Status Competition and Performance in Work Groups

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Abstract

Status involves group members evaluating themselves relative to fellow group members according to some shared standard of value. Status has been described in economics, sociology and evolutionary anthropology. Based on this work, we treat status and the associated recognition by others as an intrinsic preference of all group members. There is disagreement about whether status competition enhances group performance by pushing group members to work harder, or whether it retards performance by causing unproductive behavior.

We build a dynamic simulation model of a work group, where members are paid a bonus based on groupperformance. In addition to compensation, group members value a high status relative to their peers. Status is influenced both by contribution to group output and by non-productive, social activities of status enhancement. Group members allocate their total time between working and non-productive status enhancement, trying to maximize the combined utility from compensation and status rank.

We show that status competition can serve to push group members to work hard and perform, provided that it is mainly based on merit. However, if status is also based on political maneuvering, status competition can lead to low group performance, especially in larger groups. Moreover, group performance may fluctuate and be unstable over time if the result of effort is noisy or if the group does not allow the sharing of ranks. The susceptibility to fluctuation depends on how status is awarded and updated over time. Thus, although a firm may not be able to avoid status competition, it may succeed in influencing its effects indirectly. We demonstrate these results analytically and via simulation.

Keywords: Status, equilibrium, simulation, team production, collaboration in groups.

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1 Introduction

Men do not work to maximize their economic benefits, any more than they try to maximize their physical comfort. What does a billionaire need a second billion for? To be of higher rank than a fellow billionaire who only has a single billion (Jerome Barkow, 1975 and 1989).

The theory of the firm is in the process of a transformation. First, it is increasingly recognized in economic modeling that firms consist of separate individuals with their own minds and interests ("agents", see, e.g., DeCanio and Watkins 1998). Second, the utility-maximizing framework analyzing the behavior of such agents is being extended from the maximization of consumption and wealth (Becker 1976, 284) to the inclusion of more general social behavior, such as altruism (e.g, Frank 1988, Simon 1990, Bester and Güth 1998), and the quest for status (Frank 1984, 1985).

Work in evolutionary anthropology has convincingly argued that the striving for status has arisen over the five million year history of the human race, in order to facilitate the coordination of simultaneous competition (for mates and resources) and cooperation (against external threats) in groups (e.g., Barkow 1989, Chapais 1991, de Waal 1996). Desire for status operates through emotions (or "inborn tastes", see Frank 1988, 6) and has been largely adaptive in human history (e.g., Frank 1987, 1988, Stevens and Price 1996). However, while status behavior is still with us, it is not clear whether it continues to be adaptive in today's organizations.

In this article, we focus on the problem of team production in work groups. We build a dynamic model of self-interested agents in the group, who compete for status while simultaneously cooperating to produce a team output. In the context of this model, we examine under which circumstances status competition enhances performance (is adaptive), and under which circumstances it reduces performance.

2 Status and the Social Dilemma of Team Production

Worker performance in teams, where output is produced collaboratively and no member's contribution is separable and recognizable (except through costly monitoring), poses a well-known social dilemma: if the effort of contributing productively to the team is costly to the worker, s/he has to choose between working hard, to the fullest of his/her ability, and "shirking", or cruising at the minimum effort level that does not expose the shirker. If the benefits of the worker's effort are shared among the whole group (which is typical in teams, for example, in the form of team bonuses), they may become so diluted that they are outweighed by the worker's effort cost, so s/he rationally decides to shirk. If, however, every team member shirks, everyone is worse off (e.g., Marschak and Radner 1972, Schelling 1978, 124 - 133, Glance and Huberman 1994).

A number of solutions to this dilemma have been offered. Work in social psychology and sociology has proposed that various social mechanisms such as group norms, peer pressure, and shared values can overcome the social dilemma (e.g., Pfeffer 1994). In economics, it has been proposed to make compensation dependent on a *tournament*: not the contribution itself of a worker, but only a ranking of contributions needs to be monitored, an easier to perform ordinal measurement. This compensation can be constructed in such a way as to give workers the right "incentives" to contribute (Lazear and Rosen 1981). These authors propose that promotion of one person from a group of competing peers to a higher position with a disproportionally higher salary, such as that of a vice president, represents an example of such a tournament scheme. Huberman and Loch (1996) propose another possible solution to the social dilemma. It considers sophisticated collaboration among the workers, where the problem-solving of one individual can be leveraged for others through the sharing of information. If the performance increase of the team from additional effort is sufficiently steep, the social dilemma disappears.

In this article, we propose that an alternative explanation of how social dilemmas in teams can be overcome is offered by *status*. In sociology, *status structures* are defined as "rank-ordered relationships among actors. They describe the interactional inequalities formed from actors' implicit valuations of themselves and one another according to some shared standard of value" (Ridgeway and Walker 1995, 281). A long-standing tradition of the study of status in sociology has examined the seemingly pervasive existence of status hierarchies in group situations. Indeed, at least four theories examine the emergence of status within groups - functionalism (cf. Bales, 1953), exchange theory (cf. Blau, 1964), symbolic interactionism (cf. Stryker and Statham, 1985), and dominance-conflict theories (Ridgeway and Walker, 1995). These theories differ in the extent that status hierarchies are viewed as cooperative, goal-oriented behaviours, or as conflictual behaviors. Certainly, it is widely agreed that the resolution of status contests serve an important function for groups: it allows them to organize and proceed in pursuit of their joint goal. Individual status seeking behavior is theorized to increase individual rewards while at the same time stable status hierarchies allow groups to organize efficiently in pursuit of their joint goals. However, individual status-seeking behavior imposes a cost in terms of group effectiveness – in and of itself, status seeking is unproductive. For example, recently business literature has begun to discuss the negative aspects of status conflict (e.g., Manager Magazin 1998, Nicholson 1998, The Economist 1998).

Our model is consistent with those conflict-dominance theories that examine the trade-offs between pursuit of self-interest and contribution to a group goal (cf. Ridgeway and Diekema, 1989). We view the desire for status as rooting in *emotional tastes*. In the words of Robert Frank, "feelings and emotions, apparently, are the proximate causes of most behaviors. (...) Rational calculations are an *input* into the [internal] reward mechanism" (Frank 1988, 53). This view is based on work in evolutionary anthropology.

Evolutionary anthropologists have long recognized status competition as an ancient driver in our species (e.g., Barkow 1975, de Waal 1989, Chapais 1991, Stevens and Price 1996). Status behavior has its roots in a general primate tendency toward social hierarchy, where evolution favors competition among group members (for food, mates, nesting sites) to be performed efficiently with as little injury or risk of injury as possible. Determining which of two competing individuals would likely win the encounter, without actual fighting, leads to a status hierarchy in primate groups. This involves the capability of assessing the strength of the opponent, for example, through ritual displays and threats. However, human prestige is more complex than animal status, which is based on pure agonism (strength). Human prestige and status is *symbolic*, and it can rest on a large number of criteria that are, to some extent, choosable by the group (Barkow 1989, Chapter 8). In other words, the *striving* for status is "built into us," but we can shape the manner in which status is rewarded. The possibility of shaping status behavior is emphasized by sociology literature and an important aspect examined in our model.

This work has enabled us to understand what status looks like (e.g., sociology has described how status structures become legitimate in groups and how they stabilize) and what its sources are (the evolutionary explanation from anthropology). However, it has not been settled how status structures influence group performance. In other words, we understand why the preference for status has been adaptive for hunter and gatherer groups of our ancestors, but it is not clear whether it is still adaptive (i.e., performance enhancing) in today's organizations, which emerged over a time frame too short for evolution to follow.

A small literature in economics has begun to adress this issue, notably Frank's (1984, 1985) status theory. Suppose that workers care not only about their absolute wages, but also about how their wages compare with those earned by their co-workers. In other words, relative wages equals status within the local group. If the value of status is taken into account, the relative position in a company comes (partially) under the control of the individual. This can lead to what Frank calls the *positional treadmill*. If, within a given wage scheme, two workers (of similar productivity and thus rank) can influence their productivity with some additional effort, the fact that status depends on the relative productivity introduces a prisoner's dilemma: although both may intrinsically prefer to work only a certain amount, the benefit of gaining the higher rank over the other may cause both to work more than they really desire.

Frank's positional treadmill can be used to offer a solution to the social dilemma of team production: if workers care about what their output is, relative to that of their peers (because of the skill prestige this confers), the same effect results as if they were paid according to Lazear and Rosen's (1981) tournament compensation scheme. Suppose the salaried workers Hatfield and McCoy have preferences over effort and rank as described in Figure 1 (this example is adapted from Frank 1985, 134): this interaction represents a prisoner's dilemma, and even without any performance-related pay, both workers end up in a Nash equilibrium (shaded in the Figure) where both work hard, although both would be better off working less. When one of them works hard, he gets the higher rank, which is worth more than the extra effort spent. However, when both work hard, neither gets the preferred rank, but both pay the cost of effort. Frank's insightful analysis, thus, offers a possible explanation as to why especially professional employees work so much in some organizations without any discernible compensation incentive to do so. If the organization assigns status rankings based on effort or contribution, this may be a sufficient reason for employees to work hard, providing an alternative explanation to culture or values.

Frank's (1985) analysis has, however, two shortcomings: first, status is equated with wages. Second, his model is static (an equilibrium model). Status is, however, not equal to relative pay (although pay is one component of it, corresponding to the "skill" component of status competition mentioned above). For example, Stevens and Price (1996) generalize the measure of rank in primates to the "resource holding power," and its equivalent in humans self esteem. Barkow (1992) adds achievement, or prestige. Status in this sense

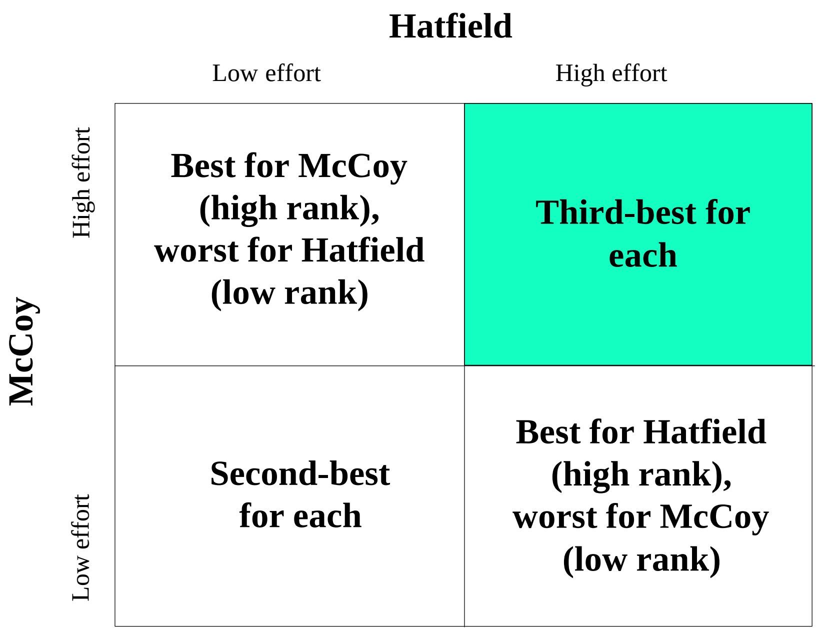

Figure 1: Effort-Status Tradeoff in a Prisoner's Dilemma

can be influenced by a number of different characteristics, such as talent, good looks, a network of friends, favors that one has done others and which are now "debts" that one can call in, knowledge about others, and so on. Building status along such dimensions will require activities that may have nothing to do with productivity on the job, and which, on the contrary, may even detract from productivity.

Second, status is not static, it changes dynamically over time (day by day). The small groups of early humans, from whom we believe to have inherited the striving for status (Tooby and Cosmides 1992, de Waal 1996) lived in the tension between the need for group cohesiveness (to be capable of responding to outside threats from other groups and from predators) and competition among individuals for resources and mates. A complicated pattern of status dominance behaviors and subordinate behaviors resulted, never attaining equilibrium. It sufficed to establish certain bounds of behavior, beyond which the group's survival would be threatened.

The present article extends Frank's model to a dynamic theory of status, treating separately the utility of money and that of status, which is influenced both by the effect of performance (prestige from skills) and by "political means" of enhancing status. We explore the dynamic effect of status behavior on cooperation behavior in the work group and, thus, of group performance over time. Thus, we combine two separate status literatures from sociology and economics, and offer new insights into the drivers of work group performance.

3 A Dynamic Model of Status Competition

3.1 Performance, Compensation and Status

Suppose there are n members in a working group, from now on referred to as *actors*, who collaborate to produce a group output (see, e.g., Huberman and Loch 1996 for a similar setup). Based on Frank's (1985) results, we do not focus on the traditional choice between work and shirking (e.g., Lazear and Rosen 1981). Rather, actors allocate their time between work (contribution to group output) and "social activities" for status enhancement (such as networking, gossiping and influencing others, exchanging favors, etc.).[1] From now on, we refer to such social, non-productive, status enhancement as "politics". Each group member periodically examines his/her status rank as well as group performance (and its resulting bonus), and then makes a decision about working behavior. Actor i allocates a fraction $k_i \in [0, 1]$ of his/her total time budget to work and a fraction $(1 - k_i)$ to politics. In the absence of focal external events, each actor will time this evaluation independently from the others, based on a number of unrelated random events (a conversation with an external colleague, a decision to buy a consumer good of high value, etc.), in which case it

[1] Note that these activities serve a different purpose than Milgrom and Roberts' (1992, 192 f.) "influence activities," which are concerned with decisions that influence the distribution of wealth among members of an organization.

is a reasonable approximation to assume that each actor sets his/her behavior according to a Poisson process of rate λ.

For the purpose of this article, we assume that all group members are equal, in order to focus our discussion on a symmetric situation. A situation where one actor has more talent, more need for money or a higher ambition would introduce distortions in our exploratory analysis; such a situation will be examined in later work. The actual performance contribution of an actor is determined by his/her work effort, albeit with a random component, stemming from the fact that results are not always fully predictable in professional work. Performance of actor i is $\pi = 1 - e^{-\theta(k_i + \epsilon_\pi)}$. π is an often used convenient function, which increases concavely from zero (no contribution) to $1 - e^{-\theta}$ (100 % contribution). The parameter θ represents the slope of this performance function as effort increases, and θ also determines the maximum attainable performance. ϵ_π is a random variable with a symmetric distribution around zero. We assume all actors are subject to random influences of the same nature, but uncorrelated (the ϵ_π are i.i.d. for all actors).

The performance of the work group is determined by the individual performance of all its members, $\Pi = \sum_1^n \pi_i$. The firm faces team production, that is, it cannot monitor the performance of the actors separately, and can only reward the group members depending on total team production.[2] A common compensation scheme is to give every group member a fixed salary w plus a performance bonus of β % of the group's total output, shared among the group members: $w + \beta\Pi/n$. Actor i derives a *utility* from this monetary compensation characterized by

$$U_m(i) = \delta_m[w + \frac{\beta\Pi}{n}]. \tag{1}$$

δ_m represents the "value of money", which needs to be compared to the value of status

[2] Π represents the production function of the group. Often, non-separability of the production function is seen as an essential part of team production. In this article, we take a linear function to simplify exposition, while stressing non-observability of the individual contributions to the firm.

rank in the group (described below).

Based on the cited work in evolutionary anthropology, we assume that group members care not only about salary, but also about their respective status rank within the group. Each group member i holds a certain level of status, or prestige, within the group, which we call S_i. Group members are ranked along this prestige dimension, and member i's rank is R_i, with rank 1 being the top, and rank n the bottom of the rank order. Assume for now that the predominant convention allows two group members of *equal* status to both enjoy the *higher* of the two ranks (e.g., the two top individuals with equally high prestige are both ranked number one, and the third individual is ranked third). Every individual attaches utility to his/her rank. The parameter δ_r stands for the value of rank, analogous to the value of money.

$$U_r(i) = \delta_r[1 - \frac{(R_i - 1)^2}{(n-1)^2}]. \quad (2)$$

This quadratic function decreases concavely from δ_r for rank 1 to 0 for rank n, and it is normalized in order to be unaffected by group size.

Individual i's status is influenced by two things: first, by his/her contribution π_i. Team members *can* observe contributions, and a strong contribution earns respect in the group. The second influence is "politics," or status enhancing activities $(1 - k_i + \epsilon_p)$. The random variable ϵ_p expresses the fact that an actor cannot perfectly predict the result of his/her politicking; it may work well or backfire, just as the result of work is not fully foreseeable. However, let us assume that the actor's prediction of the outcome of his/her action is *unbiased*, that is, the random variable ϵ_p has a distribution symmetric around zero (and thus a zero expectation). If this were not the case, the randomness would introduce "drifts" of behavior into our model, or an inherent tendency toward some type of behavior, which we want to avoid in this first effort to understand the basic characteristics of group behavior. We make a simplifiying assumption (for exposition only), namely that the uncertainty affecting politicking ϵ_p has the same distribution as the uncertainty in work outcome ϵ_π. However, the two are uncorrelated, that is, work may succeed well, while politicking at the same time may backfire. Because of this randomness, the *realized* work effort and politicking do not always add up to one.

A "meritocracy parameter" γ expresses the group's relative weighing of contribution versus politics, and it may also represent the ability of the organization to measure or observe contribution. if $\gamma = 0$, the organization cares only about politics, and if $\gamma = 1$, the organization is a "meritocracy," where only contribution counts. Finally, each individual builds on a stock of prestige from the last evaluation period, which we call $S_i(\tau - 1)$, to which s/he adds by the current activity. However, this stock of status decays over time with a rate of α per evaluation period. This corresponds to a situation where actors roughly "sense" when their status has decayed by a certain percentage, and then take action to re-evaluate their behavior. If the decay rate α is large, the group basically re-establishes status every period, and if α is small, the status quo is stable, and the current period has only a small updating influence on the rankings. Thus, the new status level of actor i, after the new effort decision (for evaluation period τ) becomes

$$S_i(\tau) = \alpha[(1-\gamma)(1-k_i+\epsilon_p)+\gamma\pi_i]+(1-\alpha)S_i(\tau-1). \tag{3}$$

The ranks R_i are determined by ranking the status levels $S_i(\tau)$ from top to bottom. If the status levels of two actors are identical, these actors *share* the same rank (analogous to a medal in the olympic games). When performances and new rankings are visible, each individual determines his/her utility by combining wages obtained and rank achieved, $U(i) = U_m(i) + U_r(i)$.[3]

As we have observed above, it is significant that a group may (partly) choose the way by which it awards and updates status rank. For example, status may decay not by a constant percentage of α per evaluation epoch (from evaluation to evaluation), but rather per unit

[3]The additive combination is consistent with experiments in sociology, see Berger et al. 1977.

of elapsed time. That is, agents check on their status level after stochastically variable (e.g., externally influenced) intervals and may find that their status has decayed more or less than expected. A third reasonable scenario is a *cumulative* status update, where newly earned status is simply added to an existing prestige "stock," which does not decay at all. As an example, consider a situation where every significant paper written by a researcher is added to his/her reputation, and old papers are remembered along with new work. Finally, we want to consider an alternative way in which status ranks are determined: Instead of adopting the convention that actors of equal status share the higher rank, the organization may not tolerate equal ranks and insists on a strict hierarchy. For example, the organization may resolve status ties randomly,like a "coin toss", or it may perform a "photo finish" analysis which is really arbitrary and corresponds *de facto* to a coin toss. Below, we will examine how such structural changes in status competition influence group behavior.

3.2 Utility Maximization by Boundedly Rational Actors

In determining his/her effort and politicking levels, each individual wants to maximize his/her expected utility for the coming period, taking into account the other group members' efforts. However, the actors are boundedly rational (Simon 1955): a full game-theoretic evaluation of the corresponding Nash equilibrium is computationally very complex, and beyond their capabilities (as is true for most individuals). Thus, we assume actor i makes two simplifications in his/her assessment of the best course of action to take.

First, s/he chooses an effort level to maximize the expectation of $U(i)$ assuming the actions of the other group members stay the same as in the previous period. Second, the individual is not capable of taking the correct expectation over the concave function $\pi_i = 1 - e^{-\theta(k_i + \epsilon_\pi)}$ of the realized effort in evaluating his/her expected performance resulting from the chosen k_i. Instead, the individual overestimates the expected performance by simply substituting

k_i into the performance function, pretending no uncertainty is present.[4] In summary, actor i chooses k_i to maximize $U(i)$, holding all $\pi_j, j \neq i$, constant and pretending that $\epsilon_p = \epsilon_\pi = 0$. Thus, the individual ignores the concavity of the performance function π.

4 Existence of Equilibria

To gain an understanding of dynamic behavior in the above-described work group, we first characterize possible equilibria analytically. In a first step, we can set bounds on the behavior that will be observed in the group. Taking first and second derivatives of actor i's expected status (3) with respect to the effort k_i (and pretending deterministic outcomes as discussed above) tells us that the status outcome as a function of effort is a concave function with its maximum at

$$k^* = -\frac{1}{\theta} \ln(\frac{1-\gamma}{\gamma\theta}). \tag{4}$$

That is, below an effort level of k^*, *both* expected performance (and thus compensation) and expected status (and thus rank) increase with more effort. Thus, no actor will choose an effort level below k^*. A high weight of politics in the work group relative to the marginal performance increase from more effort ($\frac{1-\gamma}{\gamma} > \theta$) implies $k^* < 0$, that is, at all effort levels a trade-off between working and politicking has to be made. On the other hand, a low weight of politics in determining status ($\frac{1-\gamma}{\gamma} < \theta e^{-\theta}$) makes the social dilemma disappear, that is, $k^* > 1$, so full effort allocation to work will be chosen by all actors.

Within these bounds, what level of work versus politicking will an actor choose? The choice is determined by the trade-off between gaining a higher status rank and increasing

[4] Formally, the expectation of a concave function of a random variable lies below the function of the expectation of the random variable. The assumption that actors ignore this is not critical, it merely simplifies exposition.

compensation. In the case of $n = 2$ actors, this trade-off takes the following form.

$$U(i) = \delta_m[w + \tfrac{\beta}{2}(\pi_j + 1 - e^{-\theta k_i})] + \delta_r \begin{cases} 1 & \text{if } \alpha[(1-\gamma)(1-k_i) + \gamma(1-e^{-\theta k_i})] + (1-\alpha)S_i(\tau-1) \geq S_j(\tau); \\ 0 & \text{if } \alpha[(1-\gamma)(1-k_i) + \gamma(1-e^{-\theta k_i})] + (1-\alpha)S_i(\tau-1) < S_j(\tau), \end{cases}$$

where 1 corresponds to the rank utility of having the top rank and zero is the utility of having the lower rank. The trade-off for two actors is graphically represented in Figure 2. Actor i's monetary utility increases concavely with work effort. Above the minimum rational work effort k^*, expected status decreases with more work effort (because it means less politicking). At the critical work effort $\hat{k}_i$, the resulting status falls below the status of the other group member, dropping actor i's rank from first to second position, with the associated loss in rank utility. $\hat{k}_i$ is the solution of

$$(1-\gamma)(1-\hat{k}_i) + \gamma(1-e^{-\theta \hat{k}_i}) = \frac{S_j(\tau) - (1-\alpha)S_i(\tau-1)}{\alpha} \equiv \xi. \quad (5)$$

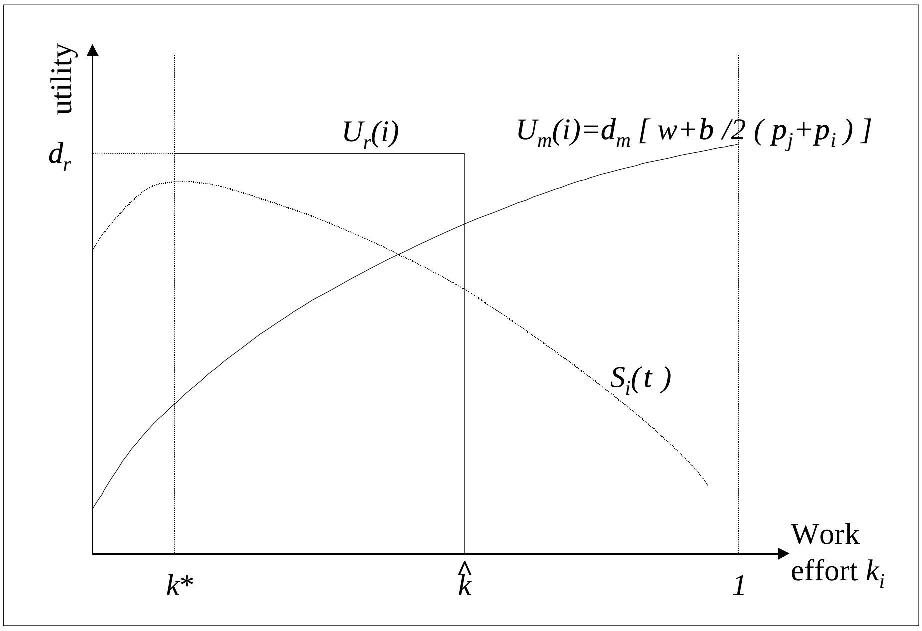

Figure 2: Optimal work effort trading off rank and monetary utility.

With this incentive structure, actor i's optimal effort allocation is clear: It is either $\hat{k}_i$ (as long as $\hat{k}_i$ lies within the bounds $[k^*, 1]$) or 1, as for all other k_i, the rank utility stays constant while the monetary utility increases with work effort. Moreover, the right-hand side of (5) indicates the dynamic characteristics of this system[5]:

Let us consider a situation where actor i has a much larger status than j even after the decay is accounted for. That is, if $S_j(\tau) \ll (1-\alpha)S_i(\tau-1)$, then $\hat{k_i} > 1$: individual i does not need to invest in non-productive status activities and optimally concentrates effort on work. In the opposite situation, when actor i has a much smaller status than j, there is no chance to catch up ($\hat{k_i} < k^*$), so again actor i can concentrate effort on working. In both of these cases, the status ranking is unambiguous and stable, which leads to no politicking and high group performance.

However, if any status decay α is present, this stable situation erodes over time, and both actors' status levels converge toward zero. At some point in time, the status levels approach each other sufficiently to enable overtaking, which introduces an incentive to politick. Full work effort, and thus high performance, can be maintained if the monetary reward is high enough. This corresponds to the curve U_m in Figure 2 being very steep, fulfilling condition (6):

$$U_m(i) \mid_{k_i=1} > U_m(i) \mid_{k_i=\hat{k_i}} + U_r(i) \mid_{R_i=1} - U_r(i) \mid_{R_i=2} . \tag{6}$$

If the monetary reward does not dominate, individual i optimally chooses the lower effort level, $\hat{k_i}$, to preserve or attain the higher rank. In this situation, we can show that in the absence of uncertainty, *any* effort level equal across actors is sustainable as an equilibrium in the status-seeking game.

Proposition 1 *If $\epsilon_\pi = \epsilon_p = 0$, $k_i = k_{equ} \in [\hat{k}, 1]$ $\forall i = 1, \ldots, n$ represent an equilibrium, provided that $k_{equ} > -\frac{1}{\theta}\ln(\frac{n\delta_r}{\beta\delta_m})$.*

Proof. Let $S = (1-\gamma)(1-k_{equ}) + \gamma(1-e^{\theta k_{equ}})$. Then, by equation (3), this status level stays constant over time for all actors. If all actors have the same status, they all share first

[5] Here, we remember that the left-hand side of (5) is decreasing in $\hat{k_i}$

rank by the convention in the group. Thus, it is not optimal to increase politicking because no rank improvement can be achieved, and performance (and thus bonus compensation) would decrease. The condition excludes the case of compensation being so high that a group member would be better off by obtaining the bonus of 100% work effort although shared) while suffering the lowest rank. □

It is important to note that this result is qualitatively robust to some changes in how the group updates status. First, under the scenario of status decay per unit time (rather than per evaluation epoch), $k_i = k_{equ}$ for all i is again an equilibrium, as the (equal) status levels of *all* actors decay together, so again, rank 1 is shared, and there is no incentive to deviate. Second, under a *cumulative* status update without decay, again any common effort level across all actors can be supported as an equilibrium, where all group members share status rank 1 and have no incentive to deviate.

However, Proposition 1 critically depends on two assumptions that we have made so far. First, the presence of performance or politicking uncertainty prevents a constant work level from being an equilibrium, as status and rank vary unforeseeably with every evaluation. The second assumption is the convention that actors of equal status share the higher rank, similar to medalists in the olympic games. If the organization insists on a strict hierarchy and resolves ties by a "coin toss", the incentive remains to out-politick the rival in order to avoid the risk of being stuck with the lower rank. However, if actors can distinguish status levels and vary behavior with perfect accuracy, an *arbitrarily small* increase in politicking suffices to out-do a rival and gain the higher rank. Consequently, politicking "creeps up" only infinitesimally slowly over time, as the actors do not want to sacrifice compensation. That is, the equilibrium is not perturbed.[6] In many cases, however, actors may not be able of perceiving arbitrarily small status differences. A lower limit on perceivable status

[6]This argument can easily be made precise: the equilibrium is perturbed by an amount less than any $\epsilon > 0$.

differences can be represented in our model as a threshhold. If two status levels are within the threshhold of each other, the actors perceive their status as equal and randomly assign the higher rank, as described above. With such a threshhold, an actor has an incentive to increase politicking by a finite amount, and the equilibrium really breaks down.

Thus, if one of these two assumptions is violated (uncertainty, or refusal to share rank coupled with imperfect status measurement), status competition will lead the system to *oscillate*, to drift between periods of stability and high performance and periods of status competition and low performance. A faster status decay α at any time compresses the status difference between the actors, and consequently makes the switch from stability to status competition more likely.[7]

We do not need to perform formal comparative statics calculations to see what influence the model parameters have on group output or performance: the performance slope θ increases performance through its influence on the range of effort levels, k^*, and on the the critical effort level $\hat{k}_i$. Through the same venue, the meritocracy weight γ enhances group performance. A faster status decay α reduces performance through its influence on $\hat{k}_i$ and because it compresses the status level differences among the actors. Value for money δ_m, wage w and bonus β all boost performance, as they make the comparison of $U_m(i) - U_r(i)$ more favorable. Conversely, the utility for rank δ_r makes this comparison less favorable and, thus, reduces performance.

In summary, our dynamic model shows that the simple view of status in a pure meritocracy (Frank 1985) misses an important aspect: status is also determined by politics. Group incentives (Milgrom and Roberts 1992, 416), that is, adjusting the incentive bonus β, does not resolve this conflict, except in the trivial case where the group performance can vary so much that it dominates status concerns. Indeed, the critical effort levels k^* and

[7]This can easily be seen by taking the derivative of ξ in equation (5) with respect to α, which is $(S_i(\tau - 1) - S_j(\tau))/\alpha^2$.

$\hat{k}_i$ do not depend on the bonus level β. The model predicts that under conditions of deterministic performance and status ties leading to equal rank, the group may settle in an equilibrium of constant work effort, but it is undetermined at what effort level this equilibrium lies. If performance or politicking uncertainty is present, or if there are no shared ranks allowed, status competition drives an organization into oscillations between predominant politicking and predominant work effort. In the following section, we will test these predictions using simulation.

5 Test of the Model in Simulation Experiments

5.1 Basic Model With Two Actors

In this section, we test the dynamic behavior of our model on a numerical example via simulation.[8] For now and for ease of exposition, we stay with an example of $n = 2$ actors. In one aspect, the actors differ: actor 1 starts the simulation with a status of 10, while $S_2(t = 0) = 0$. Thus, actor 1 is initially higher ranked, so the group can start with high work effort and output. This stable state lasts until actor 1's status level has decayed sufficiently close to zero, at which point status competition sets in.

The example has the following parameters: the performance slope is $\theta = 0.8$, that is, performance contribution per actor, π_i, varies between zero (no work effort) and $(1 - e^{-0.8}) = 0.56$, so total group performance can be maximally 1.12. The utility of money is $\delta_m = 1$ per unit of output, and the entire group output is given back to the group members, via a bonus of $\beta = 1$, in addition to a base salary of $w = 1$. The utility elasticity of rank is $\delta_r = 1$. Thus, the magnitude of rank utility is comparable to money utility.

[8]The simulation is written as a Pascal program within the Delphi environment. One simulation run over 1000 time units takes less than a second on a PC with a 300 MHz Pentium 2 processor.

Each actor examines his/her performance and status situation at random time intervals at an average rate of $\lambda = 0.05$; thus, s/he compares compensation and ranks, on average, every twenty time units (in the remainder of the article, we take a time unit to be a day). Existing status decays at a rate of $\alpha = 0.6$ from one evaluation to the next. In determining the change in status during an evaluation, politicking is weighed at $(1 - \gamma) = 0.8$, and contribution is only weighed at $\gamma = 0.2$. Thus, the group is quite "political" and not a meritocracy, although performance does have an influence.

With these parameters, Equation (4) yields the minimum effort level as $k^* = -1.3$. This means that in the situation described in the example, there is a trade-off to be made at every work effort level between pursuing compensation and pursuing rank. We expect, therefore, to observe the full possible range of work effort from zero to one.

We tested many combinations of parameters, e.g., with low and high politicking weight, with fast and slow status decay, and with steep and shallow slope θ of the individual performance curve. These preparatory results confirm the comparative statics from the analytical model: high politicking weight, fast status decay, and low performance slope all increase the amount of politicking and reduce work effort and group performance. Then, we set out to test the predictions from the analysis above.

First, consider the deterministic case, where the group members can predict with certainty the output from work and from politicking. Figure 3 shows the results of a simulation run over $1,000$ days in a graph of the evolution of total group output and of the average work effort (averaged over the two actors). On the right-hand side, the parameters of the example are repeated.

The Figure shows how group performance starts out high, with group output $\Pi = 1.12$, and average work effort $\pi_i = 1$. However, performance deteriorates (with the critical effort $\hat{k}_i$, where rank is lost or gained) as the two actors' status levels approach each other. After about 150 days, the group reaches an equilibrium, with both actors spending 65%

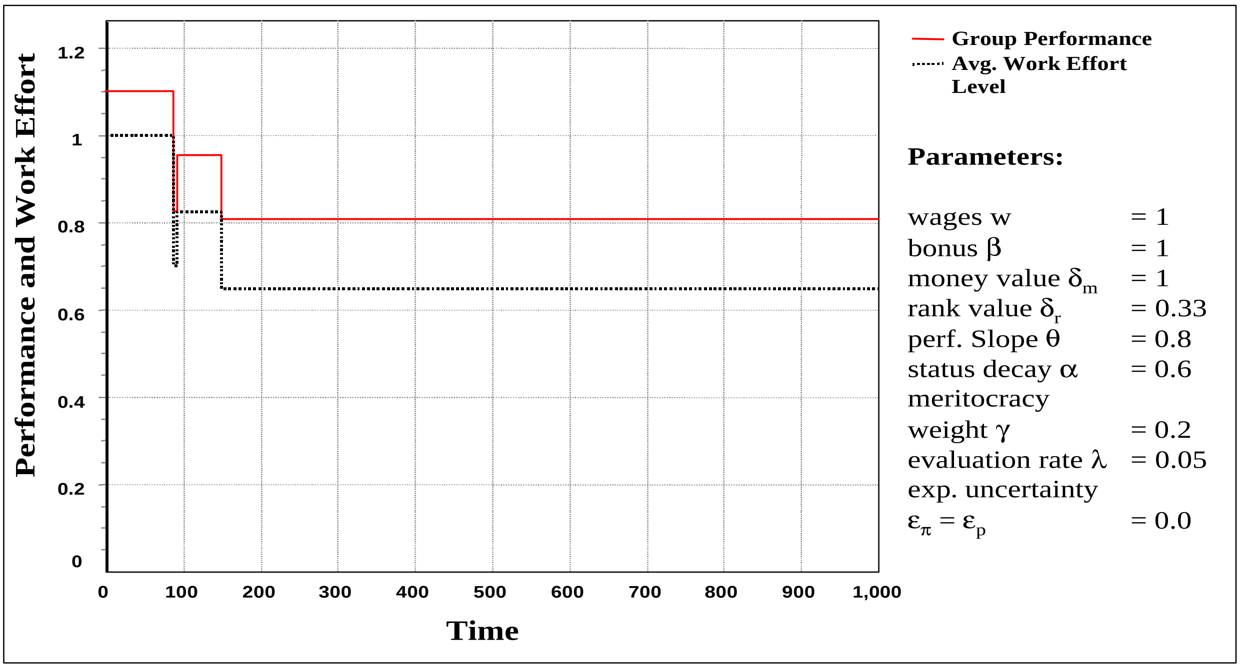

Figure 3: Evolution of group performance without uncertainty

of their time working, and 35% politicking. After this point in time, there are no more rank changes; both actors share rank 1, with a status level of 0.226.

However, the situation shown in Figure 3 is only one instance of possible group behavior (one sample path). As the actors evaluate their status asynchronously at random points in time, each simulation run reaches a different equilibrium. Over 25 runs of a 1,000 days each, the *average* effort level is 0.89. The standard deviation of the average effort levels over the 25 runs is 0.13, with a minimum of 0.57 and a mximum of 1.07. Thus, the group does settle in a stable equilibrium each time, but it cannot be predicted whether the equilibrium is one of high or of low group performance. This parallels the analysis in the previous section.

Now, we introduce uncertainty into the system. Let us assume that both uncertainties ϵ_p and ϵ_π have a symmetric exponential distribution, with an expected value of 0.05 if the random variable is positive, and an expected value of -0.05 if the random variable is negative. The exponential distribution has the characteristic that with high probability, the value of the random variable is small (e.g., the value is smaller than the mean with a probability of 63%), and the probability of larger values occurring falls off exponentially. However, very large values can occur, albeit with low frequency. In the context of our example, this is a reasonable probabilistic structure: most of the time, the actors make good guesses about the outcome of their actions, but every once in a while, a prediction is way off the mark. The same work group as in Figure 3 is simulated with this uncertainty introduced. The result is reported in Figure 4.

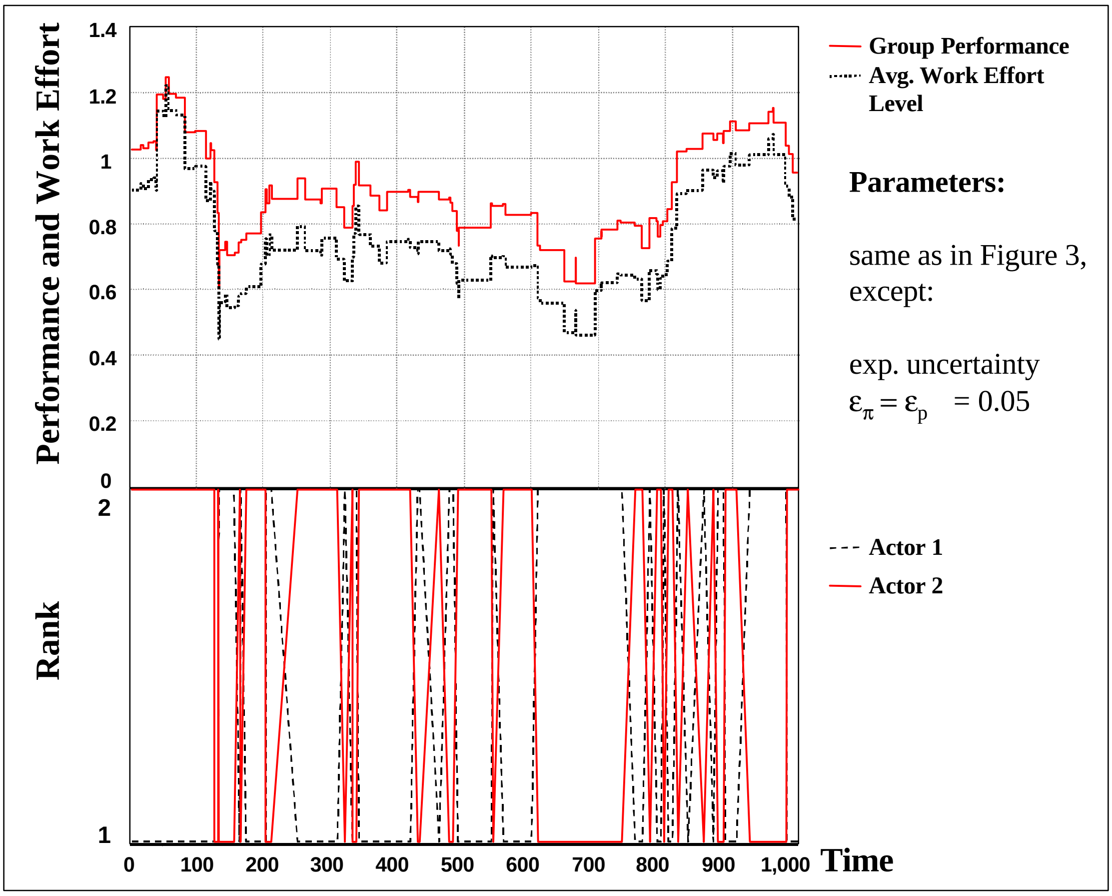

Figure 4: Evolution of group performance and ranks, with uncertainty

With uncertainty added, group output does not settle down in a equilibrium. At any point in time, output may go up or down. Moreover, the total range of observed outputs has increased: effort levels rise to above 1, and as a consequence, output increases to above

1.12.[9] This is the effect of randomness, boosting effort results some times, and rendering them ineffective at other times.

The lower part of Figure 4 shows that the random variations of performance and politicking effectiveness cause the group members to continuously contest and change status ranks. Whenever status levels are separated sufficiently to decrease the incentive to politick, the work effort level recovers. The behavior of the group fluctuates unpredictably over time.

In spite of this increased unpredictability in one simulation run, or one group history, the *a priori* group performance variability over many runs stays virtually unchanged in comparison to the base case (in Figure Figure 3). Average performance and standard deviation over 25 runs are statistically indistinguishable from the base case.[10] In other words, the fluctuations may be seen by group management as an "insurance" against the group "getting stuck" in a low-performance equilibrium. The price for this insurance is that the group will not be able to maintain a high-performance equilibrium, either.

We have, thus, confirmed the effect of uncertainty in the model. We now examine the scenario in which the group does not allow two members to share the same status rank. If two actors share the same status level, a "coin is tossed" to settle the rank. The analysis in the previous section predicts that actors will increase politicking to achieve the higher rank with certainty, if status levels cannot be distinguished perfectly. The simulation confirms this expectation: the equilibrium stays undisturbed if actors can distinguish status perfectly. However, actors vary their effort levels continuously if a threshhold of perceivable status differences is introduced. Figure 5 shows an example where the threshhold is 0.01. The larger the threshhold, the more does group performance fluctuate. Over 25 runs, the average performance and its standard deviation are again statistically undistinguishable

[9] If one waits sufficiently long, an instance of a *negative* performance will also be observed, due to the infinitely long tail of the exponential distribution.

[10] A t-test could not reject the null-hypothesis, of both collections of 25 runs coming from the same distribution, even at the 30% significance level.

from the base case (Figure 3). Thus, the impossibility of sharing ranks has a similar effect on group performance as (performance and politicking) uncertainty, provided there is a threshhold of perceivable status differences.

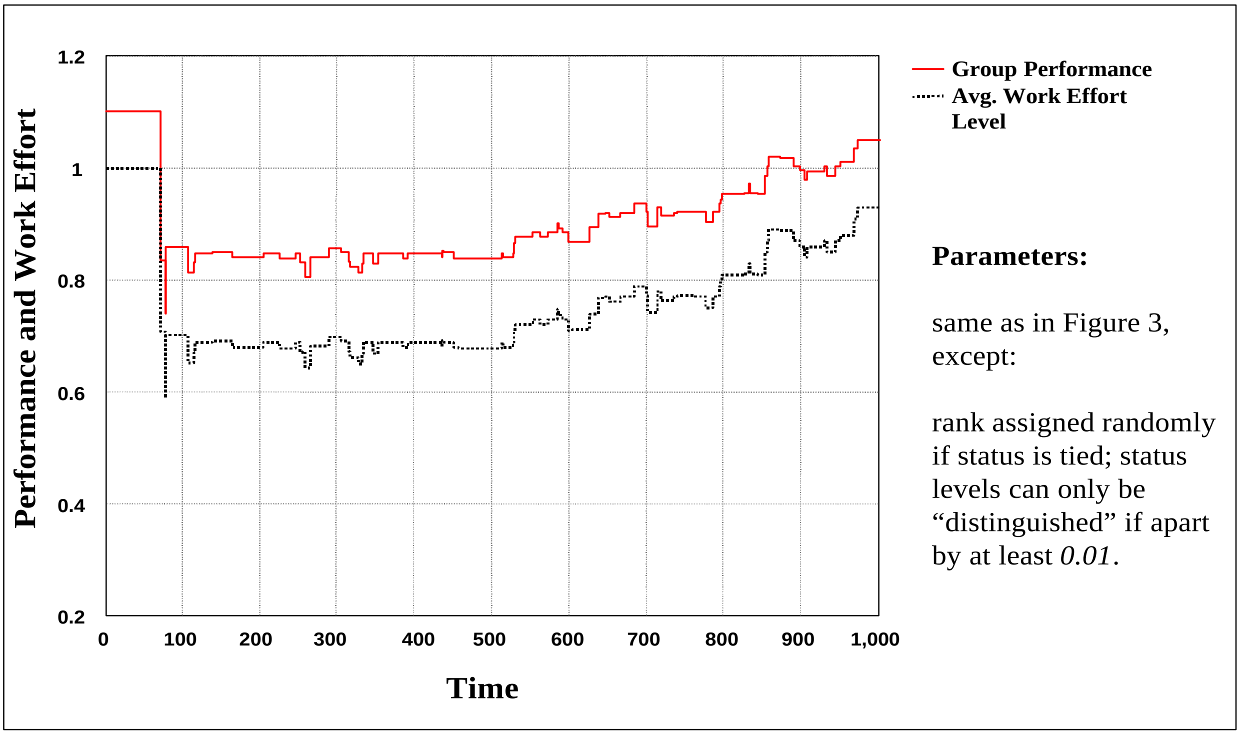

Figure 5: Group performance without shared status ranks

In the presence of performance uncertainty, the way in which status is updated over time has an important influence on the behavior of the group. The fluctuations in Figures 4 and 5 are driven by the decay of status over time, which eliminates any status separation and forces the group into politicking behavior. If, in contrast, status accumulates over time without decay, an initial status hierarchy can be sustained: no group member has an incentive to politick, as no rank gain is achievable, so status enhancements are determined by contribution only. If the initial status differences are sufficient, the performance variations average out over time and cannot destabilize the existing ranking. Thus, a group which can choose, or at least influence, the way it updates status, may be able to maintain a high performance equilibrium.

A final observation helps to illuminate the characteristics of our model. When we introduce a threshhold of perceivable status differences into the base case (without uncertainty and with sharing of ranks), the group's equilibrium, whereever it is initially, "creeps up" to full work effort and no politicking. The reason is that actors now can reduce their politicking to the point where their status is lower than their rival's by an amount just below the perception threshhold. As a result, the whole group can, over time, increase work effort. The higher the perception threshhold, the less time needs the group to reach full performance.

5.2 Larger Group Size

After the above analysis and examples, we now understand the fundamental characteristics of work behavior in our model for small groups with only two members. We are now ready to examine the more complicated case of a larger group. When the group comprises more than two actors, we expect the number of status comparisons to increase, and rank changes to occur more often because only one actor close enough in status to the one currently evaluating the situation suffices in order to elicit competition. As a result, we expect the system to become more noisy. Figure 6 shows the simulated work effort of a group of $n = 7$ actors over $1,000$ days. All other parameters are unchanged in comparison to Figure 3.

Comparing the average performance in Figure 6 with Figure 3, it increases from 0.90 to 1.19, taken again over 25 simulation runs (performance is not shown in Figure 6, as it decreases quickly from the maximum of 3.8 and then closely parallels the effort level). The group has been increased from one to seven, but output grows only by 30%. This is due to a much higher level of politicking; simple inspection makes clear that the average level of work effort allocation ("avg. contribution level" in the Figures) in the group of seven is much lower than in the group of two. The higher politicking is caused by much more frequent "encounters" of status competition between pairs of actors in the larger

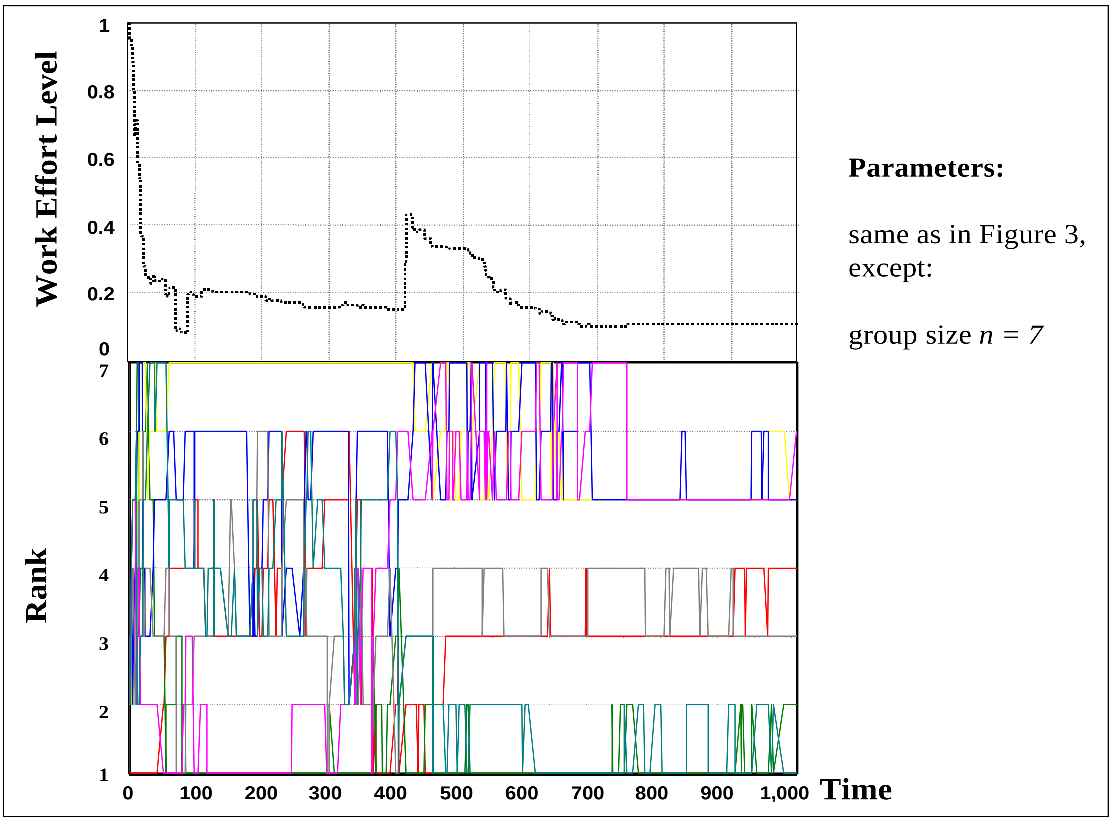

Figure 6: Work effort and ranks in a group of seven actors

group. Most of the additional work capacity introduced by the additional group members is dissipated in status competition. The frequent encounters can be seen in the lower chart of Figure 6. As a result, the group needs much more time to reach a stable level, which is at a much lower overall level of work effort. After 1,000 days, ranks are still being contested and changed. Moreover, the large group's behavior has a higher variability than the small group's: over the 25 runs, (within-run average) performance has a standard deviation of 0.50 (versus 0.13 for the two-actor group), with a maximum of 2.5 and a minimum of 0.35.

Figure 7 shows the effect of uncertainty (in the same form as in Figure 4) in the large group. As before, performance fluctuations within one sample path are increased; the group is capable of coming back to almost full performance once over the 1,000 days. Over 25 runs, the performance average is again indistinguishable from the deterministic case (Figure 6). However, the standard deviation of performance over the 25 runs is

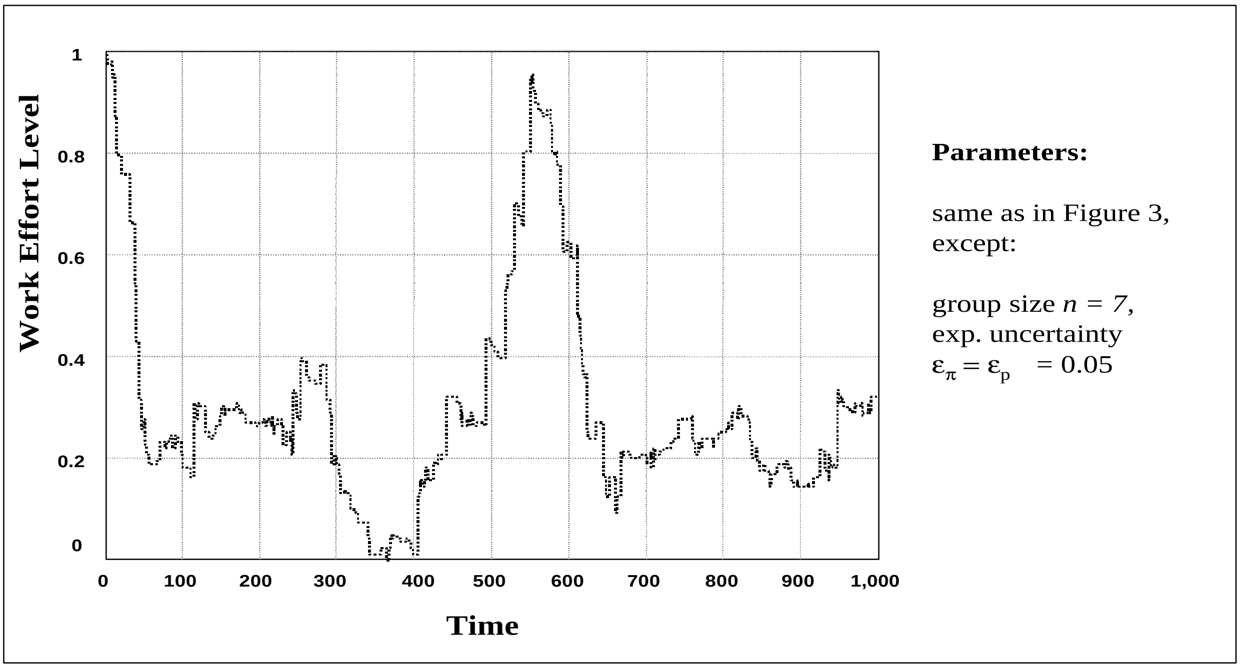

Figure 7: Work effort in a group of seven with uncertainty

decreased significantly, from 50 down to 18.[11] Thus, uncertainty in the effects of work and politicking has a *beneficial* effect for larger groups, by reducing the uncertainty of the firm about where the group's performance level will settle down.

6 Conclusion

Status is pervasive in human behavior, both in the work environment and in everyday life (Barkow 1989). This article makes a contribution to an ongoing debate whether status competition in work groups pushes employees to perform, or whether it causes wasteful jostling for position and destructive behavior. We build on work in economics, sociology, and evolutionary anthropology to formalize status as a relative standing of prestige, determined by both work output and non-productive political activities, such as building status symbols, or spreading gossip. The basic assumption of our model is that employ-

[11] An F-test for the difference of the variances is statistically significant at the level of 10^{-6}.

ees allocate their total effort “budget” between work and politicking (not between work and leisure, as in traditional economics models). This situation is particularly relevant to professional work groups, such as R&D teams, where the individual's work contribution cannot easily be monitored by management.

The relative importance of work output and politicking in the organization expresses the culture of the group or the ease of measuring contribution, whether it functions as a “meritocracy” or whether people advance via politics. We develop a dynamic simulation model of status competition, which explicitly acknowledges that performance and status competition change over time. We are, to our knowledge, the first to formally address the question of under which circumstances status competition supports group output, and under which circumstances it reduces output.

An immediate extension to be explored is interdependence of the group members' performance (for example, via a multiplicative rather than additive group production function Π). Another extension is the actors' ability to control the variance of their performance: does it pay to take performance risks in order to gain status rank? In other future work, the model parameters should be linked to constructs from practice, and the results of the model tested on real data. However, as a first step, the model parameters have face validity, that is, they seem to correspond to characteristics of real organizations. The results of the model support some basic intuitions: higher group-performance related pay increases the motivaton to work. However, a low stability of the established status ranking, as well as a high organizational weight on politics, diverts effort from productive work to politicking, thus reducing output.

Unexpected dynamic effects emerge in our model, which have not been predicted by previous theory. Status decay, together with status competition, leads to uncertainty in the group's performance to be expected. If individual performance and politicking effectiveness can be predicted perfectly by the group members, the group settles in an equilibrium of effort levels, but at what effort level cannot be predicted. If uncertainty is present (in the effect of effort or politicking), the work group cannnot settle down in an equilibrium, but *oscillates* between phases of high performance (as long as ranks are stable) and low performance (when ranks are contested). However, the *a priori* uncertainty about group performance is the same as without performance uncertainty. If the sharing of rank in case of equal status levels (analogous to shared olympic medals or a shared nobel prize) is not tolerated, group effort levels oscillate even when individual performance is not subject to unpredictability. A growing group size changes behavior: first, status levels become, relatively speaking, more compressed, so the total level of politicking grows. Thus, a substantial part of the added capacity from more group members may dissipate in strife and status enhancement. Second, a priori uncertainty about the group's performance further increases in the larger group. Unpredictability for the individual has a beneficial effect for the large group, as the *a priori* uncertainty about how the group performance level will turn out decreases.

Striving for status is inevitable as it is built into all of us, but it can be harnessed positively if structured well: organizations can influence on what they base status. Establishing a culture where contribution to output is observable and valued is one possibility. If politics cannot be suppressed, the organization can attempt to make the status rankings stable, in order to avoid continuous rank contesting, and introduce incentive compensation. If status updating over time can be influenced, status accumulation without decay may allow the group to maintain high performance. Sharing ranks may allow the group to attain a stable work effort equilibrium, which can be beneficial if the organization is capable of "nudging" the group toward a "good" equilibrium initially. In large groups, unpredictability of the results of politicking may help to at least reduce status competition. Status seems, inevitably, to influence behavior on organizations; the current article makes a contribution to include it in economic models of the firm.

References

Bales, Robert, "The equilibrium problem in small groups," In: T. Parsons, R.F. Bales, and E. A. Shils (eds.), *Working Papers in the Theory of Action*, Glencoe, IL.: Free Press 1953, 111-161.

Barkow, J. H., "Strategies for self esteem and prestige in Maradi, Niger Republic," in: *Psychological Anthropology*, T. R. Williams (ed.), The Hague ad Paris: Mouton Publishers, 1975, 373 - 388.

Barkow, J. H., "The transition from primate dominance to human self esteem," in: *Darwin, Sex, and Status*, Toronto: University of Toronto Press 1989, p. 185 - 195.

Barkow, J. H., "Beneath New Culture is Old Psychology," in Barkow, J. H., L. Cosmides, and J. Tooby (eds.), *The Adapted Mind*, Oxford University Press 1992, 627 - 638.

Becker, G. S., *The Economic Approach to Human Behavior*, Chicago: The University of Chicago Press 1976.

Berger, J. M., M. H. Fisek, R. Z. Norman and M. Zelditch, *Status Characteristics in Social Interaction: An Expectation States Approach*, New York: Elsevier 1977.

Bester, H., and W. Güth, "Is Altruism Evolutionarily Stable?" *Journal of Economic Behavior and Organization* 34, 1998, 193 - 209.

Blau, Peter, *Exchange and Power in Social Life*, New York: Wiley 1964 .

Chapais, B., "Primates and the Origins of Aggression, Power and Politics Among Humans," in: Loy, J. D., C. B. Peters (eds.), *Understanding Behavior*, Oxford University Press 1991, 190 - 228.

de Waal, F., *Good Natured: the Origins of Rights and Wrong in Animals*, Harvard University Press 1996.

de Waal, F., *Chimpanzee Politics*, Johns Hopkins University Press 1989.

DeCanio, S. J., and W. E. Watkins, "Information Processing and Organizational Structure" *Journal of Economic Behavior and Organization* 36, 1998, 275 - 294.

Frank, R. H., "Interdependent Preferences and the Competitive Wage Structure" *RAND Journal of Economics* 15, 1984, 510 - 520.

Frank, R. H., *Choosing the Right Pond: Human Behavior and the Quest for Status*, Oxford: Oxford University Press 1985.

Frank, R. H., "If *Homo Economicus* Could Choose His Own Utility Function, Would He Want One With a Conscience?" *American Economic Review* 77, September 1987, 593 - 604.

Frank, R.: *Passions Within Reason: The Strategic Role of the Emotions*, New York: Norton 1988.

Glance, N., and B. A. Huberman, "The Dynamics of Social Dilemmas," *Scientific American*, March 1994, 58 - 63.

Huberman, B. A., and C. H. Loch, "Collaboration, Motivation, and the Size of Organizations," *Journal of Organizational Computing and Electronic Commerce* 6, 1996, 109 - 130.

Lazear, E. P., and S. Rosen, "Rank-Order Tournaments as Optimum Labor Contracts," *Journal of Political Economy* 89, 1981, 841 - 864.

Manager Magazin, "Out of Their Minds (Von allen guten Geistern verlassen)," Text in German, January 1998, 167 - 186.

Marschak, J., and R. Radner, *Economic Theory of Teams*, New Haven: Yale University Press 1972.

Milgrom, P., and J. Roberts, *Economics, Organization and Management*, Englewood Cliffs: Prentice Hall 1992.

Nicholson, N., "How Hardwired is Human Behavior?" *Harvard Business Review*, July - August 1998, 135 - 147.

Pfeffer, J., *Competitive Advantage Through People,* Boston: Harvard Business School Press 1994.

Ridgeway, C. and D. Diekema, "Dominance and Collective Hierarchy Formation in Male and Female Task Groups," *American Sociological Review* 54, 1989, 79-93.

Ridgeway, C. and H. A Walker, "Status Structures," in: Cook, K. Fine, G., and J. House (eds.) *Sociological Perspectives on Social Psychology*, Allyn and Bacon 1995.

Schelling, T. C., *Micromotives and Macrobehavior*, New York: Norton 1978.

Simon, H., "A Behavioral Model of Rational Choice," *Quarterly Journal of Economics* 69, 1955, 88 - 118.

Simon, H., "A Mechanism for Social Selection and Successful Altruism," *Science* 250, December 21, 1990, 1665 - 1668.

Stevens, A., and J. Price, *Evolutionary Psychiatry*, London: Routledge 1996.

Stryker, S., and A. Statham, "Symbolic Interaction and Role Theory," in: G. Lindzey and E. Aronson (eds.), *The Handbook of Social Psychology* 3rd ed. Vol 1, New York: Random House 1985, 311-378.

The Economist, "Biology Isn't Destiny," February 14th, 1998, 97 - 99.