + \eta w \theta}} (\theta - b) - \sqrt{b + \eta w \theta} + \lambda_b = 0 \\ \frac{\partial \mathcal{L}}{\partial w} &= \frac{\eta \theta}{2\sqrt{b + \eta w \theta}} (\theta - b) - 1 + \lambda_w = 0\end{aligned}$$

We first show that bonus and wage payments are not used simultaneously. To the contrary, assume this as the case, i.e. that $\lambda_b = \lambda_w = 0$. Then, first-order conditions are

$$\begin{aligned}\frac{1}{2\sqrt{b + \eta w \theta}} (\theta - b) - \sqrt{b + \eta w \theta} &= 0 \\ \frac{\eta \theta}{2\sqrt{b + \eta w \theta}} (\theta - b) - 1 &= 0\end{aligned}$$

Second-order conditions will not hold in this case, though: The Hessian matrix of second-order partial derivatives equals

$$\begin{pmatrix} -\frac{(b + \eta w \theta)^{-3/2}}{4} (\theta - b) - \frac{1}{\sqrt{b + \eta w \theta}} & -\frac{(b + \eta w \theta)^{-3/2} \eta \theta}{4} (\theta - b) - \frac{\eta \theta}{2\sqrt{b + \eta w \theta}} \\ -\frac{(b + \eta w \theta)^{-3/2} \eta \theta}{4} (\theta - b) - \frac{\eta \theta}{2\sqrt{b + \eta w \theta}} & -\frac{\eta^2 \theta^2 (b + \eta w \theta)^{-3/2}}{4} (\theta - b) \end{pmatrix},$$

yielding a determinant equal to $-\frac{3}{2}\eta\theta < 0$. Hence, either $w = 0$ or $b = 0$.

First, assume that $w = 0$ and $b > 0$, i.e., $\lambda_b = 0$ and $\lambda_w > 0$. Then, only the principal's first first-order condition is relevant and yields $b = \theta/3$. Furthermore, effort is $e^* = \sqrt{\theta/3}$, profits are $\pi = \frac{2\theta}{3}\sqrt{\frac{\theta}{3}}$, and the agent's utility equals $u = \frac{2\theta}{9}\sqrt{\frac{\theta}{3}} > 0$.

Now, assume that $w > 0$ and $b = 0$, i.e., $\lambda_b > 0$ and $\lambda_w = 0$. Then, only the principal's second first-order condition is relevant and yields $w = \eta\theta^3/4$. Furthermore, effort is $e^* = \eta\theta^2/2$, profits are $\pi = \frac{\eta\theta^3}{4}$, and the agent's utility equals $u = \frac{\eta\theta^3}{4} + \frac{\eta^3\theta^6}{12} > 0$.

Note that the second-order conditions hold in both cases.

Profits using a wage contract are higher than using a bonus contract, if $\eta^2\theta^3 \geq \frac{64}{27}$, hence the proclaimed threshold $\bar{\eta}$ exists, with $\bar{\eta} = \sqrt{\frac{64}{27\theta^3}}$. \square

Proof. [Proof of Lemma 3.2.] If the (DE) constraint does not bind in a period t , the principal maximizes profits $\pi_t = e_t^* \theta - \left((e_t^*)^3/3 - \eta w_t e_t^* \theta + 2/3 (\sqrt{\eta w_t \theta})^3 \right) - w_t$, subject to $w_t \geq 0$.

The Lagrange function equals $\mathcal{L}_t = e_t^* \theta - (e_t^*)^3/3 + \eta w_t e_t^* \theta - 2/3 (\sqrt{\eta w_t \theta})^3 - w_t + \lambda_{wt} w_t$, where $\lambda_{wt} \geq 0$ represents the Lagrange parameter for the agent's limited liability

constraint, giving first order conditions

$$\begin{aligned}\frac{\partial \mathcal{L}_t}{\partial e_t^*} &= \theta - (e_t^*)^2 + \eta w_t \theta = 0 \\ \frac{\partial \mathcal{L}_t}{\partial w_t} &= \eta \theta (e_t^* - \sqrt{\eta w_t \theta}) - 1 + \lambda_{w_t} = 0\end{aligned}$$

First, we show that $\lambda_{w_t} = 0$. To the contrary, assume that $\lambda_{w_t} > 0$ and hence $w_t = 0$. Then, $e_t^* = \sqrt{\theta}$ and $\pi_t = \frac{2}{3} (\sqrt{\theta})^3$. In this case, a small increase of the wage would raise profits: $\frac{d\pi_t}{dw_t} \big|_{w_t=0} = \sqrt{\eta^2 \theta^3} - 1 > 0$, since $\eta > \bar{\eta}$ implies that $\eta^2 \theta^3 > 64/27 > 1$.

Since $\lambda_{w_t} = 0$, the first order conditions allow us to obtain the values for effort and wage, yielding $w_t = \frac{(\eta^2 \theta^3 - 1)^2}{4\eta^3 \theta^3}$ and $e_t^* = \frac{1 + \eta^2 \theta^3}{2\eta \theta}$. $w_t > 0$ because $\eta > \bar{\eta}$ implies $\eta^2 \theta^3 > 1$. \square

Proof. [Proof of Lemma 3.3.] Taking the (DE) constraint into account, the Lagrange function of the principal's maximization problem in a period t becomes $\mathcal{L}_t = e_t^* \theta - (e_t^*)^3/3 + \eta w_t e_t^* \theta - 2/3 (\sqrt{\eta w_t \theta})^3 - w_t + \lambda_{DE_t} [\delta (\Pi_{t+1} - \tilde{\Pi}_{t+1}) - \frac{2}{3} (\sqrt{\eta w_t \theta})^3 - (e_t^*)^3/3 + \eta w_t \theta e_t^*]$, where $\lambda_{DE_t} \geq 0$ represents the Lagrange parameter for the principal's dynamic enforcement constraint, and where we omit the agent's limited liability constraint and show ex-post that is satisfied.

First order conditions are

$$\begin{aligned}\frac{\partial \mathcal{L}}{\partial e_t^*} &= \theta - (e_t^*)^2 + \eta w_t \theta + \lambda_{DE_t} [-(e_t^*)^2 + \eta w_t \theta] = 0 \\ \frac{\partial \mathcal{L}}{\partial w_t} &= \eta \theta e_t^* - \eta \theta \sqrt{\eta w_t \theta} - 1 + \lambda_{DE_t} [-\eta \theta \sqrt{\eta w_t \theta} + \eta \theta e_t^*] = 0,\end{aligned}$$

yielding $w_t = \frac{(\eta^2 \theta^3 (1 + \lambda_{DE_t}) - 1)^2}{4\eta^3 \theta^3 (1 + \lambda_{DE_t})^2}$ and $e_t^* = \frac{1 + \eta^2 \theta^3 (1 + \lambda_{DE_t})}{2\eta \theta (1 + \lambda_{DE_t})}$. $w_t > 0$ for $\lambda_{DE_t} \geq 0$ because $\eta > \bar{\eta}$ implies $\eta^2 \theta^3 > 1$. Finally, it is straightforward to show that for $\lambda_{DE_t} > 0$, $\frac{(\eta^2 \theta^3 (1 + \lambda_{DE_t}) - 1)^2}{4\eta^3 \theta^3 (1 + \lambda_{DE_t})^2} > \frac{(\eta^2 \theta^3 - 1)^2}{4\eta^3 \theta^3}$ and $\frac{1 + \eta^2 \theta^3 (1 + \lambda_{DE_t})}{2\eta \theta (1 + \lambda_{DE_t})} < \frac{1 + \eta^2 \theta^3}{2\eta \theta}$. \square

Proof. [Proof of Lemma 3.4.] The (DE) constraint in period $T - 1$ (where on- and off-path continuation profits are $\Pi_T = \eta \theta^3/4$ and $\tilde{\Pi}_T = \frac{2\theta}{3} \sqrt{\frac{\theta}{3}}$, respectively) equals $(e_t^*)^3/3 - \eta w_t \theta e_t^* \leq \delta \left(\frac{\eta \theta^3}{4} - \frac{2\theta}{3} \sqrt{\frac{\theta}{3}} \right) - \frac{2}{3} (\sqrt{\eta w_t \theta})^3$. For first-best effort and wage levels $w_t = \frac{(\eta^2 \theta^3 - 1)^2}{4\eta^3 \theta^3}$ and $e_t^* = \frac{1 + \eta^2 \theta^3}{2\eta \theta}$, it becomes

$$\frac{3\eta^2 \theta^3 - 1}{6\eta^3 \theta^3} \leq \delta \left(\frac{\eta \theta^3}{4} - \frac{2\theta}{3} \sqrt{\frac{\theta}{3}} \right).$$

By assumption ($\eta > \bar{\eta}$), both left and right hand side are strictly positive. Therefore, the constraint is violated for first-best effort and wage levels if $\delta \rightarrow 0$.

To investigate the first part of the Lemma, rewriting the (DE) constraint gives $\frac{3 - \frac{1}{\eta^2 \theta^3}}{6\eta} \leq \delta \sqrt{\theta^3} \left(\frac{\eta}{4} - \sqrt{\frac{4}{27}} \right)$. Hence, for $\eta \rightarrow \infty$ as well as for $\theta \rightarrow \infty$, the left hand side approaches zero, whereas the right hand side approaches infinity. \square

DV: unpaid overtime	(1) Age groups	(2) Retire	(3) Old
Positive reciprocity	-0.00181 (0.0851)	0.0474 (0.0306)	0.0458 (0.0305)
age_rec05 = 2, aged 30-39	0.238 (0.630)		
age_rec05 = 3, aged 40-49	-1.051* (0.593)		
age_rec05 = 4, aged 50-59	-0.621 (0.638)		
age_rec05 = 5, aged 60+	-3.173*** (1.009)		
2.age_rec05#c.posrec05	-0.0488 (0.106)		
3.age_rec05#c.posrec05	0.133 (0.0981)		
4.age_rec05#c.posrec05	0.0411 (0.105)		
5.age_rec05#c.posrec05	0.404** (0.163)		
retire05 = 1		-1.687** (0.763)	
1.retire05#c.posrec05		0.245* (0.125)	
old = 1			-2.497*** (0.858)
1.old#c.posrec05			0.361*** (0.139)
Controls	Yes	Yes	Yes
Observations	7,011	7,011	7,011
R ²	0.0837	0.0818	0.0823

Notes: Robust standard errors reported in parentheses. Standard errors are clustered at household level. Table reports coefficients of logit regressions. Estimation in column (1) includes interaction terms of age groups and positive reciprocity, while estimations in column (2) uses interactions of proximity to retirement and positive reciprocity. Column (3) interacts a dummy indicating at least 60 years of age with positive reciprocity. Controls include years of education, gender, years of full time and part time work experience (linear and squared terms), a dummy for part-time employment, job tenure in current position (linear and squared), indicator variables for industry sector (services, agriculture, energy or mining, manufacturing, construction, trade, transport, bank or insurance) and firm size (less than 100, 100-199, 200-1999, more than 1000 employees), and an indicator variable for occupation status (white collar, blue collar, public sector). *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Interaction regressions of effort on positive reciprocity

DV: job satisfaction	(1) Age groups	(2) Retire	(3) Old
Positive reciprocity	0.343*** (0.0923)	0.186*** (0.0301)	0.199*** (0.0301)
age_rec05 = 2, aged 30-39	0.684 (0.657)		
age_rec05 = 3, aged 40-49	1.057* (0.619)		
age_rec05 = 4, aged 50-59	-0.0186 (0.679)		
age_rec05 = 5, aged 60+	-0.214 (1.138)		
2.age_rec05#c.posrec05	-0.145 (0.110)		
3.age_rec05#c.posrec05	-0.230** (0.103)		
4.age_rec05#c.posrec05	-0.0770 (0.112)		
5.age_rec05#c.posrec05	0.0107 (0.185)		
retire05 = 1		-1.691* (0.962)	
1.retire05#c.posrec05		0.236 (0.163)	
old = 1			-0.597 (0.993)
1.old#c.posrec05			0.159 (0.163)
Controls	Yes	Yes	Yes
Observations	6,475	6,339	6,475
R^2	0.036	0.033	0.034

Notes: Robust standard errors reported in parentheses. Standard errors are clustered at household level. Table reports coefficients of OLS regressions. Estimation in column (1) includes interaction terms of age groups and positive reciprocity, while estimations in column (2) uses interactions of proximity to retirement and positive reciprocity. Column (3) interacts a dummy indicating at least 60 years of age with positive reciprocity. Controls include years of education, gender, years of full time and part time work experience (linear and squared terms), a dummy for part-time employment, job tenure in current position (linear and squared), indicator variables for industry sector (services, agriculture, energy or mining, manufacturing, construction, trade, transport, bank or insurance) and firm size (less than 100, 100-199, 200-1999, more than 1000 employees), and an indicator variable for occupation status (white collar, blue collar, public sector). *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Interaction regressions of job satisfaction on positive reciprocity