

Our group decided to review two papers [Drago and Turnbull, 1991] and [Banerjee et al., 2014] that adopted two different approach analysis cooperation and competition in workplaces. The former uses the very familiar utility function approach and the latter introduces a novel idea in the setting of a treasure-hunt game where agents progressively solve a series of clues so as to arrive at a final objective. The interesting part of it is that an agent is allowed to disclose or not disclose the clue that he or she has solved for; disclosing the clue will lead to a reward, but will also allow the other agents to proceed to the next stage that when solved might generate much greater rewards. Hence the agent has to decide whether disclosing the results of his progress will maximise his rewards or lead to more competition for future rewards.

Review 1: Competition and cooperation in the workplace

Summary

In this paper the authors analyse the workplace dynamics of cooperation and competition that exists between two risk averse workers with similar attributes. A worker's utility is a function of the worker's effort, μ and the worker's income y , presented as an expectation $\mathbf{E}[U(y) - V(\mu)]$. U and V are utility functions that convert income and effort respectively into a common measure. A worker's effort is represented by $\mu_i = \mu_{ii} + \mu_{ij}$, made up of his or her own effort μ_{ii} and a helping effort μ_{ij} , which denotes effort in helping agent j . The paper does not clearly define each worker's task or their task as a whole but uses a more generic measure of the worker's output represented by a production function $Q_i = f^i(\mu_{ii}, \mu_{ji}) + \epsilon_i$, which is a function of own effort and helping effort from other agents and the ϵ_i is some random disturbance to the production. The paper requires knowledge of the distribution of ϵ to compute the average utility received by a worker. The random disturbance is assumed to be uncorrelated to each other as it imposes $\mathbf{E}[\epsilon_i \epsilon_j] = 0$ and $\mathbf{E}[\epsilon_i] = 0$. Instead of proposing a production function explicitly, the paper characterizes f by imposes three restrictions on it; we would potentially like to adopt the following two of them into our discussion:

(a) $f^i(0, \mu_{ji}) = 0$ which implies $\frac{\partial f^i(0, \mu_{ji})}{\partial \mu_{ji}} = 0$

(b) For $\mu_{ii} > 0$,

$$\left. \frac{\partial f^i}{\partial \mu_{ii}} \right|_{\mu_{ij}=0} < \left. \frac{\partial f^i}{\partial \mu_{ij}} \right|_{\mu_{ij}=0}$$

The first is a natural property aligned to real scenarios in workplaces; the amount of work produced by an agent is deemed as zero if the agent's effort is zero, even if there are positive helping efforts from the other agents. The second is a design to induce helping efforts – by making the production per unit of effort higher for helping effort than own effort whenever an agent directs all effort to oneself.

With the desired properties of the components of the utility function established, the papers considers different scenarios based on the different behaviour of the workers in the sense of their classifying them based on these partial derivatives:

$$\frac{\partial \mu_{ii}}{\partial \mu_{jj}} = \frac{\partial \mu_{jj}}{\partial \mu_{ii}} = a \quad \frac{\partial \mu_{ij}}{\partial \mu_{ji}} = \frac{\partial \mu_{ji}}{\partial \mu_{ij}} = b \quad (1)$$

(i) A *Cournot* behaviour is one where $(a, b) = (0, 0)$, the workers efforts are not related to each other in any way. (ii) Partial bargaining behaviour is when $(a, b) = (0, 1)$; the amount of helping effort exchanged between the workers are the same but own effort is independent of others independent effort. (iii) Complete bargaining occurs when $(a, b) = (1, 1)$.

The next consideration of the paper is the incentive scheme: tournament or quota, which sets up a competitive and non-competitive environment in the workplace respectively. In the contest scenario, the workers are ranked and afforded prizes accordingly; in their two workers scenario they the higher ranked is assigned a prize of $+x$ and the lower is given a prize of $-x$. In the quota scheme, workers are given the prizes when they fulfil an expectation; thus everyone can get the prize ($+x$) and similarly fail to get the prize ($-x$).

As every worker aims to maximise their utility that is the expectation introduced earlier, using \bar{Y} as a fixed income-base the expectation is given by $\mathbb{P}_i(\mu)U(\bar{Y} + x) + (1 - \mathbb{P}_i(\mu))U(\bar{Y} - x) - V(\mu_i)$ and Karush-Kuhn-Tucker (KKT) approached is used to find the optimal utility of the player. Conditioning on the sufficient conditions for KKT, the paper then derives the type of behaviours to be exhibited by the workers when they individually try to maximise their utility on both the contest and quota schemes.

The last discussion in the paper compares the difference between the tournament and quota schemes using the term welfare, which then requires some knowledge of the density of ϵ ; the paper examines the cases when ϵ is uniform and the case when it is unimodal symmetric.

The conclusion derived from this paper is that we cannot expect any helping efforts in a tournament and for a quota scheme, helping efforts only exists when there is partial or complete bargaining. This result is consistent with our intuition and experience that people are more willing to lend a helping hand in noncompetitive environment than in a competitive one.

This paper is more of a worker-centric paper where the focus is more on how the workers can obtain the best utility with the least effort. In the tournament scheme, as the workers are just competing relative to each other with no production benchmark set by the firm, we see that in a complete bargaining tournament the workers are playing with the flaw in the compensation scheme by all refusing to work. In the case of the quota scheme, proposition 5 and 6 simply says that the classification of own and helping efforts are blurred as the production of an agent derived from a unit of own effort is no different from production derived from a unit of helping effort and by the symmetrical actions of the workers, everyone will exert similar amount of effort (this effort is any effort, be it own or helping). Thus the allocation of effort does not matter in a quota scheme with nonzero bargaining.

The workers in the scenario provided in this paper are treating the firm that they work for as an adversary and does not see themselves as part of the firm. What we would like to model is one where the workers have to see the firm and their fellow workers as allies worthy of cooperating with, as the whole is greater than the sum of its parts. Although this paper provides useful approaches and ways of analysis, it lacks the idea of the model that we are aiming for.

Positivity

The paper works with only the distribution of ϵ makes the model much more neat; if there are too many distributions to manage, the analysis will be complex – too much integrals that might not be tractable. Classification into the tournament and quota schemes tells us something important: the way the workers are graded plays an important role in whether the dynamic of the workers lean towards cooperation or competition. This is also seen in schools, where using a bell curve to grade students lead to very individualistic behaviour as compared to assigning grades based on the student's raw score.

Lastly, the paper allows the workers to know which scheme they are compensated under and we see that it is workers will tend to the direction that either give them more wages or require less effort from them. This leads to the thought that if the idea is to promote helping efforts without the firm being exploited, the compensation scheme should be designed in such a way that it is fully disclosed to them but due to some incomplete information, the way to raise their utility is to increase own or helping effort. This would lead to the consideration of a hybrid tournament and quota scheme: a quota will be set in place to ensure the minimum efforts are guaranteed to obtain the output quota and any surplus outputs are then rewarded; this is exactly the type of compensation scheme that we see today. Although this point was not mentioned in the paper, it indirectly points to why the compensation schemes in most companies are of this structure.

Negativity

The assumptions that the workers' behaviour are homogeneous may have made it easier to make deductions on the own and helping efforts but workers do not generally exhibit the same working behaviour. A deviant from the workplace culture might lead to very different dynamics. As we recall that in an equilibrium, unless it is a strong Nash equilibrium, we can have a coalition of players that might deviate due to some benefits to be derived from. The paper also does not use any concept of equilibrium in its discussion which makes the strategies of the players derived from a given scheme and bargaining level constrain on the KKT conditions just some theoretical concepts and may not be the case observed in real situations.

The definition of the partial and complete bargaining behaviours is too constrained as we set the values to either 0 or 1 in the partial derivatives in (1) which does not incentivize helping efforts. This constrain is the reason for the results of propositions 2 and 3, where helping efforts do not occur even in a partial or complete bargaining tournament. It seems that this constrain is preventing helping efforts, although the imposing of the restriction (b) on f was aimed to promote helping efforts. It will be a tad bit too mecenary to require more help effort than what was offered but in our idea of cooperation, we view helping efforts being able to create some synergy between the parties such that it reaps greater benefits for the team as compared to everyone working isolatedly.

The paper fails to consider that the firm needs to be operating to a certain level of expectation in order to be able to pay their workers wages, which resulted in proposition 3 being able to make the conclusion that all efforts are

identically zero. Without such a consideration it seems to make the assumption that the firm has infinite resources and the workers can stand to take and not give in a complete bargaining tournament, ironically the workers are cooperating; cooperating to exploit the firm of its resources.

References

- [Banerjee et al., 2014] Banerjee, S., Goel, A., and Kollagunta Krishnaswamy, A. (2014). Re-incentivizing discovery. In *Proceedings of the fifteenth ACM conference on Economics and computation - EC '14*, pages 149–166, New York, New York, USA. ACM Press.
- [Drago and Turnbull, 1991] Drago, R. and Turnbull, G. K. (1991). Competition and cooperation in the workplace. *Journal of Economic Behavior and Organization*, 15(3):347–364.