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"Essays On Distribution Rules, Identity and Social Preferences In Team Production Technologies"

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Contents

Chapter 1

I. Introduction

This thesis contains five essays on the research topic of how culture shapes social preferences, group identity and distributional rules in teams.

As a research methodology I combine theoretical analysis with experimental evidence to analyze individual and group behavior in production settings. Specifically, this dissertation is concentrated in team production problems, as described in the papers of Alchian and Demsetz (1972) and Holmstrom (1982). Team production technologies imply complementarity among production inputs so joint production increases total output with respect to separate production. The organization problem occurs when the resources used in production belong to different owners and collaboration requires providing the right individual incentives. The two main organization designs proposed for solving the motivation and coordination problems in team production are self-management (where resource owners share the group output as compensation for their collaboration), and hierarchy (where resource owners receive a compensation for their input and the supervisor earns the residual income).

My research contributes to to the literature on organization design decisions in several ways. First, it extend the study of organization in team production to situations where resources owners have different contributions to total output, for example, because resources are of different quality or workers have different skills. Second, it models the choice and decisions on sharing rules under two settings: when collaborating parties only care about the monetary payoff from their collaboration, and when the group members share a common culture that modifies their preferences, including distributional concerns and group identity. Third, the research examines in a theoretical and experimental way the performance in team production when a social planner chooses the second best output-sharing rule (sharing rule that maximizes team wealth taking in account the Nash equilibrium level of contributions of organization members), and when the group members themselves democratically choose the sharing rules. The results allow also comparing settings where group identity is manufactured with others where is not. Finally, the thesis provides new field experimental evidence on the effect of different dimensions of heterogeneity –origin (international or domestic), skills, ethnicity and gender- on performance in self-managed organizations with team production technologies.

The first chapter is an introduction that presents the state of art of the research in team production, organizational culture, social preferences, peer pressure and identity. In this dissertation I combine these concepts to give an economic framework of the effects of the organizational design on distribution rules and consequently on productivity of team production technologies.

The second chapter contains the paper *"Effects Of Organizational Identity On Self-Managed Teams: A Theoretical Framework."* In this chapter I develop a theoretical model of output based incentives in self-managed groups to examine the properties of the second best optimal solution. I compare a context where group members are homogeneous in their contributions to the group's output to a setting where they have different skills and therefore contribute differently to the teams' output.. Then I extend the analysis of optimal incentive design to situations where heterogeneity of membership is combined with identity. I argue that identity leads to fairness and to peer pressure.

The theoretical results show that second best optimal sharing rules are proportional to input owners skills and that an equal sharing is only second best if input owners are symmetric. First, I show that the creation of wealth is higher under second best optimal sharing rules than under the equal sharing rule.

Second, I show that organizational identity conditions fairness and peer pressure, as it can lead to more egalitarian distributional rules at the same time that can increase social welfare. These effects depend on the level of equalitarianism of the team (fairness) and on the intensity of the group pressure.

The third and the forth chapter of the thesis investigate experimentally the theoretical results of the second chapter. I decided to use experimental data since it is created explicitly for scientific purposes under controlled conditions. This data allows controlling for behavioral variables that could be affected by other variables that are difficult to measure with empirical data.

The third chapter contains the paper *"Output Sharing Rules In Heterogeneous Partnerships: An Experiment."* Here I experimentally investigate the welfare implications of two distinct output sharing rules in partnerships with a heterogeneous composition. In particular the paper examines the trade-off between the potential benefits of a simple equal output sharing rule and a distribution rule that maximizes total welfare, the second best sharing rule. This output sharing rule, which is recommended, is unequal in heterogeneous production groups.. The experimental setup is based on a team production technology model, where Nash equilibrium contributions are located in the interior of the set of feasible contributions.

The results confirm that second best output sharing rules give higher welfare than equal ones when the two are different. Then, there is a trade off to be considered, when deciding on the team composition (the equal sharing rule is second best optimal in homogeneous partnerships), and when deciding the sharing rule given the group composition. We also find that the experimentally created wealth with equal sharing is higher than the anticipated from pure rational behavior because less skilled collaborating partners contribute with more input than anticipated. This is interpreted as evidence that less productive partners perceive a sense of unfairness when receive a similar share of output than the more productive ones, and decide to correspond with higher input contribution.

In a post-experimental questionnaire, I find that the majority of subjects indicate preferences for the sharing rule that lead them to better monetary outcomes. Nevertheless, there is a slightly tendency of preferences for equality from the high skilled subjects.

Considering the results of the third chapter, one question arises: If the second best sharing is more efficient, why many teams use the equal sharing rule when diversity is present? Are there social preferences that induce high skilled subjects to prefer equal outcomes? Or social interaction changes distributional preferences of team members?

The forth chapter tries to answer some of these questions. It includes the paper "*"Does Identity Affect Distributional Rules And Productivity Of Heterogeneous Teams? An Experiment."* This paper examines experimentally the effects of social identity and communication on teams' distributional rules and wealth creation. The context studied is team production technologies with multiple resource owners of different skills in self-managed organizations. In these organizational settings, heterogeneity of skills might create a conflict between equity, equality and social welfare. Herein, I provide experimental evidence for the choice of distributional rules, based on a social identity theory.

The results of a two-stage experiment, where subjects vote on the distributional rule in stage I and make their effort decisions in stage II, indicate that induced group identity prompts preferences for equality even at the expense of wealth created. However, I find that compared to a setting where social interaction is absent, identity does not increase team productivity, but equalizes individual payoffs. These findings indicate that group identity triggers the wide spread use of equal sharing rules by heterogeneous teams, as it increases the team level of egalitarianism. Moreover, it provides recommendations for organizational decision-making.

The fifth chapter includes the paper "*Do We Speak The Same Language? A Field Experiment On the Determinants Of Team Performance,"* a joint work with Pablo Guillen. This paper provides new field experimental evidence on the effect of different dimensions of heterogeneity –origin (international or domestic), skills, ethnicity and gender- on teams performance. Using data from a randomized field experiment performed in a classroom of the university of Sydney, we analyze if the performance of heterogeneous teams is higher than those teams composed by members with similar skills, ethnic or gender.

Our general results show that international teams indeed perform worse than domestic or heterogeneous teams (one international and one domestic). However, we do not find significant differences between domestic and heterogeneous groups. By type of heterogeneity we find that skills' heterogeneity (English native language) and ethic diversification is positive or at least does not damage team performance. Female teams are the most productive, followed by mix gender and finally male teams.

In the next section I present the state of art of the related research. I first review the literature on incentives in team production technology according to the standard economic models and later the organizational culture and social preferences literature.

II. Literature review

A. Team production and free-riding

Since the pioneer work of Alchian and Demsetz (1972) on the theory of the firm many papers have dealt with the problem of organizational design in team production technologies when each input belongs to a different owner. A team production technology implies that the joint output produced from the contribution of many providers of inputs is higher than the sum of outputs from each resource owners producing separately with the same technology. One implication of team production is that the marginal productivity of one input depends on the quantity used on other inputs, which in turn implies that contribution of one input to the total output cannot be separated and evaluated independently of the quantity and quality of other inputs used in the joint production. The total output from joint production may be observable but the individual contributions of each input to it, is not. Self-management organizational designs where total output is fully shared among the resource owners induce free riding behavior and welfare losses. One way to improve efficiency is by compensating input providers as a function of the quantity and quality of the contributed resources. Monitoring inputs may be a complex task that justifies specialization. Alchian and Demsetz explain the capitalist firm with an entrepreneur that monitors inputs' quantities and qualities and earns a residual income (profit) as an alternative to self-management to curve free riding and increase efficiency.

Alchian and Demsetz did not explore in depth the design of output sharing rules in self-managed organizations. Holmström (1982) addressed this particular issue and formally showed the impossibility of fully allocation the joint output of the team so that the resulting non-cooperative game among the agents has a Pareto efficient optimal Nash equilibrium. Holmstrom's impossibility theorem shows that a risk neutral agent will supply first best effort only if all other agents equally supply first-best effort and she is compensated with the full marginal return of her effort. Consider a partnership contract where each agent independently chooses the action that maximizes her own utility, given the other agents actions. If all agents receive the full marginal return form their effort, there could be a Nash equilibrium where all agents supply first best effort levels. Therefore, first best output level may be achieved if each agent gets a compensation contract providing her with the full marginal return form her effort, when all other agents also supply the first-best effort level. However, this cannot be done for every agent in the partnership if the budget constraint implies that all production have to be fully allocated among all agents.

Holmström shows that free riding behavior and welfare losses in self-managed organizations as those just described, are the consequence of the binding budged constraint. Efficiency of output based compensation schemes can be restored if they are implemented without the binding budged constraint. From this point of view, Holmstrom justifies the role of the entrepreneur -owner in the capitalist firm as a way of implementing an output based compensation scheme with a non- binding budged constraint. Compensations depend on the difference between actual output produced and the pre determined output standard equal to the efficient one. If the two coincide then a compensation scheme is implemented that shares all output produced among the input owners. If they do not coincide then a penalty is applied so all or part of the output produced goes to the entrepreneur (the budged constraint is not binding). This solution requires, however, sufficient endowment from the agents. When this is not the case, there could be a contract where agents are compensated with a Mirrless contract, which rewards each agent with a bonus if first best output is realized, and a punishment with a penalty to be paid to the budget breaker if any other output is obtained. Although this solution can bring multiple equilibrium, some of which inefficient, these schemes can be used to solve moral hazard in teams.

Hierarchical monitoring and softening the budged constraint are the organizational design responses to the efficiency losses from self-managed organizations, as it assumes that preferences of group members are given and independent of the organizational design. Another line of research that justifies self-managed organizations and output sharing schemes considers that the organizational design influences the "culture" under which the collaboration takes place. Presumably self-managed organizations will foster more intense interactions, as for example, team spirit and mutual monitoring, than hierarchical organizations where compensation of each member depends only on her own actions.

Next we revise the some of the more relevant research in organizational culture and social preferences.

B. Organizational culture: social preferences, peer pressure and identity

According to Schein (1985) culture is a symbol of values or believes that are shared by the members of a social collective. Each member of the organization behaves according to a culture that he thinks as given, since his integration in the organization is also incorporation in the culture's organization. This culture facilitates the resolution of problems that occur in the organization's life.

To economists, culture is a non-pecuniary mean to improve coordination between agents. Kreps (1990, 1996) assumes that individuals are self-interested and introduce the corporate culture notion as a solution to coordination problems using game theory and repeated games. In Cremer's (1993) approach, culture is an ex-ante investment to lower communication costs and hence induce coordination. He decomposes culture as a common language or coding, a shared knowledge of pertinent facts and a shared knowledge of the norms of behaviour. In his view, there is a gradual culture diffusion where new member of the organization learn knowledge and coding spending time with experienced members.

Kandel and Lazear (1992) see organizational culture as the collective norms and references with capacity to orient and converge people's attention in a certain way, modeling attitudes and behaviors. According to these authors, the individuals that are integrated in the organizational culture of the firm recognize the peer pressure from co-workers when decide to take some individual actions. This peer pressure can adopt the form of guilt and shame. I will explain in later sections how these feeling, among others can be implemented in the utility function of a self-managed team member and how can affect the team's distributional rule.

In Hodgson's (1996) opinion, culture serves to mold the individual's preferences, attitudes, and ways of thinking. His approach rejects the neoclassical economic view where individuals don't change their preferences, attitudes and ways of thinking when they move from one situation to another. In Hodgson's view, the situation is acting in the actor at the same time that he is acting in a situation, this changes the actor not only by providing her information and skills, but also causing her preferences to change.

In the same line, Akerlof and Kranton (2005) incorporate identity in workers' utility function. Their model contrasts with the standard economic model where an individual's preferences are fixed and utility are not situation dependent. In their framework when an individual enters an organization and adapts its organization culture, he will take actions to fulfill the organizations' goals.

Akerlof and Kranton argue that their framework is an extension and synthetization of some of previous work on non-pecuniary sources of worker motivation as status (see for example Fershtman et al, 2001), morale (Bewley, 1999), team spirit (Kandel and Lazear, 1992), preferences for cooperation (Rob and Zemsky, 2002) and fairness (Akerlof and Yellen, 1990).

Akerlof and Kranton claim that identity can be a common language to describe corporate and organizational culture. We follow their view, and assume that when an individual assumes the team or organization's culture as his own, he feels identified with it. This identification can shape the preferences of individuals in their social relations and therefore affect cooperation, peer pressure, fairness considerations and solidarity. We next review the most relevant papers that motivate this research agenda.

Social preferences

The conflict between equality and efficiency has been continuously present in economic environments, since Adam Smith (1759), Marx (1875), Sen (1966) and Rawls (1971) to the present day. Among the first authors to introduce non-pecuniary variables in utility functions is Sen (1966). In his approach solidarity is an important phenomenon in the evaluation of economic outcomes. He considers a setting where N identical families form a cooperative. Families like income (y_i) and dislike work (l_i). Each family has an identical utility function defined as: $U_i = U(y_i, l_i)$. However, families are not necessarily indifferent to the happiness of other families and their notion of social welfare takes into account the utility of other families. Individual j attaches a weight a_{ij} to a unit of the utility of individual i in aggregating the social welfare: $W_j = \sum_{i=1}^{n} a_{ij} \, . \, U_i$

The utility of his own family can serve as the unit of account ($a_{ij} = 1$), and it is assumed that he attaches a weight somewhere between 0 and 1 to a unit of the utility of other families ($0 \leqq a_{ij} \leqq 1$). This means that while he may like other people to be happy, he does not attach greater weight to the happiness of other families than he does to his own. Thus the welfare of a cooperative as viewed by individual j is: $W_j = U_j + \sum_{\substack{i=1 \\ i \neq j}}^{n} a_{ij} \, . U_i$, with $0 \leqq a_{ij} \leqq 1$.

Sen defines social welfare (W) as an aggregate of individual utilities: $W = \sum_{i=1}^{n} U_i$

The set of a_{ij} for any individual j defines his attitude to the welfare of other families. Therefore, the aggregate measure of his sympathy for other families, or his "social consciousness" (S_j) is: $S_j = \frac{1}{N}\sum_{i=1}^{n} a_{ij}$, with $\frac{1}{N} \leq S_j \leq 1$. The more he values other families' happiness vis-à-vis his own, the closer is the value of S_j to 1. The sympathy the family i receives from other families, its their social goodwill and is defined by (T_i): $T_i = \frac{1}{N}\sum_{j=1}^{n} a_{ij}$ with $\frac{1}{N} \leq T_i \leq 1$. The more goodwill that this family has, the closer is the value of T_i to 1.

To the analysis of centralized and voluntary allocation of labor[1], Sen assumes "symmetric sympathy", where all families have the same measure of social consciousness: $S_j = S$, for all *j*. He also assumes "symmetric goodwill", where all families have the same measure of social goodwill: $T_i = T$, for all *i*.

In a voluntary allocation of work, results are allocated according to a system of rewards. Considering total income (V) and total work (L), Sen assumes that a proportion α of income is distributed according to "needs" and the rest (1- α) according to "work". The value of α lies in the closed interval between 0 and 1. From the identical families assumption, he also assumes that needs are equal, and thus α proportion of income is equally distributed. the rest is distributed in a way that family i gets $\left(\frac{l_i}{L}\right)$ proportion of it. Formally: $y_i = V\left(\frac{\alpha}{N} + (1-\alpha)\left(\frac{l_i}{L}\right)\right)$.

Individual j maximizes W_j for variations of his own labour l_j, given the amount of income and labour performed by others, their social consciousness and his goodwill.

Sen shows that distributions purely according to needs lead to under allocation of labor and that distributional purely according to work lead to an over allocation of it. He argues that optimization requires a mixed system of distribution according to work and needs. A pure system (needs or work) can only work if there is complete social consciousness, where every individual values equally his and the others happiness.

[1]In the centralized allocation of labor, individuals' work is decided by management and in the voluntary allocation of work, individual members of the cooperative decide how much work to put in.

Fabella (2000) adopts Sen sharing rule to the team production problem with identical members and observable effort. He analysis a two stage game solved by backward induction where in stage I members decide upon the sharing rule and in stage II they make their effort decisions. Thus, the organization members decide how much equality they want in the distribution of income they decide the amount of effort provided.

Fabella considers F as a function of the total revenue of the team defined over total effort $L = \sum_i^n L_i$. F is totally allocated among members according to the Sen sharing mechanism described above: member I's share $s_i = \left[(1-\alpha)\left(\frac{L_i}{L}\right) + \left(\frac{\alpha}{n}\right)\right], 0 \leq \alpha \leq 1$. Thus $\sum^n s_i = 1$ and no residual claimant exists. If $\alpha = 0$, the sharing is purely effort based; if $\alpha = 1$ the sharing is purely egalitarian. He interprets α as a Rawlsian equalization parameter and shows that if a member is consulted on his preferred level of egalitarianism $(\alpha > 0)$ he will choose the α that maximizes his own individual utility, subject to the constraint that α affects his and the others effort supply. A team is contractarian, as he calls it, if the team sharing parameter α^* (optimum α) takes the value most preferred by at least a simple majority of members. Imposing individuals symmetry and effort observability, Fabella shows that every member will prefers the α that sets marginal product of effort equal to marginal disutility, the Pareto condition. Relaxing these assumptions, there could be an infinite number of equilibria as there will be n different α's to n different members, depending on their preferences.

Our work is, to some extend related to Sen (1966) and Fabella (2000). Although these models assume observable effort, which is different from our setting, it is interesting to extend these analyses to the team setting here studied, where free-riding occurs due to a lack of observability or verification of contributions. In teams where members are not symmetric and effort observability is absent, a conflict between preferences for equality and preferences for efficiency can emerge.

Understanding teams' distributional preferences is an essential step to analyze how identity affects these preferences, fairness considerations and team efficiency. We consider that even though our work is in the specify domain of self-managed teams, it is a step forward to understand social preferences formation, which, we claim, is conditioned by fairness considerations and individual principles of justice.

The literature on theories of justice shows that different principles of justice might lead to heterogeneous distributional preferences in different contexts. For one hand individuals can have principles that incorporate a concern for the well-being of the least well-off members of the society such as Rawlsian preferences for equality or the need principle, which calls for the equal satisfaction of the basic needs. On the other hand, individuals can have utilitarianism principles, which implies that resources must be allocated first to the person who derives the greater marginal utility; or welfarism (Sen 1979), which implies aggregation of individual utilities to derive social welfare; or even equity principles, which are based on proportionality and individual responsibility and accountability (see Konow, 2003, for an extensive review on theories of justice and its empirical evidence).

Although the impact that distributional preferences have on economic outcomes have been discussed under several theories of justice during the past years, in the last decade the social preferences literature has been given a great deal of attention due to the growing number of economic experiments finding discrepancies between efficiency and equality in agents' behavior. (Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000; Charness and Rabin, 2002). These scholars developed models of difference aversion based on the premise that in addition to self-interested individuals, some are concerned about the payoff of others, disliking outcomes that are perceived as inequitable.

Although these models could explain many experimental results in distribution preferences Fehr and Schmidt (1999) and Bolton and Ockenfels (2000) work does not address efficiency considerations as a motive and Charness and Rabin (2002) model includes efficiency motives along with fairness, but does not predict the relative strength of efficiency and distribution motives when the two are in conflict. Because of that and due to a nonobservability of individual contributions assumption, we do not use these models. Notwithstanding, we acknowledge that individual preferences for equality might be driven by difference aversion motives

Although, in some of these experiments equality is perceived as equitable, this is not always the case. In fact, experimental evidence does not favor egalitarianism, although they reveal a concern for the least advantaged. Charness and Grosskopf (2001) and Charness and Rabin (2002) show that subjects tend to choose distributions that maximize total surplus over more equal or even that favor themselves. Hoffman and Spitzer (1985), Burrows and Loomes (1994) and Durant et al (2012) find that equality is not favored when unequal incomes are perceived as earned. On the other hand, Bolton and Ockenfels (2004) find that in simple voting games twice as many people deviate from their self-interest for equality than for efficiency reasons. Grober and Reuben (2009) find that in a competitive market votes for equal profit distribution are favorable. Therefore, the literature gives support both to preferences for equality and for efficiency. As suggested by Fong (2001), Alesina and Giuliano (2010) among others, it seems that redistribution could depend on fairness considerations. Our study is based on this premise.

Although these models could explain many experimental results in distribution preferences they do not consider the effects of organizational culture on groups' productivity. Herein, we analyze two components of organizational culture: peer pressure and identity. We then claim that the first is a consequence of the second.

Culture: Peer pressure

In an important contribution to the study of organizational culture in team production, Kandel and Lazear (1992) introduce the effects of peer pressure in the utility function of agents. The incorporation of peer pressure in cohesive groups means that the participants in the collective action have preferences that no depend only from monetary payoffs, but also psychological payoffs as shame, guilty and marginalization from the reference group.

Kandel and Lazear consider a peer pressure function: $P(a_i;\ a_{-i};\ t_i; \dots; t_n)$ where the pressure agent *i* feels depends on his effort (a_i) and on the effort of his peers (a_{-i}) as on other actions that he and his peers may take (t_i, t_{-i}) which have no direct effect on firm output. Using Holmstrom (1982) formalization, the worker effort is not only dependent on the share total output he receives less the cost of performing actions to the collective action. It also depends on the amount of peer pressure in the team: $U_i = \frac{f(a)}{N} - C(a_i) - P(a_i, N)$

Their approach considers that peer pressure arises when individuals deviate from group norms. Therefore it can be specified as a penalization for working less than the group norm: $P(a_i, N) = P(\bar{a} - a_i)\gamma$, where $\bar{a} \equiv 1/(N-1)\sum_{i \neq j} a_j$ and γ is a measure of the penalty associated with the falling below it. Therefore, the incorporation of peer pressure in workers' utility function increases the equilibrium level of effort in comparison to the standard economic model.

They distinguish between two forms of peer pressure. Internal, guilt and external, shame. The first exists when an individual gets disutility from hurting others, even if others cannot identity the offender. The last arises when the disutility depends on the identification by others as is the case of mutual monitoring. When workers have the possibility of affecting the choices of others or their well-being, they have incentives to pressure and even punish those who fail to perform adequately.

Most of the experimental evidence on peer pressure has been focused on mutual monitoring. It suggests that peer effects have a positive effect in productivity (Falk and Ichimo, 2006; Barron and Gjerde (1997); Backes-Gellner, Mohnen, and Werner (2006); Mohnen et al (2008); Sausgruber (2005); Bellemare et al. (2010)). However, if this increase in effort arises from the pressure of being monitored by their peers, or by the fact that being caught deviating from the norm gives them shame, it could lead to a decrease of work satisfaction.

Therefore, guilt can be a better an effective form of pressure as it arises from loyalty. Although more difficult and expensive to implement in teams, it provides incentives that operate even in the absence of observability. As $P(\cdot)$ is endogenous, they argue that it is worthwhile for partnerships to invest resources in spirit building activities that can alter $P(\cdot)$ to provide better incentives for the team members. They give, as an example, the military that spends much time and money creating loyalty and team spirit.

Their explanation on how to create peer pressure is intimately connected to the identity concept. (P808): "Partnerships are often formed among friends or family members. Despite the free-rider problems inherent in the partnership structure, partners often put in long hours and exert substantial effort. One explanation is that when partners are friends or relatives, empathy is strong, so shirking results in significant guilt or shame."

Therefore, guilt, we conjecture, can only have a positive effect on workers performance if there is some sense of identity towards the group. Thus, peer pressure could be a consequence of group identity. By group identity we mean that individuals collaborating in production care about the welfare of other group members when making their input contribution decisions.

Culture: Group identity

Bringing the social-psychological concept of identity to economic analysis can convey advantages for the study of group behavior as it can account for many phenomena that standard economics cannot well explain. According to the social identity theory (SIT), developed by Tajfel and Turner (1979), social identity could be defined as a perception of oneness with a group of persons. It has three major components: categorization, identification and comparison. The first is the process of putting others and ourselves into categories, such as gender, ethnicity, profession, age cohort, religious affiliation, sports clubs, etc. As these examples suggest, people may be classified in various categories. A woman can be Asian, a young lawyer, affiliated to some religion, political party and/or be a fan of some sports club. This social classification enables individuals to locate or define themselves in the social environment. Categorization leads to identification, which is the process by which we associate ourselves with certain groups. Finally, identification may lead to comparison, which is the process by which we compare our groups with other groups, creating some favoritism towards the group we belong to.

Social identity has been shown to be a central concept in understanding group behavior in social psychology, sociology, anthropology and political science. Management science has also applied the SIT to explain organizational identification. Ashforth el al. (1989) argues that organizational identification is a specific form of social identification as the individuals' organization may provide an answer to the question: who am I? The SIT literature suggests three general consequences to organizations. Firstly, individuals tend to perform actions consistent with relevant aspects of their identities. Secondly, it affects the outcomes associated with intragroup cohesion, cooperation, fairness, altruism, pride and loyalty to an organization or to its culture. Finally identification may also prompt internalization and adherence to group values and norms and engender homogeneity in attitudes and behavior. We expect that our experimental evidence shed light on these consequences.

The concept of identity was first introduced in the economics' literature by Amartya Sen (1985). He considers that the sense of identity can disconnect a person's choice of actions from the pursuit of self-goal as can make individuals to accept certain rules of conduct as part of obligatory behavior towards others in the community. Therefore, a person's goal may include objectives other than maximization of his own welfare, as for example social justice.

Nonetheless, the formal introduction of identity concept in economic models only starts with Akerlof and Kranton (2000), henceforth AK . They incorporate identity as a motivation for behavior in individual's utility function. They apply this model to explain economic issues as gender discrimination, poverty, social exclusion, division of labor and education (Akerlof and Kranton, 2002). Their model contrasts with the standard economic model where an individual's preferences are fixed and utility are not situation dependent.

In their formulation identity is based on social categories, **C**. Each person i has an assignment of people to these categories, $\boldsymbol{c_i}$, so that each person has a conception of her own categories and that of all other people. Prescriptions **P** indicate the behavior appropriate for people in different social categories in different situations. The prescriptions may also describe an ideal for each category in terms of physical characteristics and other attributes. Categories may also have higher or lower social status. They use the word identity to describe both a person's self-image as well as her assigned categories. In this thesis we adopt AK formulation and expand on their work to study how social identity conditions fairness and affects effort levels and productivity in a self-managed organization setting composed by heterogeneous members.

In Akerlof and Kranton (2000) they propose the following utility function: $\boldsymbol{U_i = U_i(a, a_{-i}, I_i)}$**.** Utility depends on i's identity or self-image $\boldsymbol{I_i}$**,** as well as on the usual vectors of i's actions, $\boldsymbol{a_i}$, and others' actions, $\boldsymbol{a_{-i}}$. Since $\boldsymbol{a_i}$and $\boldsymbol{a_{-i}}$ determine i's consumption of goods and services, these arguments and $\boldsymbol{U_i}(\cdot)$ are sufficient to capture the standard economics of own actions and externalities. They propose the following representation of $\boldsymbol{I_i}$**:** $\boldsymbol{I_i = I_i(a_i, a_{-i},; c_i, \varepsilon_i, P)}$**.**

A person i's identity $\boldsymbol{I_i}$ depends, first of all, on i's assigned social categories $\boldsymbol{c_i}$. The social status of a category is given by the function $\boldsymbol{I_i(\cdot)}$, and a person assigned a category with higher social status may enjoy an enhanced self-image. Identity further depends on the extent to which i's own given characteristics $\boldsymbol{\varepsilon_i}$, match the ideal of i's assigned category, indicated by the prescriptions **P**. Finally, identity depends on the extent to which i's own and others' actions correspond to prescribed behavior indicated by **P**. They call increases or decreases in utility that derive from $\boldsymbol{I_i}$ gains or losses in identity.

As in previous research on organizational culture, their model of identity is related to norms, as to how people think they and others should behave, and how people respond to these norms in a particular situation, depending when, where, how and between whom they interact. Sociologists often use the term of social categories to describe types of people and consider that people behave accordingly to the social category they belong to. The term identity is therefore used to describe a person's social category (a person is a man or a woman, black or white, form a nation or another) and a person's self-image. In a model of utility, a person's identity describes gains or losses in utility from behaviour that conforms or departs from the norms for a particular social category in a particular situation.

In AK conception utility functions can change because norms differ across space and time and can be taught, this means that people can internalize norms and behave according them. Identity is also useful because it gives a way to think about how behaviour should vary across types. The combination of *identity, social category*, *norm* and *ideal* allows modelling how utility functions change as people adopt different mental frames of themselves. That is, people can take on different possible identities depending on the situation context.

In the last years the economics of identity analysis was extended to organizations (Akerlof and Kranton, 2005) and workgroup (Akerlof and Kranton, 2008). In these studies identity is incorporated in a principal-agent model and in principal-multi agent model (respectively) and works as a part of incentives.

In Akerlof and Kranton (2005) they incorporate identity in a principal-agent model where identity works as part of their incentives. In their approach a worker can be either identified with the firm being an insider (*N*) or not being an outsider (*O*). If she is an insider, the norm is to act in the interest of the firm and perform a high effort, if she deviates from the ideal action she loses utility. On the other hand if she is an outsider, she will perform a low effort, as this is her ideal action. Their formalization of workers utility is the following: $U(y, e; c) = lny - e + I_c - t_c|e^*(c) - e|$

Where U is the worker's utility, y is her income, e is her actual effort, c is her social category (insider (N) or outsider (O)), I_c is her identity utility from being in category c, and $t_c|e^*(c)-e|$ is the disutility from diverging from the ideal effort level for category c, denoted $e^*(c)$.

This formulation represents the individual's identity utility in parallel to standard terminology in social psychology. The individual belonging to category *c* has an ideal of behaving according to the norms of her social category. This is her *ideal type.* She derives a given amount of utility from belonging to the category in question, but she also will lose utility insofar as those actions fail to live up to her ideal for how someone in her social category should behave.

Although our work is based in the same concept that identity could increases performance, our analysis is quite different from theirs as we focus on self-managed groups. Moreover, AK formulation is close to Kandel and Lazear (1992) model. As we claim that peer pressure is a consequence of identity, we combine both models to develop a framework of identity in self-manage teams. Akerlof and Kranton (2008) use the previous formulation on a principal-multi agent model to analyze identity effects on group incentives. However, their focus is again in hierarchical forms of organization.

While previous models on organizational culture indicate that the incorporation of non-pecuniary variables, such as identity, could increase productivity and models of difference aversion indicates that members dislike inequality outcomes, none of them addresses the effect that organizational culture can have in distributional preferences. In chapter II and IV I try to cover this gap by analyzing the effect that identity has on distributional preferences and efficiency when members differ in productivity.

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Chapter 2

Effects Of Organizational Identity On Self-Managed Teams: A Theoretical Framework.

I. Introduction

This paper examines the optimal design of sharing rules in self-managed groups producing with a team production technology, when group members develop a collective culture in the form of team identity and compares the results with those obtained under standard preferences. Previous research on team production incentive design has found that self-management organization induces to free-riding behavior, which lowers potential output. Thus, external monitoring, hierarchy, appears as a more efficient organizational solution (Alchian and Demsetz, 1972). However, hierarchical monitoring is costly too and there are many forms of collaboration in practice that are organized as self-managed groups (partnerships, research groups, joint ventures, cooperatives, etc) achieving high levels of performance (Lawler et al. 1995; Jehn et al. 1999). Self-management design in team production is then a relevant research topic and in fact it has attracted a lot of attention. Existing research includes papers that look for optimal output-sharing rules in team production when team members have standard preferences, and papers that take the output sharing rules as given and model the preferences of group members as a function of culture. This paper moves a step forward integrating the two lines of research by examining the design of optimal output-sharing rules in team production when group members have non- standard preferences such as group identity (Akerlof and Kranton 2000, 2005), and each provides inputs of different quality (heterogeneous inputs).

The search for optimal output sharing rules in team production goes back to the seminal work of Holmstrom (1982), who shows that there is no sharing rule that meets exactly the budged constraint and induces a first best level of effort among group members in team production technologies. This impossibility result does not imply that all sharing rules are equally efficient, and hence, it still makes economic sense to search for optimal second best sharing rules. Research on second best output-sharing rules, however, has been scant. The empirical evidence indicates that equal sharing rules are a common practice in self-managed teams (Encinosa et al., 2007). However, equal sharing is not always second best efficient, especially in teams with heterogeneous inputs. Having heterogeneous inputs into the same team production technology makes sense because it takes advantage of the combination of different backgrounds and experiences of team members (Hoffman and Maier, 1961; Hamilton, 2003; Lazear, 1998a, 1998b; Farrel and Scotchmer, 1988). According to Farrel and Scotchmer (1988) skill diversity increases team efficiency, as information and knowledge transfers are essential to production and diversification strategies. Nonetheless, they show that the use of equal sharing rules in heterogeneous partnerships lowers efficiency since it causes groups to be too homogenous or inefficiently small, as the ablest people are reluctant to subsidize the least able people The empirical evidence reveals that indeed the most able workers tend to leave heterogeneous teams when equal sharing rules are applied (Prendergast, 1999; Weiss, 1997, Abramitzky, 2008).

The incorporation of organizational culture in the functioning and efficiency levels of self-management production with team technology is part of the explanation of why self-management is more frequent in practice than what could be expected from the theoretically grounded free-riding inefficiencies.

The latest development in the study of economic behavior is the incorporation of social and psychological variables into standard economic models. Behavioral economics modifies the standard economic model to account for psychophysical properties of preferences and judgment, which creates limits on rational calculation, willpower and greed. Thinking about organizations naturally extends the definition of behavioral economics to include how socialization, networks and identity shape individual behavior in organizations. The basic risk-incentive model divides the worker's world into efforts they dislike, and rewards they like. It is convenient to talk about wages as rewards because they are easily measured. However people are motivated by many others types of non-pecuniary "psychic income" as well.

Sen (1966, 1985) was pioneer in pointing out the importance of culture to explain economic outcomes. Kreps (1990) formally modeled organizational culture as part of the solution of a repeated bargaining problem between employers and employees.

Kandel and Lazear (1992) used the management model of Japanese firms to justify the importance of culture (peer pressure) to explain outcomes in self-managed organizations. Akerlof and Kranton (2000, 2005) introduced in the economic analysis of organizational design the socio-psychological concept of identity developed by Tajfel and Turner (1979) and referenced earlier by Sen (1985) [2].

Notwithstanding the advances in team production research that behavioral economics has reached, the incentive design on team production is still one of the most challenging tasks in labor economics. Most of the previous research on organizational culture argues that individuals are not just motivated by monetary rewards but also by other nonpecuniary gains. However, a more general theoretical framework is needed to capture the effects of social variables on the distribution of total production. It is therefore interesting to compare the solution to the motivation problem under efficiency consideration with the solution given by organizational culture, specifically social identity. Our work intents to contribute to economic research on incentives in team production and organization when individual and group behavior is constrained by both, monetary rewards and social culture.

In this paper we model the choice of second-best output-based sharing rules in heterogeneous team production when the preferences of group members are shaped by organizational culture. Specifically we focus on the effects of group identity in terms of fairness considerations and peer pressure.

Our aim is to capture the effects of culture on the distributional rules of self-managed teams with a heterogeneous membership composition, an issue unexplored so far as organizational culture has most often considered only homogeneous groups. We do so by modeling the design of efficient sharing rules in self-managed groups with team production technologies when members of the teams are heterogeneous and share a culture that promotes a sentiment of identity within the group. We solve a two steps decision problem where first members decide on how much to contribute to production for a given sharing rule, and second, taking into account the equilibrium in the first step, we solve for the (second best) sharing rule.

[2] Other relevant papers are Akerlof and Yellen (1990); Cremer (1993); Hodgson (1996) Rabin (1993); Rotemberg (1994); Lazear (1995); Fehr and Schmidt (1999); Bolton and Ockenfels (2000); Charness and Rabin (2002); Rob and Zemsky (2002). Hermelin (2000) contains an extensive review and critique on corporate culture models

We find that in the absence of identity and in the absence of culture effects in general, the second best sharing rule in heterogeneous teams is an unequal sharing rule where each member receives a share of output correlated with her marginal contribution to output.

We show that the presence of group identity can condition individuals' perception of fairness. We provide a theoretical explanation based on Akerlof and Kranton (2000), and claim that individuals' perception of fairness depends on the social context. Thus, the level of egalitarianism, as in Sen (1966), depends on the team members' identification with the team 's goals and norms.

If the team norm is to reach full efficiency, then, the team should perform under a second best sharing rule. However, if the team norm is to minimize differences in utility, identity will increase the levels of egalitarianism. In this case teams should perform under a sharing rule that being more egalitarian, compensates for the differences in costs, even if it implies a sacrifice of wealth creation.

On the other hand social identity can induce subjects to feel guilty when they perform actions that deviate from the ideal behavior prescribed by the group they belong to. Therefore, it can induce the interior form of peer pressure, guilt. We find that this peer pressure increases effort levels as members get disutility by performing an effort lower than the effort norm. Moreover, if members comply with the norm the social welfare is higher than in the standard case. Though, when the intensity of the deviation from the norm is low, it does not have an impact on the second best sharing rule. Interestingly, if group identity leads to a high intensity of the deviation from the norm, where members must exactly comply with the effort norm, as any deviations from it, in either direction, bring disutility, it leads to a more egalitarian second best sharing rule (although not totally equal) for the same level of heterogeneity. We conjecture that under such a strong group culture team members' incentives are not only monetary but also include psychological variables. Moreover, it could prompt higher levels of effort norms for both high and low skilled members, giving higher incentives for low skilled workers to work hard and learn from the most skilled partners. Therefore, under these conditions, if the group decides upon an effort norm close to the first best level of effort, Pareto or near Pareto optimum can be achieved.

The rest of the paper is organized as follows. Section II presents the formal model of joint production under self-management and examines the equilibrium outcomes with standard preferences. Section III introduces identity on the standard model. Section IV concludes. Proofs are in the Appendix.

II. Team production model with self-management organization

This section presents a team production model with self-management organization under classical standard economic preferences. We first define the general specifications, then present a team technology example.

1. General Specifications

Consider N ≥ 2 inputs and the same number of input owners. Each agent, indexed by $i \in \{1,2,\ldots,N\}$, has an observable skill $q_i \in \Re^+$ and takes an unobservable and unverifiable action $a_i \in \Re^+$ in the production process.

Let $a = (a_1, \ldots, a_n) \in \Re_+^n$; $a_{-i} = (a_1, \ldots, a_{i-1}, a_{i+1}, \ldots, a_n)$; $a = (a_i, a_{-i})$. and $q = (q_1, \ldots, q_n) \in \Re_+^n$; $q_{-i} = (q_1, \ldots, q_{i-1}, q_{i+1}, \ldots, q_n)$; $q = (q_i, q_{-i})$.

The actions of the N individual agents determine a joint monetary outcome Q according to the production function $F : \Re_+^N \to \Re_+$. F is non decreasing, continuous, twice differentiable and concave function homogenous of degree r >0 in resource inputs a, for a given vector of skills: $Q= F(q; a)$. In exchange for the collaboration each agent receives a compensation in the form of a non negative share of the output, $S_i(Q)$ so that $\sum_i S_i(Q) = Q$. Resource inputs and skills can be assigned to alternative uses so that there is an opportunity cost for participating in the joint production, $C_i(q_i; a_i)$, increasing and convex in a_i. Taken into account compensation and cost, the utility of resource owner i from participation in production is given by: $U_i = S_i(Q) - C_i(q_i; a_i)$

In the self-management organization design each partner will decide the input contribution a_i maximizing the utility U_i and the joint decision will determine the Nash equilibrium solution from individual rational decisions. The total welfare (U) maximizing solution is the one that maximizes the sum of utilities or:

$$U=\sum_i U_i = \sum_i S_i(Q) - C_i(q_i;a_i) = F(q;a) - \sum_i C_i(q_i;a_i) \qquad (1)$$

Assuming that $S_i \in (0,1)$, then $\sum_{i=1}^{n} S_i(Q) = 1$, thus U equals the total output production less the sum of the opportunity costs of all members of the team. The sharing rule that maximizes U is the second best sharing rule.

Assume that in stage I a social planner decides the sharing rule and in stage II agents make their effort decisions. Solving by backward induction, the sharing rule that maximize the social welfare U is obtained as follows:

$$\begin{aligned} &Max_{s_i} U(a_i(s_1 \ldots s_N) \ldots, a_N(s_1, \ldots s_N)) \\ &Subject\,to \sum_i s_i = 1 \end{aligned} \qquad (2)$$

The second best sharing rule (S_i^*) is given by the first order condition: $(\partial F(a_i(S_i))/\partial S_i) = dc_i(a_i(S_i))/dS_i$. Imposing symmetry, this sharing rule is egalitarian. Relaxing the symmetry assumption, the second best should be more proportional to agents' skills and inputs. We next present a theoretical analysis of a self-managed team technology.

2.1. **Team production technology with heterogeneous members**

To illustrate the theory described above the team production technology[3] and the cost function are given by the functional forms:

$$F(q;a) = \sum_i k_i(q_1, \ldots, q_N) a_i \qquad (3)$$

$$C_i(q_i, a_i) = \frac{a_i^2}{2q_i} \qquad (4)$$

The function k_i aggregates the skills of team members into a measure of the productivity of member i. We assume that skills are complementary in the sense that k_i is increasing in q_i, for all i, and $k_i(q_1,\ldots,q_N) > k_i(q_1,\ldots,q_{N-M})$ for any subset M in N, and $k_i \geq 1$ for any i. The complementary skills mean, in this case, that adding more individuals with different skills to the production team, increases the marginal contribution to output of the quantity of resource i for all i. The functions k_i are restricted to those that satisfy the condition that

[3] Team production technology properties are borrowed from Hamilton et al. (2004).

$k_1(q_1,...,q_N) \geq k_2(q_1,...,q_N) \geq ... \geq k_N(q_1,...,q_N)$ when $q_1 > q_2 > ... > q_N$. This technical condition assures that the marginal contribution to productivity of the resource *i* from increasing the skill level q_i is higher than the increase in productivity from higher q_{-i} for *-i* different from i.

Team production will only be used if it yields an output larger enough than the sum of the separable individual outputs, therefore under individual production the total output of individual *i* is given by $y_i = a_i$, consequently $(k_i(q_1, \dots, q_N) - 1)a_i$ is the additional output created by the member's collaborative actions that could make team production more productive than individual production.

2.1.1. **Nash equilibrium with standard preferences**

Considering the specifications indicated above. The individual utility of each input owner is given by the expression:

$$U_i = S_i\left(\sum_{i=1}^{N} k_i a_i\right) - \frac{a_i^2}{2q_i} \tag{5}$$

The first best, welfare maximizing solution is obtained from:

$$MaxU = \sum_{1}^{N} k_i(q_1, q_2, ..., q_N)a_i - \sum_{i}^{N} \frac{a_i^2}{2q_i} \tag{6}$$

The optimal solution is

$$a_i^{**} = k_i q_i\ , \tag{7}$$

For an optimal social welfare of

$$U^{**} = \frac{1}{2}\left(\sum_{1}^{N} k_i^2 q_i\right) \tag{8}$$

Lemma 1: From the condition that $q_1 > q_2 > ... > q_N$ implies $k_1(q_1,...,q_N) \geq k_2(q_1,...,q_N) \geq ... \geq k_N(q_1,...,q_N)$, the first best input contribution is higher for individuals with high skills (h) than for individuals with low skills (l), $a_h{**} > a_l{**}$

An equal sharing rule implies that $S_i(Q) = \frac{1}{N}Q$. The Nash equilibrium decision from the utility maximizing input contribution of each partner is obtained from simultaneously solving the N problems:

$$Max_{a_i} \frac{1}{N}\left(\sum_{1}^{N} k_i a_i\right) - \frac{a_i^2}{2q_i} \quad , i=1,\dots,N \tag{9}$$

The solution to this problem is:

$$a_i^{*E} = \frac{1}{N} k_i q_i \tag{10}$$

With a social welfare,

$$U_I^{*E} = \frac{2N-1}{2N^2}\left(\sum_{i}^{N} k_i^2 q_i\right) \tag{11}$$

On the other hand, the second best linear output sharing rule is obtained as in (2), where $a_i(s_{1,\dots,}s_N)$ is the Nash equilibrium solution from:

$$Max_{a_i} s_i \left(\sum_{1}^{N} k_i a_i\right) - \frac{a_i^2}{2q_i} \qquad i=1,\dots N \tag{12}$$

The solution to this problem is:

$$s_i^* = \frac{k_i^2 q_i}{\sum_i k_i^2 q_i} \tag{13}$$

Substituting in (2) and in the objective function,

$$a_i^{*SB} = \frac{k_i^3 q_i^2}{\sum_i k_i^2 q_i} \tag{14}$$

and the social welfare:

$$UT^{*SB} = \sum_{i}^{N} \frac{k_i^4 q_i^2}{\sum_{i}^{N} k_i^2 q_i} - \frac{1}{2}\sum_{i}^{N} \frac{k_i^6 q_i^3}{\left(\sum_{i}^{N} k_i^2 q_i\right)^2} \tag{15}$$

Lemma 2: *The second best sharing rule is non-decreasing on skills.*

From the condition that $q_1 > q_2 > \dots > q_N$ implies $k_1(q_1,\dots,q_N) \geq k_2(q_1,\dots,q_N) \geq \dots \geq k_N(q_1,\dots,q_N)$, the second best sharing rule gives a higher share of output to high skill inputs (h) than to low skill (l) ones: $s_h^* > s_l^*$.

The previous results are summarized in the following proposition:

Propositions

1. In self-management organization with team production technologies, the Nash equilibrium solutions for the input contributions in both, equal (E) and second best output sharing rules (SB), are lower than the first best ones: $a_i^{*E}<a_i^{**}$, $a_i^{*SB}<a_i^{**}$. Self-managed organizations, as described, induce free riding behavior.
2. If $s_i^*>1/N$ then $a_i^{*SB}>a_i^{*E}$ and $U_i^{*SB}>U_i^{*E}$ .In contrast, if $s_i^*<1/N$ then $a_i^{*SB}<a_i^{E*}$and $U_i^{*SB}<U_i^{*E}$ (For prove see appendix A). This proposition implies that whenever the share individual *i* receives under the second best output sharing is higher than the equal share, her input contribution will be higher under this sharing rule than under equal distribution. This, in turn, induces a higher individual utility under the second best output sharing than under equal share. In contrast, if the second best share is lower than the equal distribution, she will contribute less under the second best sharing rule and have a lower utility than under the equal share.
3. Total welfare with the second best output sharing rule is in between the total wealth of equal sharing (lower) and of first best welfare: $U^{*E}<U^{*SB}<U^{**}$.(Prove in appendix A)
4. Equal output sharing is second best optimal iff all inputs have similar skills: $a_i^{*E}= a_i^{*SB}$ iff $q_i=q_{-i}$ for all *i* and *-i*.

According to the standard economic model, which assumes that individuals are selfish, in self-managed organizations composed by homogeneous members, the equal sharing rule is the distribution that maximizes team efficiency, taking into account that agents will supply the effort level that maximizes their only utility function. However, when there is a heterogeneous composition of the team, this second best optimal sharing rule is proportional to the quality of the different inputs.

According to these results, we would expect that every organization with self-managed design and some degree of heterogeneity to implement a proportional distribution of results. However, this is not always the case. Many partnerships and cooperatives, e.g., use an equal sharing rule, independently of its composition (Farrel and Scotchmer, 1988). Thus, if subjects are selfish, heterogeneous organizations should not exist, as the more able people would prefer to work alone.

Hamiltom et. al, (2003) show that heterogeneous teams are productive. They empirically show that when employers of a firm are given the option to work in a team or individually, they opt for teamwork, even in cases where the more able workers are matched with the less able ones. The equal distribution of team output does not seem to affect the high ability workers, as heterogeneous teams turn out to be highly productive and neither high nor low-ability workers decide to leave the team when given that option.

Keser and Montmarquette (2007) experimentally find similar results. They investigate whether teamwork should be voluntary or enforced by management and the impact of asymmetry in participants' effort costs. They find that asymmetric teams cooperate less than teams whose members have symmetric effort costs. Nonetheless, they find that in 72% of the rounds with asymmetric costs subjects, both high and low cost subjects choose to work in a team than to work individually, where with an equal sharing rule the lower cost subjects were expected to choose private remuneration. They find no differences in asymmetric team's payoff between voluntary or enforced teamwork.

Although in Hamilton el al (2003) context and Keser and Montmarquette (2007) experiment, the effort was observable, they show that even with an equal sharing rule, heterogeneous teams are productive. It would be interesting to compare these results with the implementation of the second best sharing rule. According to our theoretical results, we conjecture that productivity would increase in both cases.

These results suggest nonpecuniary rewards for teamwork, and non-selfish behavior. We claim that these rewards are associated with identity. We next demonstrate how identity can justify these types of behavior, affecting fairness and peer pressure.

3. Team production with Identity

According to the social identity theory (Tajfel and Turner, 1979) and to organizational identity definition (Asforth, 1989, Akerlof and Kranton, 2005), if individuals are identified with the group they belong to, they will take actions that are congruent to the prescribed behavior for the group, even if those actions apart from self-maximization and suppose a monetary loss. Therefore, group identity can have an effect on fairness considerations and can induce to the internal form of peer pressure, guilt, when subjects perform actions that are not according to the group norm. We first analyze how identity can affect distributional preferences and second, we analyze how peer pressure affects the second best efficiency.

3.2. Effect of identity (1): Fairness

To understand the effects of identity on fairness, we analyze the case where team members endogenously decide the distribution rule (which could be through a bargaining process, consensus or majority). Our model borrows from Sen (1966), who suggests that an optimal allocation of resources has part given to families according to needs and part given according to labor, and from Akerlof and Kranton (2000) who consider that the perception of fairness is affected by individuals' identity.

Consider the general specifications described in the previous section. The output sharing rule will belong to the family of sharing formulas proposed by Sen (1966):

$$S_i = (1-\alpha)S_i^* + \frac{\alpha}{N} \quad (16)$$

Where α is a parameter between zero and one and the S_i^* is the second best efficient sharing rule calculated as follows:

$$Maximize_{S_1,\dots S_N} F(a_1(S_1,\dots,S_N),\dots a_N(S_1,\dots S_N)) - \sum_i C_i(a_i(S_1,\dots,S_N))$$

$$Subject\ \ to \sum_i S_i = 1, S_i \geq 0, \forall i \quad (17)$$

Where $a_i(S_1,\dots,S_N), \forall i$ is the Nash equilibrium solution to the input contribution decision by the input suppliers for a given output share:

$$Max_{a_i} U_i = Max_{a_i}\left((1-\alpha)S_i^* + \alpha/N\right)F(a_1, a_2, \dots, a_N) - C_i(a_i), \alpha\, \epsilon [0,1] \quad (18)$$

The parameter α captures the weight assigned to the second best efficiency outcome relative to the weight given to egalitarian considerations. A value of the parameter equal to 0 means that only efficiency matters, while a value of 1 implies that all the weight is on equal output sharing. A value of α=1/2 indicates that an intermediate weight is given to each goal, efficiency and equality.

A social planner will implement the second best sharing rule as it maximizes team welfare. In the case where teams endogenously decide the distributional rule, members have to choose, or manifest, their preferred level of equality, knowing that α is going to affect theirs and others level of effort in stage II. Assuming economic standard preferences, each member would prefer the sharing rule that increased his monetary payoff. Nevertheless, as reported in the related literature review, there is sufficient experimental evidence showing that selfish behavior is not fairly likely as predicted by standard economics, which suggests that social effects may play a role on individuals' decisions.

Under group identity, it is natural to think that a norm will emerge on the group depending on the team objectives. If the team seeks to maximize efficiency they will choose an α=0. However, the team could prefer to minimize differences in utility, even with a loss on wealth creation. Therefore, the α^* that minimize differences in utility is obtained from simultaneously solving the N problems[4]:

$$\underset{\alpha}{\text{Min}}\ \sigma_U^2 = \min_\alpha \frac{\sum_{i=1}^{N}\left(U_i - \frac{\sum U_i}{N}\right)^2}{N-1} \quad (19)$$

Which has the solution:

$$\alpha = 1 - \frac{\sum C_i(a_i)(S_i - 1/N) + \sum C_{i-1}(a_{i-1})\big((1-S_i) - 1/N\big)}{F(a)(2S_i(1-S_i) - 1 + 1/N)} \quad (20)$$

$$A = \frac{\sum C_i(a_i)(S_i - 1/N) + \sum C_{i-1}(a_{i-1})\big((1-S_i) - 1/N\big)}{F(a)(2S_i(1-S_i) - 1 + 1/N)} \quad (21)$$

$$\alpha^* = 1 - A \quad (22)$$

Proposition 5:

a) α^*=1 iff A =0:
   i) If the sharing rule is equalitarian ($S_i = 1/N$);
   ii) If $C_i(a_i) = C_{i-1}(a_{i-1})$

Proposition 2 indicates that an equal sharing rule ($S_i = 1/N$) minimize differences in utilities as it sets A=0. As well as equal opportunity costs (identical members), as if $C_i(a_i) = C_{i-1}(a_{i-1})$, then A=0, and α^*=1 (equal sharing rule). Notwithstanding, as

[4] The normalized variance is used to measure inequality in this research, but other measures of inequality, such as The Gini coefficient or indices, such as the Theil, Herlindahl, or Exponential, would serve equally well.

demonstrated in the previous section, an α>0 damages team efficiency. Thus, why some teams seek to minimize differences in utilities?

In this research we provide an explanation for nonselfish distributional preferences based on social identity theory. We follow Akerlof and Kranton (2000) and assume that individuals' perception of equality or fairness depends on the social context. When individuals join for production each can have a different personal and social background that conditions her preferences for egalitarian or efficiency led outcomes.

Therefore, we argue that the level of egalitarianism depends on team members' personal identity I_i. Our theoretical representation of Identity borrows from AK (2000): $\boldsymbol{I_i = I_i(a_i, a_{-i},; c_i, \varepsilon_i, P)}$**.** We claim that a subject revels his level of equality according to his perception of fairness, which is conditioned by how his actions can affect the team ($\boldsymbol{a_i}$); the action of others ($\boldsymbol{a_{-i}}$***);*** his individual characteristics ($\boldsymbol{\varepsilon_i}$), which are associated with the social categories he belongs to ***(***$\boldsymbol{c_i}$***);*** and to the corresponding prescribed or ideal behaviour ***(P)***.

Thus, in the group decision-making context here analyzed, we assume that the social category[5] $\boldsymbol{c_i}$ is the team, with whom she may be or not identified with, and that $\boldsymbol{P}$ is the behavior she considers as ideal for the teamwork category or/and the ideal behavior prescribed by the team. Therefore, individuals can have different prescriptions *(P)* about what is fairest and have different levels of egalitarianism ($\boldsymbol{I_i}$). Hence, the following possibilities are true: There could be subjects who prefer the sharing rule that better suit their monetary interests; Others that have equity or welfarism principles and see equitable to implement the second best sharing rule; Subjects who have Ralwsian preferences or need principles and might see equitable to use an equal sharing rule; And subjects who see equitable to implement a sharing rule that gives part to needs (equal) and part to equity (second best).

First, we claim that when the manifest of her level of egalitarianism affects hers and others income ($\boldsymbol{a_i}$) and its affected by others ($\boldsymbol{a_{-I,}}$), her reveled preferences could

[5] Although AK do not consider that individuals may belong to several social categories, Davis (2006) and Kirman and Teschl (2004) argue that this is possible and quite natural. According to their approach of social identity, individuals can belong to several categories, whit different prescribed behaviours, which conditions behaviour in different context. Moreover, this could create a group conflict; therefore, individuals tend to choose groups, whose members are close on social categories, or group interests. Here, we acknowledge the possibility of several social categories, with different prescribed behaviors associated and contemplate its impact on behavior. We consider this as formation of her individual characteristics (ε_i).

be her true preferences, but may also be strategic or altruistic (Rotemberg, 1994) or even conditioned by inequality aversion motives (Fehr and Schmidt, 1999).

Second, we suggest that reveled preferences might be changed by the creation and manipulation of the social categories c_i and prescriptions **P.** Therefore, individuals might have equity preferences, for example, but due to social interaction with the group change their reveled preferences towards equality, if this is the social correct behavior indicated by **P** or because they became altruist towards their teammates.

However, if the team chooses a sharing rule that benefits the low skilled members it is possible that the group members set objectives that require a certain amount of effort by its members, what we call an effort norm. If members are identified with the team they will perform actions to comply with the persecution of these objectives and feel guilty when deviate from it. We next analyze the effect that guilt, as a form of peer pressure, has on teams' distribution rules and efficiency.

3.3. Effect of identity (2): peer pressure (guilt)

In this section we explore the relation between identity, peer pressure, distributional rules, and efficiency. Our model builds on the work of Kandel and Lazear (1992) and Akerlof and Kranton (2005). There are, however, important differences in our analysis. First, Kandel and Lazear (1992) study the effect of peer pressure on partnerships' productivity. They argue that if members can monitor each other, they will feel shame if performing an effort lower than their partners. The disutility caused by peer pressure increases productivity. However, as they do not take in account the psychological benefits from belonging to a team, this peer pressure can deteriorate work relations. Even though their focus is more on the effects of mutual monitoring, they consider that guilt could be an effective way to increase performance when observability is absent. They give, as an example, the case of loyalty and team spirit created in the army. The same example is given by Akerlof and Kranton (2005) to explain the effect of identity in organizations. Hence, we consider that guilt could be a consequence of group identity.

Our analysis differs from Kandel and Lazear as we acknowledge the benefits from belonging to the team. This difference is noted in cases where any deviations from the norm (below or above) cause guilt and therefore, disutility. They argue that the level of effort chosen in these cases equal the level that would be chosen in the absence of peer pressure. We argue that, when members are highly identified with the team and feel guilty by performing an action that damages the objectives of the team, a strong group identity could lead to levels of effort near to the optimal value.

Therefore, we introduce peer pressure (guilt)[6] in members ' utility function as an effect of group identity. Following the general specifications describe previously, formally we have:

$$U_i = S_i^I(Q) - c_i(a_i) - t_c(\bar{a} - a_i)^{\gamma} \qquad (23)$$

$$i = 1, \ldots, n;\ t_c \in [0,1];\ \gamma = 1,2.$$

Where S_i^I is the sharing rule; t_c captures the importance of leaving up to the group norm or the level of identification within the team[7]; γ is a parameter that defines the intensity of the deviation from the norm and $\bar{a}$ represents the actions that individuals should perform. Although the level of effort is non-observable, teams could set objectives that require a certain minimum amount of effort by the members. Which they will perform if identified with the team.

The Nash equilibrium effort with the incorporation of identity, which we represent by (a_i^I), is given by the first order conditions: $S_i^I \frac{\partial F}{\partial a_i} - \frac{\mathrm{d}c_i}{\mathrm{d}a_i} - \gamma t_c(\bar{a} - a_i)^{\gamma-1} = 0$

Effort level is conditioned by the sharing rule, the level of identification with the teams, the effort norm and the intensity of the deviation from that norm.

As previously, assuming that in stage I a social planner decides the sharing rule and in stage II agents make their effort decisions, we solve for the second best optimal solution with identity by backward induction:

$$\max_{S_i} \quad F(a_i^I(S_i^I, S_{-i}^I), a_{-i}^I(S_i^I, S_{-i}^I)) - \sum_{i=1}^{N} c_i[a_i^I(S_i^I, S_{-i}^I)] - \sum_{i=1}^{N} t_c[(\bar{a} - a_i^I(S_i^I, S_{-i}^I)]^{\gamma}$$

$$St: \quad F(a_i^I(S_i^I, S_{-i}^I), a_{-i}^I(S_i^I, S_{-i}^I)) - \sum_{i=1}^{N} t_c[(\bar{a} - a_i^I(S_i^I, S_{-i}^I)]^{\gamma} \geq \sum_{i=1}^{N} c_i[a_i^I(S_i^I, S_{-i}^I)]$$

$$\sum_{i=1}^{N} S_i^I = 1$$

[6] Kandel and Lazear (1992) and Akerlof and Kraton (2008) model peer pressure and group identity (respectively) in a similar same way. We use the notations of Akerlof and Kranton (2008).
[7] This parameter could increase with communication, socialization or group activities.

The level of identification with the team depends on the value of t_c:

$$t_c = 0 \qquad \text{if no identity}$$

$$t_c > 0 \Rightarrow \begin{cases} t_c(\bar{a} - a_i) & \text{if } \gamma = 1 \quad \text{low identity} \\ t_c(\bar{a} - a_i)^2 & \text{if } \gamma = 2 \quad \text{strong identity} \end{cases}$$

$t_c=0$ indicates that agent i is not identified with the team, therefore he will have the same utility than with standard preferences (6). If the agent is identified with the team ($t_c>0$) he gets disutility by performing an action lower than the team norm ($t_c(\bar{a} - a_i)^\gamma$), as he feels guilty about it. If γ =1 the intensity of fulfilling the group norm is low. Hence he gets disutility when $\bar{a} > a_i$ and an increase in utility in the opposite case. We will call this the low identity case. When γ =2 the intensity of fulfilling with the group norm is high. Hence, he will feel guilty by deviate from the norm, by excess or defect. This case is labelled the high identity case. We consider that this case could be applied to groups that create such a strong group identity that any deviation of the norm is seen as a strong violation towards the group. If the team commits to fulfill certain objectives and a member does not take the action that lead to the persecution of these objectives, he will feel guilty if deviating from the norm.

Always when $\gamma t_c(\bar{a} - a_i)^{\gamma-1}$ is positive, the presence of identity implies an equilibrium solution a_i^{*I} higher than a_i* (equilibrium effort level in the standard case). However, under the assumption that identity increases the utility of its members, the collective efficiency cannot be only evaluated by the creation of wealth, Therefore, the incorporation of identity improves the joint welfare of the team, in comparison with the cases without social norms, only if:

$$F(a^I) - \sum_{i=1}^{N} c_i(a_i^I) - \sum_{i=1}^{N} t_c(\bar{a} - a_i^I)^\gamma \geq F(a^*) - \sum_{i=1}^{N} c_i(a_i^*) \qquad (24)$$

Which is conditioned to the values of t_c, γ. and the effort norm.

This formulation represents the individual's identity utility in parallel to standard terminology in social psychology. The individual who is identified with the team takes the objectives of the team as his own and is compelled to behave accordingly to the norms of his social group. He derives a given amount of utility from belonging to the group, but loses utility insofar his actions fail to fulfill the norms established by the group.

3.3.1. **Nash equilibrium with peer pressure**

Consider the specifications described above and the team production technology defined to illustrate the theories developed in this thesis. The first best, welfare maximizing solution is now obtained from:

$$\max_{a_i} U = \sum_i^N k_i(q_1, \dots, q_N)a_i - \sum_i^N \frac{a_i^2}{2q_i} - \sum_i^N t_c(\bar{a} - a_i)^\gamma \tag{25}$$

The optimal solution is now:

$$a_i^{**I} \begin{cases} a_i^{**LI} = k_i q_i + q_i t_c & if \quad \gamma = 1 \ (low\ identity) \\ \\ a_i^{**HI} = \frac{k_i q_i + 2q_i t_c \bar{a}}{1+2q_i t_c} & if \quad \gamma = 2 \ (high\ identity) \end{cases} \tag{26}$$

and a social welfare of :

$$UT^{**I} \begin{cases} UT^{**LI} = \frac{1}{2}(\sum_i^N k_i^2 q_i + k_i q_i t_c - q_i t_c^2) & if \ \bar{a} = a_i^{**LI} \quad , \quad \gamma = 1 \\ UT^{**HI} = \sum_i^N \frac{k_i q_i + 2q_i t_c \bar{a}}{1 + 2q_i t_c} - \frac{1}{2q_i}\left(\frac{k_i q_i + 2q_i t_c \bar{a}}{1 + 2q_i t_c}\right)^2 - t_c\left(\bar{a} - \frac{k_i q_i + 2q_i t_c \bar{a}}{1 + 2q_i t_c}\right)^2 & if \ \gamma = 2 \end{cases} \tag{27}$$

Propositions:

6. The incorporation of identity in the team with a low intensity on the deviation of the norm (γ=1), induces to an increase of the effort level in comparison with the standard case. Moreover, if members comply with the group norm, the total welfare of the team increases: $a_i^{**LI} > a_i^{**}$; $U^{*LI} > U^{**}$.(Proof. See appendix A).
7. In the case of high identity (γ=2), the level of effort will depend on the effort norm decided by the group:

$$a^{**HI} \begin{cases} = a^{**} & if \ \ \bar{a} = a^{**} \\ = a^{**LI} & if \ \ \bar{a} = {}^1\!/_2 + a^{**LI} \end{cases}$$

   Thus, higher the effort norm, higher the effort level and the total welfare.

On the other hand, as members have to fully distribute the output, the Nash equilibrium solution will result from simultaneously solving the N problems:

$$\mathrm{Max}_{a_i}\ U_i = S_i^I\left(\sum_{i=1}^{n} k_i a_i\right) - \frac{a_i^2}{2q_i} - t_c(\bar{a} - a_i)^\gamma \qquad (28)$$

The solution is:

$$a_i^{*SI} = s_i k_i q_i + q_i t_c = s_i a_i^{**I} \qquad (29)$$

And the second best sharing rule with identity:

$$S_i^{*I}\begin{cases} S_i^{*LI} = \dfrac{k_i^2 q_i}{\sum_i^N k_i^2 q_i} & \text{if} \quad \gamma = 1 \\ \\ S_i^{*HI} = \dfrac{\frac{k_i^2 q_i}{1+2q_i t_c}}{\sum_i^N \frac{k_i^2 q_i}{1+2q_i t_c}} & \text{if} \quad \gamma = 2 \end{cases} \qquad (30)$$

Propositions:

8. With low identity, the second best sharing rule is the same as in the standard case (7). Thus, as $a_i^{**LI} > a_i^{**}$ it must be true that $a_i^{*SLI} > a_i^{*SB}$
9. With high identity, the second best sharing rule is more egalitarian than in the case without identity or low identity: $S_i^{*HI} < S_i^{*LI} = S_i^*$ (Prof. see appendix A).
10. If $\bar{a}^{SHI} > \bar{a}^{SLI}$ teams can perform under more equal sharing rules without damaging efficiency: $UT^{SHI} > UT^{SLI} > UT^{SB}$

With high identity the high skilled members receive a lower percentage of the total output than in the standard or the low identity case. However, higher than what they receive under the equal sharing. Similarly, the low skilled members receive a higher share of the total output than in the standard case, however lower than with an equal split. The intuition is that when members have such a strong sense of identity that any deviation from the group norm derives a great amount of disutility, their motivation to exert a high effort is highly compensated per psychological variables. Moreover, in this case the group can set an effort norm close to the first best level of effort and therefore reach a social welfare close to the Pareto optimum.

The presence of identity in the teams could lead to an increase of preferences for equality or fairness. This means that even though high identity induces to more equal sharing rules, the decision of the sharing rule will depend on the level of egalitarianism of the team members. Therefore, members' utility function could be defined as:

$$U_i = \left((1-\alpha)S_i^{*I} + \alpha/n\right)F - c_i(a_i) - t_c(\bar{a} - a_i)^{\gamma} \qquad \text{(f)}$$

With strong group norms and a high level of egalitarianism, teams can set an effort norm that compensate for the inefficiency of the equal sharing rule. Therefore, a distribution rule that is decided by majority or consensus in a group that share sentiments of identity can lead the team to reach an equilibrium with higher levels of performance when compared to a setting without identity culture even when performing under more equal sharing rules.

III. Conclusion and discussion

This study examines the design of optimal output sharing rules in team production when group members have non-standard preferences such as group identity and each input owner provides inputs of different quality.

To this aim we have developed a two-stage team production model composed by members with complementary but different abilities. First we have focused on the compensation scheme that improves team efficiency when members are not influenced by team identity. Second, we introduce team identity in the standard model, following Sen (1966), Kandel and Lazaer (1992) and Akerlof and Kranton (2008) model specifications. Our analysis demonstrates that group identity can condition fairness and induce to peer pressure in the form of guilt.

Our model offers some novel results that could help heterogeneous self managed teams to better design their incentive systems. Firstly, we show that if self-managed teams composed by heterogeneous members operate under a distributional rule that takes in account the different productivities, although still inefficient, it generates a higher social welfare than under an equal sharing rule. Secondly, we show that identity can shape the distributional preferences of team members. With group identity teams' decision on the distributional rules will depend on the objectives of the collective. For one hand, if the team seeks a higher creation of wealth, they will implement the second best sharing rule, however, if the team seeks to minimize differences in utility, they will implement a more egalitarian sharing rule. This could justify the implementation of equal splits in some non-hierarchical forms of organizations.

Nevertheless, as effort is related to members' skills but conditional to the proportion they receive from the total production of the team, this change in preferences does not have an impact in performance unless there is some group norm that induce members improve efficiency.

Therefore, a team member who feels identified with the team and take the objectives of the team as their own will get disutility if doing an effort lower than the norm. In a team where the intensity of fulfilling with the norm is low but they feel identified with the group, members' effort level will increase in comparison to the standard case. Although identity can increase the level of equalitarianism of members, in the low identity case the second best sharing rule is the same as in the standard case. In teams that have a strong intensity regarding members fulfilling with the effort norm, the high identity case, the second best sharing rule is more equalitarian than in the standard or low identity case. Moreover, if the effort norm is the efficient effort, members could do an effort near to Pareto optimum. There could also be the case where the effort norm is set to be a lower effort level. In this case the effort with strong norms could be lower than in the low identity case and consequently the team efficiency could decrease. Although this case would not be common in self-managed teams, as members are the residual claimants, it could be true in teams that respond to a supervisor.

Our work contributes to understanding the black box of team production. Our findings suggest that identity could justify the use of more equal distribution rules in heterogeneous teams without decreasing efficiency. Nevertheless self-managed teams should use compensation schemes that accounts for members' abilities. Notwithstanding the dispersion on efforts this distributional rule could cause, high skilled members will be strongly motivated to exert a high effort and could help low abilities to improve their own productivity and consequently increase efficiency.

Future research should test the results of the model, both on second best efficiency and the effects of identity on fairness and on peer pressure.

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Appendix A:

Prove of proposition 2:

Lemma 2 indicated that the second best sharing rule for heterogeneous members is nondecreasing in abilities. Assuming that $q_1 > q_2 > \ldots > q_N$, this distribution rule gives a higher share of the output to the more productive worker and lower to a less productive one.

Therefore individuals will be better off with the second best sharing rule than with an equal sharing, only if $S_i^* F - c\left(a_i^{*SB}\right) > {}^1\!/_2\, F - c\left(a_i^{*eq}\right)$, which is: $U_i^{SB} > U_i^{eq}$. Mathematically we have:

Member's individual utility with the second best sharing rule is given by:

$$U_i s = \frac{(k_i\, a_i\, **)^3 \left[2\sum_{i=1}^{N} (k_i\, a_i\, **)^2 - 1 \right]}{2(F(a**))^2} \qquad \text{(a)}$$

Member's individual utility with the equal distribution is given by:

$$U_i e = \frac{2\sum_{i=1}^{N} (k_i\, a_i\, **) - (k_i\, a_i\, **)}{2N^2} \qquad \text{(b)}$$

Hence, for $k_i\, a_i\, ** > \frac{F(a**)}{N}$, $a_i s* > a_i eq*$ *and* $\frac{U_i s}{U_i eq} > 1$.

When the collaborative efficient effort of individual *i* is higher than the mean of the efficient production he will be better off in the second best sharing rule. High skilled members will do a higher effort in the second best sharing rule and will be better off in under this sharing rule, opposite to low skilled members that will do a high effort in the equal sharing rule and will be better off under this sharing rule.

Prove of proposition 3:

The team welfare in the second best sharing rule is given by:

$$UT^S = \sum_{i=1}^{N} \frac{(k_i\, a_i\, **)^2}{F(a**)} - \sum_{i=1}^{N} \frac{(k_i\, a_i\, **)^3}{2\left(F(a**)\right)^2} \qquad \text{(c)}$$

And the welfare of the team with the equal sharing rule is given by:

$$UT^{eq} = \sum_{i=1}^{N} \frac{(2N-1)}{2N^2} k_i\, a_i\, ** \qquad \text{(d)}$$

Hence:

$$\frac{\sum_{i=1}^{N} \frac{2(k_i\, a_i\, **)^2 F(a**) - (k_i\, a_i\, **)^3}{2(F(a**))^2}}{\sum_{i=1}^{N} \frac{2Nk_i\, a_i\, ** - k_i\, a_i\, **}{2N^2}} > 1 \qquad \text{(e)}$$

Therefore, *UTs*>*UTeq*, when $N * k_i a_i < F(a**)$.

Whenever there is dispersion on abilities, the proportional sharing rule increases the total welfare of the team.

Prove of proposition 6:

The team welfare in the standard case (c) with second best sharing rule is:

$$UT^{S} = \sum_{i=1}^{N} \frac{(k_i\, a_i **)^2}{F(a**)} - \sum_{i=1}^{N} \frac{(k_i\, a_i **)^3}{2\left(F(a**)\right)^2} \qquad \text{(c)}$$

And the welfare of the team with the low identity and second best sharing rule is:

$$UT^{LIS} = \sum_{i=1}^{N} \frac{(k_i\, a_i **)^2}{F(a**)} + a_i ** - \sum_{i=1}^{N} \frac{(k_i\, a_i **)^3}{2\left(F(a**)\right)^2} + \frac{q_i t_c}{2} - \sum_{i=1}^{N} tc\left(a - \frac{k_i\,(a_i **)^2}{F(a**)} + q_i t\right) \text{(f)}$$

Hence, it must be true that:

$$\frac{\displaystyle\sum_{i=1}^{N} \frac{(k_i\, a_i **)^2}{F(a**)} + t_c a_i ** - \sum_{i=1}^{N} \frac{(k_i\, a_i **)^3}{2\left(F(a**)\right)^2} + \frac{q_i t_c}{2} - \sum_{i=1}^{N} tc\left(\bar{a} - a_i^{LIS}\right)}{\displaystyle\sum_{i=1}^{N} \frac{(k_i\, a_i **)^2}{F(a**)} - \sum_{i=1}^{N} \frac{(k_i\, a_i **)^3}{2\left(F(a**)\right)^2}} > 1 \qquad \text{(h)}$$

If members are identified with the team they will perform a higher effort than in the standard case. The joint welfare of the team will be higher depending on the effort norm decided by the team and if members comply with this norm. Therefore, $UT^{*LI} > UT^{**}$ if $\sum_{i=1}^{N} tc\left(\bar{a} - a_i^{LIS}\right) \leq 0$

Prove of proposition 9:

$$S_i^{LI} > S_i^{SI} \Leftrightarrow \frac{k_i a_i **}{\sum_{i=1}^{N} k_i a_i **} > \frac{\dfrac{k_i a_i **}{1 + 2q_i t_c}}{\sum_{i=1}^{N} \dfrac{k_i a_i **}{1 + 2q_i t_c}} \Leftrightarrow \sum_{i=1}^{N} 1 + 2q_i t_c > 1 + 2q_i t_c \qquad \text{(i)}$$

From equation (i) we can see that high skilled members will receive a lower share of the total output in the high identity case than in the low identity case. For low skilled members the opposite is true. Therefore, the second best with high identity is more equalitarian.

Chapter 3

Sharing Rules in Heterogeneous Partnerships: An experiment

1. Introduction

The distinctive feature of partnerships is that total output produced is equally shared among all collaborating members, even though each member may contribute different amounts to total output (Farell and Schotchmer 1988). Although partnerships are common in so different activities as fishing, law firms and scholarly production, little is known about the design of efficient output sharing rules in partnerships. This paper shows the results of an experiment that compares the performance of collaborative production among individuals with different skills in two situations, with equal sharing and with an output sharing rule determined from a welfare maximizing criteria (second best). Our results show that the choice of the output sharing rule matters for productive efficiency in joint production, and that the response of collaborating partners to equal and unequal output sharing is different for high and for low skilled partners. Therefore the potential gains in fairness, simplicity and rent seeking avoidance of equal sharing rules (Farell and Schotchmer, 1988), must be balanced against the potential loss in efficiency.

The conceptual framework to study partnerships behavior in this paper is taken from the theory of self-management organization in team production technology as initially formulated by Alchian and Demsetz (1972) and Holmstrom (1982). Team production technologies are those where resource inputs are complementary in production (higher quantity of one input increases the productivity of the others) so there are potential gains from joint production over separate one. The organization design problem appears when the resources belong to different owners and information problems make impossible to compensate each resource owner according to their marginal contribution to output. In these situations the compensation of collaborating partners will be tied to the output of the group, which will result in inefficient input contributions from the point of view of welfare maximization (free riding behavior). Holmstrom (1982) showed that when the budged constraint is binding there is no output sharing rule that will implement the first best welfare maximizing solution. However, this result does not mean that all sharing rules will be equally efficient in joint production with team technologies.

In this paper we experimentally investigate if the choice of the output sharing rule matters for efficiency in production partnerships and if it matters as predicted by the theory. Namely, if the second best sharing rule gives higher level of welfare than the equal sharing rule when the two are different.

The experiment is designed as a team production environment where individuals endowed with (simulated) different skills, high and low, decide how much to contribute to the joint production under a given output sharing rule. The joint production and team technology result from the imposed condition of complementary skills that in turn imply different marginal contribution to output and different marginal costs. The experiment has two treatments. In the first the output is shared equally amongst the members of a group of four. In the second, the output is shared accordingly to a theoretically determined second best sharing rule that assigns higher share of output to high skilled individuals than to low skilled ones. The design is stranger matching with complete information on skills (skills' differences are common knowledge) but with no information about the decision of the other subjects.

The aim is to compare group and individual decision-making on input contributions and the resulting total welfare between and within treatments. Moreover, we aim to compare the observed behavior with the Nash equilibrium solutions in a non-cooperative game. Herein, each player chooses the input contribution that maximizes individual utility, which is determined as the difference between compensation and opportunity cost. There are two Nash equilibrium solutions to compare with, the one for the equal sharing rule and the other for the second best one.

The results of the experiment confirm the prediction that self-managed organization with output sharing and balanced budged constraint generates free riding behavior in the collaborating partners. We find that the input contributions and the total wealth created from joint production are lower that the welfare maximizing ones (first best). The inefficient behavior is observed under both, equal and unequal (second best) output sharing rules. However, the loss in total welfare is lower under the second best sharing rule than in the equal sharing one, confirming that the choice of the output sharing rule matters for efficiency in self-management with team production technologies.

In terms of the observed behavior of high and low skilled individuals in the two treatments, we find that the high skilled contribute with more input than the low skilled ones under the two sharing rules. This result is in line with Nash equilibrium predictions. However, the observed contributions are above the predicted by the Nash equilibrium in the two experimental setting, equal and unequal output sharing rules. The upward deviation from the Nash equilibrium, i.e. over-contribution, is commonly observed in experiments with potential free riding behavior in nonlinear settings, where Nash equilibrium contributions are located in the interior of the set of feasible contributions (Rapoport and Suleiman, 1993; Keser, 1996; Nalbantian and Schotter, 1997; Van Dijk et al., 2002; Sadrieh and Verbon, 2006; Irlenbusch and Ruchala, 2008).

Nonetheless, we observe that while high skilled individuals deviate in a similar amount from the Nash equilibrium solutions under the two sharing rules, the low skilled ones deviate more upwards in the equal sharing rule than in the unequal, second best, sharing rule. Low skilled individuals benefit (free ride) from the higher productivity of the high skilled ones under equal sharing and, aware of this, they seem to be compelled to contribute more than what it would be individually rational to joint production. The high skilled ones, however, appear to be unaffected by any sense of fairness when receive an equal share of output, as their over-contribution is similar in both treatments.

Furthermore, we find that input contributions are quite stable over rounds and do not convergence towards the Nash equilibrium. This result is consistent with Chan et al. (1999). However, is inconsistent with the common observed decline on contributions over rounds in public good games with both, homogeneous (see for example Fehr and Gatcher, 2000a) and heterogeneous players (see for example Buckley and Croson, 2006).

The research presented in this paper is related to the experimental literature on the determinants of the contributions to public goods in nonlinear settings. The vast majority of previous experimental literature that examined the potential free riding behavior has been focused in linear public good games of homogeneous individuals (Ledyard, 1995 surveys the results of the early public good experiments). Some studies have introduced heterogeneity in linear public games by giving subjects different endowments (Dickinson and Isaac, 1998; Buckley and Croson, 2006; Reuben and Riedl, 2013), by assuming different costs of effort (Schotter and Weigelt, 1992), or by varying the marginal incentive to contribute to the public good (Fisher et al., 1995).

Only a few experimental studies have analyzed endowment heterogeneity in nonlinear settings (Rapoport and Suleiman, 1993; Hackett et al., 1994; Ostrom et al., 1994; Chan et al., et al., 1996; Chan et al., 1999; Van Dijk et al., 2002; Sadrieh and Verbon, 2006). Each of these studies has focuses on comparing aggregated group contributions between homogenous and heterogeneous group. The experimental evidence on the benefits of heterogeneity in comparison to homogeneity is mix. While Ostrom et al. (1994) and Van Dijk et al. (2002) find that heterogeneity leads to lower contributions, Sadrieh and Verbon (2006) find no significant differences and Hackett et al., (1994), Chan et al. (1996) and Chan et al. (1999) find a positive effect of heterogeneity.

The last two studies are the closest to our study. Chan et al. (1996) find evidence that sufficiently large dispersion in endowments leads to higher aggregate contributions to the public good than a homogeneous composition. Chan et al., (1999) investigate the effect of group composition in contributions to a public good. They compare aggregate contributions between homogeneous groups, groups with single heterogeneity (with different endowments or with different payoff preferences) and groups with double heterogeneity (on endowments and on payoff preferences). They find no differences between homogeneous and single heterogeneous groups' contributions. However, the observed contributions increase when double heterogeneity is introduced in a setting with complete information on endowment and preferences' heterogeneity. To the best of our knowledge, this is the only study that introduces simultaneously different kinds of heterogeneity in a nonlinear setting. Nonetheless, the focus of their study is on the effects of group composition on contributions, under different information conditions and no analysis at the individual level is made.

Our paper is different from previous research in several ways. First we model and experimentally test the free riding behavior in an environment of self-management organization of production of a private good that may be shared in equal or in different proportions by each production partners. In public good games the good produced is consumed equally and fully by all contributing partners. Self-management organizations, for example partnerships or workers' cooperatives, are important organization forms in production of private goods, and are viewed as alternatives to other organization forms such as the capitalist firms (Alchian and Demsetz, 1972). Therefore the paper contributes to the literature on the choice of organization forms in production for the market.

Second, the paper is the first to combine several forms of heterogeneity in team compensation experiments: heterogeneous skills that imply different marginal contributions to joint output; heterogeneous opportunity costs of inputs; and unequal sharing rules determined as a second best output sharing solution. Our experimental set up allows us to compare the differences in observed behavior under the two output sharing rules, with the differences between the theoretically predicted (Nash equilibrium) behavior under one rule and the other. This increases the power of the tests of the predictions on free riding in self-managed organizations, compared with the power of tests that compare only observed and predicted behavior.

Third, the results of the paper offer new insight into organizational design of self-managed organizations. For example, the result that equal sharing lowers the efficiency in production in self-managed organizations with heterogeneous input suppliers will have to be considered when designing the composition of production groups; if the constraint is from choosing an equal sharing rule then there are clear incentives to homogeneous groups (where equal sharing is second best optimal). On the other hand, if the first condition is that the group is composed of individuals of different skills then the efficiency consideration indicate that unequal output sharing, with partners suppliant more productive inputs receiving a higher share of output, is a better option than equal sharing.

The rest of the paper is structured as follows. In Section 2 we present the experimental design and main hypotheses. Our experimental results are reported in section 3 and section 4 concludes.

2. Experimental design and hypotheses

*2.1 **Experimental design***

The experimental setup is based on the theoretical analysis of the previous chapter. The aim is to investigate if individuals and groups behave accordingly to the theoretical predictions of chapter 2 and what are the economic implications of those behaviors. Specifically, we experimentally test the propositions derived in the section: Nash equilibrium under standard preferences. The experiment is designed as a non-real effort experiment[8] and involves groups of four people that individually and simultaneously decide how much to contribute to the joint production under a given output sharing rule. In the following we present the main equations and the precise parameters used in the experimental study in order to avoid a repetition of the model.

Experimental parameters

The production technology *F(q,a)* and the opportunity cost functions $C_i(q_i a_i)$ are as described in the chapter 2. For the experimental implementation and Nash equilibrium predictions, the team production component of the technology, $k_i(\ )$ is given by the following expression:

$$k_i(q_i,q_{-i}) = q_i^{1/2}\left(q_i^{1/4}\prod_{i\neq 1}^{N} q_{-i}^{1/4}\right),\ (q_i;q_{-i})>1 \qquad (1)$$

The subjects' individual payoff is therefore defined by:

$$\text{Subject}_i\text{:}\ \pi_i = s_i\left(\sum_{i=1}^{N} k_i a_i\right) - \frac{a_i^2}{2q_i}\ : \qquad (2)$$

The experimental design includes two treatments: The *Equal treatment* and the *Proportional treatment.* In the first all members receive the same percentage of the total team output. In the *Proportional treatment* the share of total output corresponds to the second best sharing rule. For simplicity reasons, we analyze groups with only two different skills, high and low. Thus, in each group, two individuals are randomly endowed with high skills and two other with low skills. We fix the values q_{high}=10 and q_{low}=5 along all the experiment.

Therefore, in the equal treatment, $s_i=1/4$ and in the proportional treatment, $s_i^H=0.40$ for each of the high skilled individual and $s_i^L=0.10$ for each of the low skilled subject. Table 1 summarizes the values of the experimental parameters under the assumptions above. Table 2 gives the optimal and equilibrium solutions for wealth

[8] Non-real effort experiments allow controlling for purely strategic aspects. Real effort experiments can bring the effect of intrinsic motivations that can crowd out the extrinsic motivations (see for example Fehr and Rockenbach (2003); Fehr and Gachter (2000b) and Gneezy (2005)).

maximization and Nash equilibrium solutions for each treatment, *Equal* and *Proportional*.

Table 1: Experimental parameters

Parameters	
Skill of high types Skill of low types	10 5
k (value of number) high types k (value of number) low types	22 16
Cost high Cost low	$a_i^2/20$ $a_i^2/10$
Proportional share - high skilled Proportional share - low skilled	40% 10%
Equal share	25%

Table 2 – Theoretical predictions

	Treatments	
Predictions	*Proportional*	*Equal*
Nash Equilibrium effort High skilled Low skilled	 88 8	 55 20
Individual payoffs High skilled Low skilled Team net payoff	 1297 417 3428	 627 744 2743
Pareto equilibrium effort High skilled Low skilled Team net payoff	 220 80 6250	

The choice of parameters was motivated by the following considerations. First we decided to use an utility function with in which the Nash equilibrium is located in the interior of the set of feasible contributions for two main reasons. The first is to have a comparable design to some benchmark studies on team incentives (Keser, 1996; Chan et al. 1999, Irlenbush and Ruchala, 2008; Sutter, 2006). The second reason is to avoid corner solutions, as moving the equilibria to the center of the set of feasible contributions tends to reduce or neutralize any bias due to decision errors. (Laury and Holt, 1998)

Secondly, being our goal to understand if the choice of the sharing rule matters for efficiency in heterogeneous groups, we differentiate subjects by endowing them different skills. Previous experiments in public good games that focus on heterogeneity give subjects different endowments (Buckley and Croson, 2006; Dickinson and Isaac, 1998) and others use different costs of effort (Schotter and Weigelt, 1992; Keser and Montmarquette, 2007). We opt by doing both to be consistent with the team technology production model. The imposed condition of complementary skills implies different marginal contribution to output and different marginal costs. This translates into different values and costs for subjects' chosen "numbers." Moreover, accordingly to human capital theory (Becker, 1964; Mincer, 1974) those who have more skills have lower costs to perform the same level of effort. This theory explains differences in the compensation of workers as a result of differences in their observed skills. Furthermore, we differentiate subjects with the double of the skill, which lead to a considerable difference in the skills' complementarity function (equation 5), in the cost function (equation 2) and in the second best sharing rule (equation 4). According to Bergstrom et al. (1986) model and Chan et al. (1999) experimental evidence, only sufficiently large differences in distribution can affect contributions in public good games. The chosen parameters insure a sufficient large distribution in the proportional treatment.

Implementation:

We recruited 48 undergraduate students from Universitat Autonoma de Barcelona using online recruitment system (ORSEE), with 24 subjects in each session. We conduct one session per treatment. The experiment was designed with experimental software z-tree (Fischbacher, 1999).

Non-real effort experiments are used to avoid uncontrollable suggestive influences (Irlenbusch and Ruchala, 2008). Therefore, language was kept neutral during the experiment. We substitute expressions like "effort" and "cost of effort" by "number" and "cost of number"; the k function was set to represent the "value of the number". "Team wealth" was referred as "result", which was described as the sum of the value of the numbers of all four members of the group. Expressions like high and low skilled types were also substituted by "type 1" and "type 2" subjects, respectively.

At the beginning of each session subjects were randomly allocated to one computer each. Printed instructions[9]were distributed and read aloud to all participants. They knew that in their group there were two members of each type and that the "number" "type 1 (type 2)" participants chose had a higher (lower) value and a lower (higher) cost than the number that "type 2 (type 1)" participants chose. Cost tables with all the possible integer numbers, corresponding values and costs for each type of participant were distributed along with the instructions. Their payoffs were explained as being a proportion of the sum of the values of the numbers chose by the four members of the group less the individual cost of own chosen number.

After calculating some examples to demonstrate their understanding of the game, the experiment starts. Subjects were randomly assigned to a team and randomly attributed "type 1"(high skilled) or "type 2"(high skilled). They were asked to choose a number out of the integer set N € [0,250][10]. At the end of each round subjects received feedback on the own number chose, its value and cost, their individual payoff and the result (team wealth), however, no information about the decisions of the other participants was provided. No interaction was allowed during the experiment and no information about the identities of the subjects was given.

Subjects played first one-shot round not knowing that the experiment was going to be repeated. This round served as a learning round, as well as to control for the validity of the one-shot rounds in a sequential repeated setting.

After finishing this one-shot round, all the participants showed a clear understanding of the game. Therefore, they were told that they will play the game for 10 rounds and that their earning will be added to the final payment. In each round subjects were randomly assigned to a different group (stranger treatment), but their types were kept constant during the ten rounds.

At the end of each session subjects were asked to answer a post-game questionnaire. First, they fulfilled some demographic questions. Second, two questions related to distribution preferences were asked. They were given a table with three options that correspond to three distribution rules: Equal sharing (option A) - 25 percent each; Second Best (option B)– 40 percent for each "type 1" and 10 percent for each "type 2"; and Option C – 33 percent for each "type 1" and 17 percent for each

[9] Original instructions were written in Spanish. They are available upon request. An English translation of the equal treatment is given in the Appendix A. Note that the proportional treatment just differs in the payoffs.
[10] From the theoretical predictions de Pareto optimum level of effort for high skilled members is to choose the number of 220. Therefore we set the range of decision numbers to be from 0 to 250.

"type 2" (this sharing rule is the mean of equal and second best). In the first question subjects were asked to indicate the option they preferred, in the second question they were asked to indicate the option they thought the others members of the group (type 1 and type 2) would prefer.

Each session lasted for about 60 minutes including instructions time. Subjects were paid anonymously at the end of the experiment and earned on average 13 Euros plus 5 Euros that corresponded to a show up fee.

2.2 Hypotheses

Our hypotheses are according to the results of Chapter 2. We derive five main hypotheses on individual and team behavior according to the propositions of the model. These hypotheses are therefore based on the theoretical predictions reported in table 2.

Hypothesis 1: "Contribution":

Hypothesis 1a: Team output sharing induces to free riding.

According to proposition 1 in Chapter 2 and previous experimental evidence, subjects free-ride, contributing with less input than the Pareto optimum level.

Hypothesis 1b: High skilled subjects contribute with more input under a proportional sharing rule (second best) than under an equal distribution;

Hypothesis 1c: Low skilled subjects contribute with less input under a proportional sharing rule (second best) than under an equal distribution.

According to proposition 2 in Chapter 2, whenever the share individual *i* receives under the second best output sharing is higher than the equal share, her input contribution will be higher under this sharing rule than under equal distribution. This, in turn, induces to a higher individual payoff under the second best output sharing than in the equal share. In contrast, if the second best share is lower than the equal distribution, she will contribute less under the second best sharing rule and have a lower payoff than under the equal share.

Hypothesis 2: "Individual payoff":

Hypothesis 2a: With an equal distribution the high skilled subjects receive a lower payoff than low skilled subjects;

Hypothesis 2b: With a proportional sharing rule (second best) the high skilled subjects have a higher payoff than their low skilled teammates.

Hypothesis 3: "Dispersion":

Equal sharing rules reduce dispersion on efforts and on individual profits.

Hypothesis 4:"Team efficiency":

Equal output sharing in teams composed by members with heterogeneous skills decreases the total team net payoff when compared to compensation schemes that account for heterogeneity (second best), damaging team efficiency.

According to proposition 3 in Chapter 2, the total welfare with the second best output sharing rule is higher than the total wealth of equal sharing, but lower than the first best welfare.

3. Experimental results

3.1 *Behavior under equal and proportional sharing rules: Nash comparison*

Table 3 reports average contribution, its standard deviation, average individual payoff and average team net payoff[11] for each treatment aggregated over all 10 rounds[12]. Additionally, it reports the binomial test results on the deviations from Nash equilibrium predictions[13].

The results reported here Recall that subjects played a one-shot round before the 10-rounds game. We treat this round as a learning period, thus we did not include it in the data analysis. Nonetheless, in appendix B, table 6, the interested reader can find a regression analysis on effort that controls for the effect of this one shot round. We find a positive significant effect of the learning round for low skilled subjects.

[11]The average team net payoff is the total team wealth less the sum of subjects' cost of effort.

[12]Recall that subjects played a one-shot round before the 10-rounds game. We treat this round as a learning period, thus we did not include it in the data analysis.

[13] According to Siegel (1988) the binomial test is appropriated to analyze dependent samples Irlenbusch and Ruchala (2008) use the same test.

We find that subjects free-ride, contributing less than the Pareto optimum in both treatments (see table 2 for Pareto predictions) (binomial test, event probability=0.5, p=0.0000 for each type of player in each treatment). This result confirms our hypothesis 1a (and proposition 1) that team output sharing induces to free-riding behavior and supports previous experimental evidence of free-riding in teams (Nalbantian and Schotter, 1997; Irlenbusch and Ruchala, 2008).

Table 3: Overall results

	Average Contribution	SD of Contrib	Average Payoff	Average Team Net payoff
Equal sharing				3350***(2743) 0.000
High skilled	78***(55) 0.003	11.13	736***(627) 0.000	
Low skilled	39***(20) 0.000	5.30	939**(744) 0.046	
Aggregate	58***(38) 0.007	21.8	838***(685) 0.002	
Proportional Sharing				3617**(3428) 0.026
High skilled	115***(88) 0.001	12.33	1307 (1297) 0.448	
Low skilled	14**(8) 0.026	12.83	501***(417) 0.007	
Aggregate	65 (48) 0.738	52.3	904 (857) 0.738	

Predicted values are given in brackets.*** Significantly above the equilibrium value at 1% ** significantly above the equilibrium value at 5% * significantly above the equilibrium value at 10% (binomial test, α=0.5, two tailed)

Consequently, the team net payoff is also lower than Pareto optimum (p=0.000 in both treatments). The inefficient behavior is observed under both treatments. However, the loss in total welfare is lower in the proportional treatment than in the equal treatment (Mann-Whitney test, p=0.0278). This result confirms our hypothesis 4 (and proposition 3) that the use of second best output sharing rules yields a higher creation of wealth and lowers inefficiency when compared to an equal split. We can, therefore, conclude that the choice of the output sharing rule matters for efficiency in self-management with team production technologies and that the equal sharing is not second best when team members differ in skills, confirming proposition 4 in Chapter 2.

Result 1 (**Free-ride and Team wealth**):

I. Self-managed organization with a heterogeneous composition and balanced budged constraint generates free riding behavior in the collaborating partners.

II. The loss in wealth created, generated by the free-ringing behavior, is lower under the second best sharing rule than in the equal output sharing..

In terms of individual behavior, we find that both types of subjects tend to contribute more than predicted in both treatments. (Binomial test, event probability=0.5: Equal treatment: high skilled types: p=0.003; low skilled types: p=0.000; aggregate: 0.007. Proportional treatment: high skilled types: p=0.001; low skilled types: p=0.025; aggregate: p=0.738). The exception is the aggregate contribution in the proportional treatment. This is justified by the high standard deviation on contributions. This result is illustrated in Figure 1 and Figure 2, which depict the development of average contributions over the 10 rounds per treatments and per types of players. The over-contribution[14] result is quite common in public good games with non-linear setting with homogenous (see for example Irlenbusch and Ruchala, 2008) and heterogeneous subjects (Sadrieh and Verbon, 2006; Van Dijk et al., 2002; Rapoport and Suleiman, 1993). It seems to indicate some non-pecuniary benefits of working in a team.

Figure 3 depicts team net payoff per treatment. As we can observe, due to the over-contribution result, team net payoff is significantly higher than predicted in both treatments (binomial test, event probability=0.5: Equal treatment: p=0.000; Proportional treatment: p=0.026). Interestingly, the difference between actual wealth created and predicted, is higher under equal sharing than under proportional sharing rule (Mann-Whitney test, p=0.0032). These findings could suggest non-pecuniary rewards of an equal distribution. Next we analyze differences in treatments.

[14]Contribution higher tan Nash equilibrium. Figure 5 in appendix B shows the over-contributions by type and treatment.

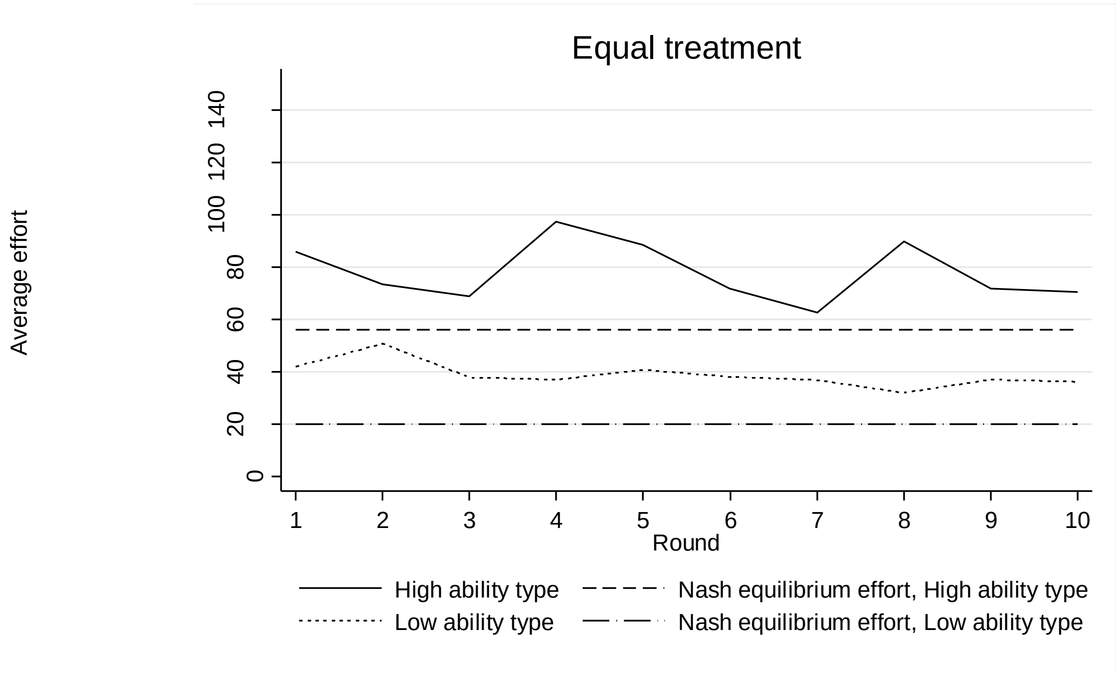

Fig. 1. Average contribution– Equal treatment

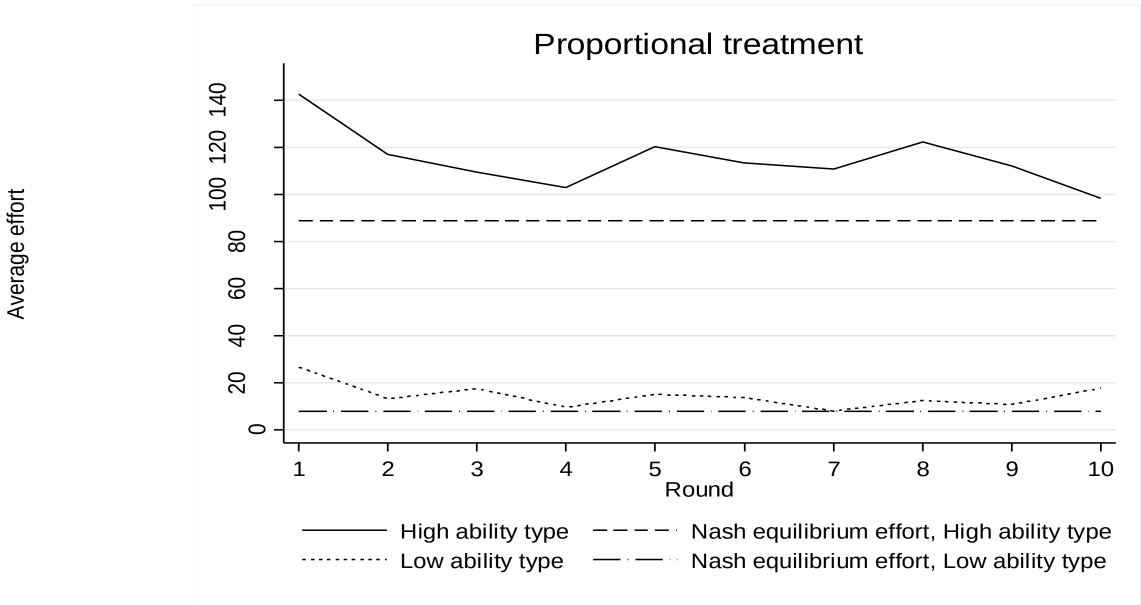

Fig. 2. Average contribution– Proportional treatment

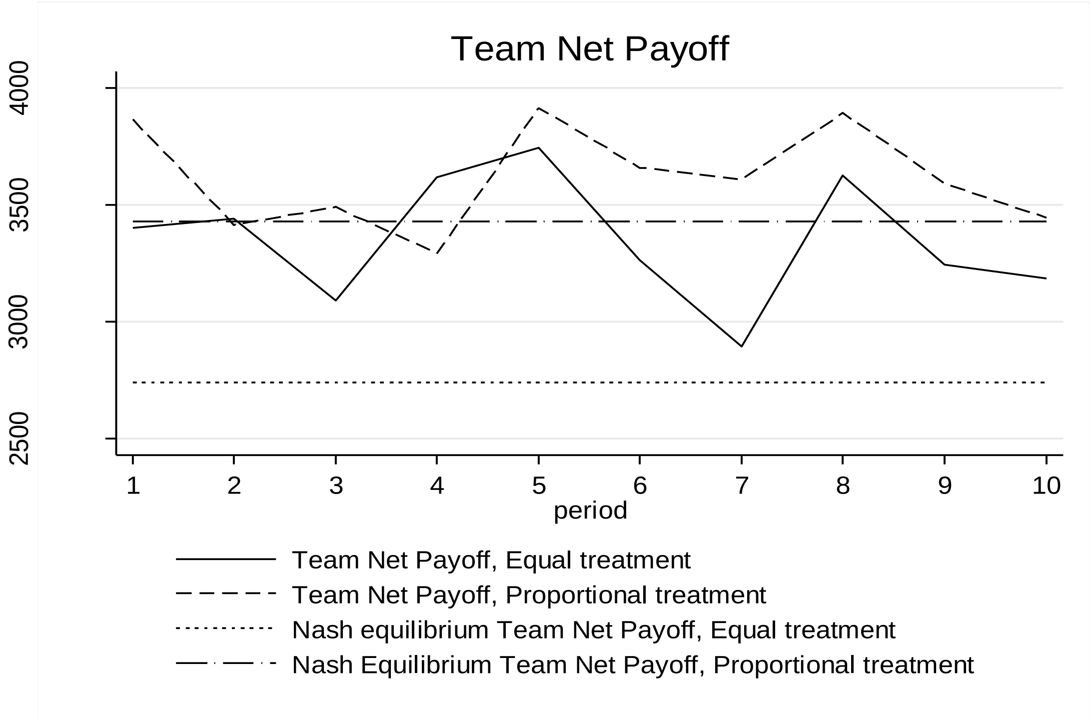

Fig 3 – Total team revenue by treatment

3.2 *Comparison within and between treatments*

Table 4 shows the results from an OLS data analysis. The first row contains information about the sample used. The dependent variable in the five models is the individual contribution. The explanatory variables are: a dummy representing the proportional treatment, a dummy representing the high skilled types and Period dummies.

The results confirm our theoretical predictions. Within treatments we observe that high skilled subjects contribute with more input than the low skilled ones in both treatments, as indicated by the significant coefficient of the "high skilled type" dummy variable in model [1], [4] and [5].

In what concerns subjects' response to the different distributional rules, we cannot reject hypotheses 1b and 1c. We can observe an increase on high skilled subjects' contribution levels from the equal to the proportional treatment, as indicated by the significant and positive coefficient of the proportional treatment variable in model [2]. In contrast, as we can see in model [3], the low skilled subjects decrease their contribution levels from the equal to the proportional treatment. These findings confirm proposition 2 in Chapter 2 that whenever the individual share is higher (lower) than the equal share, subjects will perform a higher (lower) effort under the second best sharing rule[15].

Table 4 –OLS regression results for heterogeneous teams[16].

	All Subjects	*High skilled*	*Low skilled*	*Equal Treatment*	*Proportional Treatment*
	[1]	*[2]*	*[3]*	*[4]*	*[5]*
Proportional treatment	6.23	36.87	-24.41		
	(5.93)	(9.52)***	(2.91)***		
High skilled type	69.87			39.23	100.5 (8.18)***
	(5.05) ***			(3.19)***	(8.322)***
Period 2	-10.56	-18.79	-2.33	-1.75	-19.38
	(15.83)	(25.55)	(7.83)	(16.04)	(27.54)
Period 3	-15.77	-24.92	-6.63	-10.50	-21.04
	(18.06)	(34.89)	(5.16)	(20.44)	(23.60)
Period 4	-12.46	-13.92	-11.00	3.38	-28.29
	(7.17)	(15.35)	(7.13)	(17.25)	(16.48)
Period 5	-8.06	-9.75	-6.38	0.75	-16.88
	(9.11)	(9.55)	(11.35)	(18.94)	(16.68)
Period 6	-14.98	-21.54	-8.42	-8.88	-21.08
	(11.30)	(19.32)	(6.85)	(19.35)	(12.11)
Period 7	-19.58	-27.29	-11.88	-14.08	-25.08
	(10.03)	(16.98)	(7.49)	(13.31)	(14.95)
Period 8	-10.08	-8.08	-12.08	-3.04	-17.13
	(8.49)	(19.62)	(7.01)	(12.57)	(18.89)
Period 9	-16.31	-22.21	-10.42	-9.54	-23.08
	(12.22)	(21.95)	(4.27)	(10.37)	(18.64)
Period 10	-18.54	-29.67	-7.42	-10.50	-26.58
	(11.87)	(25.26)	(7.64)	(17.55)	(18.84)
Intercept	36.24	95.78	46.58	44.34	34.37
	(13.29)**	(19.18)***	(7.56)***	(15.67)**	(15.02)*
Observations	480	240	240	240	240
R^2	0.3503	0.1037	0.2338	0.1999	0.5072

Standard errors adjusted for group clusters are given in parentheses.***significant at 1%; **significant at 5%;*significant at 10%;

[15]Non-parametric tests (Mann-Whitney) confirm all these results at 1% level of significance.

[16]The five models in table 4 are estimated using OLS. Reported standard errors are corrected for robustness by clustering observations by group. This technique follows the approach designed by Liang and Zeger (1986). Moreover is normally used in research on public good games with stranger matching (see for example Fehr and Gachter, 2000) For results robustness we run OLS regressions without clustering for groups and GLS regressions and find similar results. For the interested reader, Table 6 in appendix B presents GLS models controlling for the learning round.

The increase on contribution of the high skilled subjects is not significantly different from predicted (Wilcoxon test, p=0.5337). However, the low skilled contribution's decrease is higher than predicted (Wilcoxon test, p=0.0409). The low skilled individuals benefit (free ride) from the higher productivity of the high skilled ones under equal sharing. Aware of this, they seem to be compelled to contribute more than what it would be individually rational to joint production. The high skilled ones, however, appear to be unaffected by any sense of fairness when receive an equal share of output, as their over-contribution is similar in both treatments.

Result 2 (Individual Effort):

I. High skilled individuals contribute with more input than their low skill teammates under both equal and second best sharing rules.

II. The use of an unequal sharing (second best) induces to a higher contribution level from high skill individuals, when compared to the equal sharing, but to a lower contribution from the low skilled subjects.

Our results are consistent with Chan et al.'s (1996, 1999) who find that high-endowed subjects contribute more than low endowed subjects in a nonlinear public good experiment. Nonetheless, they find that the high-endowed subjects' contribution was mainly below Nash predictions and that just low endowed subjects over-contribute.

Although the predicted behavior in public good games is indeed that the high endowed should contribute more than the low endowed subjects, previous experimental evidence indicate that high and low endowed subjects contribute the same absolute amount (Fisher at al, 1995; Buckley and Croson, 2006; Dickinson and Isaac, 1998). Moreover, Buckley and Croson (2006) and Van Dijk et al., (2002) find that low endowed subjects contribute a higher percentage of their income to the public good than high endowment subjects.

Hence, our results contribute to the discussion of individual and group behavior in heterogeneous teams. When contributing to a public good, low endowed subject contribute the same or even more than high endowed ones. This suggests a non-selfish behavior from the low endowed. It is common to hear that the poor people tend to give more to those in need than the rich ones. Our findings suggest that that in a self-management organization context, subjects behave more as predicted. Next we analyze individual behavior in more detail.

3.3 *Individual Behavior*

Analyzing single individual choices, we find that around 20 percent of subjects choose the Nash equilibrium level of contribution. While in the equal treatment about 50 percent of low skilled subjects' contributions are lower or equal the predicted equilibrium effort of 20, 37 percent of these players choose their dominant strategy. In another 16 percent of all choices they choose the effort of 50. We observe that the distribution of high skilled players' contribution range from 0 to 250, nonetheless, 80 percent of the choices are under 100. Around 50 percent of their contributions are equal or below the predicted value and around 25 percent choose Nash equilibrium. This indicates that the over-contributions are made by 50 percent of high and low skilled players. There are picks of choice of 50 and 100, which confirms a tendency to choose round numbers in experiments (Irlenbusch and Ruchala, 2008).

In the proportional treatment 56 percent of the effort choices of low ability players are below 10. They do not contribute in about 20 percent and 15 percent chose Nash equilibrium (8). High skilled participants used all the entire effort space, but only around 37 percent chose an effort below Nash equilibrium (88), we can find peaks in 100 and 125. This justifies the high level of over-contribution of the high skilled subjects in the proportional treatment.

For a better understanding of individual choices, we test absolute and relative contribution in relation to Pareto optimum level of effort. The Nash prediction is that subjects contribute the same percentage of input as the share they receive from the total output. In the equal treatment, where the prediction was that both high and low skilled subjects contribute 25 percent of the Pareto optimum, about 32 percent of contribution choices were the predicted equilibrium. We find that on average high skilled subjects contribute 35 percent of Pareto optimum (10 percent more than predicted) and low skilled subjects contribute 49 percent (24 percent more). In the proportional treatment high skilled subjects should contribute 40 percent of Pareto optimum and low skilled just a 10 percent. We find that only 9 percent of subjects played Nash equilibrium. High skilled subjects contribute about 52 percent (12 percent more than predicted) and low skilled subjects contribute about 17 percent of Pareto optimum (7 percent more).

In absolute aggregate contributions, we find that high skilled subjects over-contribute significantly more than low skilled subjects. Although, the absolute over-contribution is only significant in the proportional treatment, the relative contribution is significant in both treatments (Wilcoxon sign-rank test: Absolute: all: p=0.0072; proportional treatment: p=0.0069; equal treatment: p=0.7213. Relative: all: p=0.0674; proportional treatment: p=0.0674; equal treatment: p=0.0051).

Between treatments, we do not find differences in over-contributions (Mann-Whitney test: absolute: p=0.1517; relative: p=0.5338). By types, we find a similar absolute over-contribution of high skilled types on both treatments but a higher relative over-contribution in the proportional treatment (Mann-Whitney test: absolute: p=0.5453; relative: p=0.002). We find that the low skilled members over-contribute more in the equal treatment in absolute and relative terms (Mann-Whitney test: absolute: p=0.0011; relative: p=0.002).

These over-contribution results, seems to indicate some non-pecuniary benefits of working in a team. Nonetheless, the high skilled subjects' over-contribution in the equal treatment and the over-contribution of low skilled subjects in the proportional treatment are quite surprising. In the team technology studied in this paper, the experimental parameters were such that under an equal sharing the Nash equilibrium was a lower individual profit to the high skilled subjects than to their low skilled teammates. As this constitutes another source of inefficiency, we would expect high skilled subjects to under-contribute in the equal treatment, as in Chan et al, (1996,1999).

As contributions are higher but in line with the model predictions, the results on individual payoffs also follow the predicted pattern (see table 3). We find that with an equal compensation scheme, high skilled subjects have lower profits than low skilled subjects (Wilcoxon sign-rank test p=0.005) mostly due to the cost of a higher contribution without being compensated by doing it. On the other hand, high skilled types are highly compensated for a high contribution in the proportional treatment and achieve higher individual profits when compared to the equal treatment (Mann-Whitney test, p=0.000) and earn significantly more than the low skills (Wilcoxon sign-rank test p=0.005). In contrast, the low skilled members' free riding leads to a loss in earnings in the proportional treatment when compared to the equal treatment (Mann-Whitney test, p=0.000).

According to inequality aversion theories (Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000) subjects could have tried to equalize payoffs, specially the high skilled ones. We conjecture that if information about the other players' level of contribution were released, we would have found this type of results on the equal treatment.

Result 3 (Individual profit):

I. The use of a proportional sharing (second best) increases the payoff of high skill individuals when compared to the equal sharing, but decreases the payoff of low skilled ones.

II. Under an equal (proportional) sharing rule high skill individuals get lower (higher) individual payoffs than their low skill partners.

Comparing model [4] and model [5] in table 4, and by the visual inspection of Fig.1 and Fig.2, we can observe that in the proportional treatment there is higher dispersion on contributions than in the equal treatment (Mann-Whitney test, p=0.000). The use of the second best sharing rule increases the average contribution level of high skilled players in about 47 percent but decreases the low skilled' level of contribution in about 64 percent, when compared to the equal treatment. This dispersion effect is consistent with the model and with Chan et al., 1996. We find that in the equal treatment there are no significant differences between the predicted and actual contribution's dispersion between high and low skilled members (Wilcoxon test, p=0.5937). In the proportional treatment we do find a higher dispersion on contribution levels than predicted (Wilcoxon test, p=0.0505). Consequently, the dispersion on individual profits is also higher in the proportional treatment than in the equal treatment (Mann-Whitney test: p=0.000).

Result 3 (Dispersion): There is a lower dispersion on efforts and on individual payoffs with an equal sharing rule than with a proportional sharing rule (second best).

3.4 Trend over rounds.

Observing figures 1 and 2 it is not clear if contributions decrease over time, as it generally observed in public good experiments.[17]It is therefore interesting to have a look at the changes of behavior over rounds. From table 4, we can observe that average contribution is generally stable over rounds[18], as indicated by the non-significant coefficient of the variable round at the aggregate level (model [1]) and in both treatments (model [4] and [5]). Nonetheless, we observe differences between types. While the high skilled subjects maintain their contribution level quite constant over rounds (model [2]), the low skilled members slightly decrease contributions over time (model [3]).

Result 4 (Trend):

I. In teams composed by heterogeneous input owners, aggregated contributions do not decrease over rounds.

II. At the individual level, while the high skilled subjects' average contribution is quite stable over rounds, the low skilled subjects' contribution level slightly decreases.

This is a quite different result from the majority of public good games where contributions converge to Nash equilibrium over rounds in both homogenous (see for example Fehr and Gachter, 2000a; Irlenbusch and Ruchala, 2008) and heterogeneous groups (see for example Buckley and Croson, 2006).

However, just some of the few studies with heterogeneous subjects in nonlinear settings have analyzed trend over rounds. Our results are consistent with Chan et al., 1999, who find that with heterogeneous players (both with single and double heterogeneity) and partner matching, average contributions were quite stable, however, near or below Nash equilibrium. Additionally, from the visual inspection of Chan et al., 1996, it seems that average contributions do not decrease over rounds, however, there is no statistical support. On the other hand, it is quite common to find stability on contributions when introducing bonus or prizes (Irlenbusch and Ruchala,

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[17]This trend is also typically observed in public good games (see Ledyard, 1995 for a survey on experiments on public good games).

[18] We also calculated the average Pearson correlation coefficient between round numbers and average contributions. The Binomial test shows that the Pearson correlation coefficients in not significantly more often negative than positive in none of the models (event probability $\alpha=0.5$, $p>0.453$).

2008; Sutter 2006, Dickinson and Isaac, 1998), communication (Issac et al. 1988) or punishment (Reuben and Riedl, 2013).

Hence, we conjecture that heterogeneity combined with complete information and stranger matching originate stability over rounds.

3.5 Individual response to group behavior

To better understand the effect of the different sharing rules in individual behavior, we investigate the adjustment of subjects' level of contribution to group output. At the end of each period subjects were able to observe the total output of the group. Thus, they could approximately estimate the average contribution of the group. We analyze if subjects raise their contribution because they thought that it was lower than the average contribution of the group, or on the contrary if they lower it because they thought that their contribution was higher than the average. Similarly to adjustment process observed by Selten and Stoecker (1986), Selten and Ockenfels (2005) and Irlenbusch and Ruchala (2008) we find that subjects lower their contribution in the next period more often than they raise it when their contribution is higher than the average contribution of the group. However, this response to average contribution is mainly observed in high skilled players (Wilcoxon signed-rank test; overall: p=0.009; high skilled: p=0.0148; low skilled: p=0.3657). Similarly, we find that high skilled subjects raise their effort more often than lower it when their contribution is lower than the group average. The low skilled subjects do not respond to average contribution (Wilcoxon signed-rank test: overall p=0.0017; high abilities: p=0.0000; low abilities p=0.4310).

By treatment, we find that high skilled subjects respond with an increase in contribution, when their contribution is lower than group average, more in the proportional treatment than in the equal treatment. We find no differences in treatments for the low skilled subjects (Mann-Whitney test: overall p=0.0756; high abilities: p=0.0103; low abilities: p=0.1595). However, subjects decrease their contribution in the next period when their contribution is higher than the group average, similarly in the equal and in the proportional treatment (Mann-Whitney test:

overall p=0.2622; high skilled: p=0.3035; low skilled: p=0.4945)[19]. These results seem to indicate that while high skilled subjects are conditional cooperators, i.e., their contribution is conditioned by the group behavior (see Fischbacher et al, 2001; Bowles and Gintis, 2004; Croson et al. 2005) low skilled subjects are not.

3.6 . Post-experimental questionnaire: Preferred sharing rule

After inform subjects about their individual profit in the session, they were told that the experiment was over and asked to answer two questions about preferences for distributional rules. They were given a table with three options that correspond to three distribution rules: Equal sharing (option A) - 25%; Second Best (option B)– 40% for “type 1” and 10% for “type 2”; and Median sharing (option C) – 33% for “type 1” and 17% for “type 2” (this sharing rule is the mean of equal and second best). In the first question subjects were asked to indicate the option they preferred, knowing their type (the same type they were attributed during the experiment). In the second question they were asked to indicate the option they thought the other members of the group (type 1 and type 2) would prefer.

We find differences between treatments. As we can observe in tables 5a and 5b, after playing the equal treatment 67 percent of the high skilled subjects indicated they prefer the second best sharing rule and 8 percent showed preferences for the median share. They thought that only 50 percent of the other high skilled subjects and 8 percent of the low skilled subjects would choose that compensation scheme. In fact, none of the low skilled subjects chose the proportional share. We find that 83 percent chose the equal share and 17 percent chose the median share. They believed that 92 percent of the high skilled subjects would choose the proportional share and that none of their low skilled teammates would choose this distributional rule.

After playing the proportional treatment the percentage of high skilled subjects that indicate preferences for the proportional sharing was 83 percent and the remaining 17 percent chose the equal sharing. They believed that all of the other high skilled subjects and none of the low skilled subjects would choose the proportional sharing. In fact, 17 percent of the low skilled subjects indicate preferences for this

[19] We perform the same tests with lagged average effort and the results are quite similar. Moreover, as contributions of high skilled and low skilled types are quite different we perform the same tests with average contribution of the same type in the same group. We also find similar results.

distributional rule and 8 percent for the median share. They believe that 75 percent of their high skilled teammates and 8 percent of the other low skilled would choose the proportional share.

These results seem to indicate that the choice of the sharing rule was influenced by the context that subjects were playing. In a context were subjects' answers were anonymous and with no implications for the other subjects, we would expect that 100 percent of subjects indicate preferences for the distribution rule that better suits their economic interests. However, after playing under a certain distributional rule, at least 17 percent of the subjects considered that sharing rule as preferable in comparison with the one that will lead then to better payoffs. This could be explained by conformity theories (Asch, 1946; Jones, 1984). The most sticking evidence of this fact is the 50 percent increase on the beliefs of high skilled members about the preferred distribution rule of the other high skilled subjects from the equal to the proportional treatment. Experiencing an equal environment could influence preferences and decisions on distribution rules.

Table 5a – Distributional rules choices after treatment

	Choice		
Type	Proportional Share	Equal Share	Median Share
High abilities			
Equal treatment	67%	25%	8%
Proportional treatment	83%	17%	0%
Low abilities			
Equal treatment	0%	83%	17%
Proportional treatment	17%	75%	8%
All members			
Equal treatment	33%	54%	13%
Proportional treatment	50%	46%	4%

Table 5b – Believes on the other members' choice (relation to proportional share)

	Other High ability members	Other Low ability members
High ability members		
Equal treatment	50%	8%
Proportional treatment	100%	0%
Low ability members		
Equal treatment	92%	0%
Proportional treatment	75%	8%

RESULT 5 (Preferences): The majority of the high skilled subjects indicate they would choose a proportional sharing rule. In contrast, the majority of the low skilled subjects indicate they would chose an egalitarian distribution rule after playing both treatments.

In the demographic questionnaire we asked subjects to indicate their gender. As the sample was quite balanced in both sessions, we briefly analyze gender differences on contribution. Overall, we find that females contribute significantly more than males (Mann-Whitney test: p=0.0010). By treatments we find that females contribute significantly more than men in the equal treatment but we find no significant differences in the proportional treatment (Mann-Whitney test: equal treatment: p=0.000; proportional treatment: p=0.1217).

Previous experimental results on gender differences in public good games are quite mixed. While some authors find that men contribute more toward the public good than women (Sell and Wilson, 1991; Solow and Kirkwood, 2002) others find that woman are the ones who contribute more (Seguino et al, 1996) and others find no significant differences (Sell and Wilson, 1993; Andreoni and Petrie, 2008). Our findings indicate that in heterogeneous groups and an equal division of total output, females tend to contribute more than men.

4. Conclusion and discussion

We experimentally investigate the inefficiency of an equal distributional rule on partnerships composed by input owners of heterogeneous skills. We report the results of a non-real effort experiment, based on a theoretical model of team production. The experimental design includes two treatments, the Equal and the Proportional treatment. In the first treatment, the total team output is equally distributed amongst all members of the group. In the second treatment, the distribution of total output corresponds to the second best sharing rule, which involves paying a higher share of the total output produced to the more skilled subjects.

Our results are in line with the theoretical predictions and support the model's propositions in Chapter 2. First, we find that subjects do free-ride, although less than predicted in both treatments. Second, we find that the use of an unequal sharing rule, increase team net payoff when compared to an equal distribution. Hence, in heterogeneous partnerships, equal sharing is not second best and brings inefficiency to the team. Third, at the individual level, we find that whenever the individual share is higher (lower) than the equal share, subjects will perform a higher (lower) effort under the second best sharing rule.

We also find that high skilled subjects contribute more than low skilled participants in all treatments, both in absolute and in relative (percentage of Pareto level of contribution) terms. As predicted, this leads to a lower profit than their low skilled teammates in the equal sharing, which constitutes another source of inefficiency of the equal sharing. As in Chen et al, (1999), we do not find a significant decrease of contributions over rounds. We conjecture that this stability was to some extent due to the double heterogeneity and stranger matching design, but mostly due to the lack of information about the contribution level of other members of the group. It could be interesting to study subjects' reaction when that information is released in a partner matching design. According to inequality aversion theories (Fehr and Schmidt, 1999), subjects tend to equalize payoffs, thus, we conjecture that if this theory is true, contributions would decrease over rounds until an equalization of payoffs is reached.

Furthermore, our results indicate that while the high skilled subjects' over-contribution is similar in both treatments, the low skilled subjects over-contribute more in the equal sharing. This leads to a higher difference between actual and predicted wealth created in the equal treatment than in the proportional treatment. These findings seem to indicate that the use of equal sharing rules could lead to nonpecuniary rewards in heterogeneous teams.

In summary, from an efficient point of view, our results highly recommend the use of unequal sharing rules in self-manage teams and partnerships. However, from a practical point of view, the implementation of this kind of sharing rules have to be carefully studied, as we find that higher the dispersion on rewards, also higher the dispersion on efforts. A very unequal sharing rule, highly decreases the effort level of low skilled workers and significantly increases their free-riding behavior. It would be interesting to study the effects of a distribution that weighs equal and second best sharing rules, as option C in the post-game questionnaire. We conjecture that this type of sharing rules could increase team efficiency as it takes in account the individual interest of both types of subjects.

In the post-game questionnaire, this sharing rule (option C) was the less chosen. The high skilled subjects indicate preferences for the second best and the low skilled ones indicate preferences for the equal sharing. However, in this questionnaire, subjects' decisions did not have an effect in others' payoffs. An Interesting venue for future research would be to study how heterogeneous subjects decide the distributional rule. Would they prefer an equal distribution, or an efficient one, given by the second best solution? Or maybe option C will be preferred when individual decisions affect other subjects. Moreover, it would be interesting to analyze the effects of those preferences on effort decisions,

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APPENDIX

Appendix A:
Instructions (Equal Treatment)

You have been asked to participate in a study that analysis group decision making. During the experiment we will speak in terms of Experimental Monetary Units (EMUs) instead of Euros. Each participant will receive an initial endowment in EMU. You may earn an additional amount of money depending on your decisions in the experiment. Your payoffs will be calculated in terms of EMUs and then converted to euros at the end of the experiment at a rate of 800 EMUs = 1 Euro. This money will be paid to you, in cash, at the end of the experiment. You were given a set of instructions that will be read aloud to all participants. If you have any question, please raise your hand and one of the experimenters will go to you and your question will be solved.

The decision situation:

At the beginning of the experiment you and three other participants will be randomly assigned to your group. The identity of the other participants will not be revealed and you cannot interact with the other members of the group.

In your group there are two participants that will be called of type 1, and two participants of type 2. You will be random selected to be a type 1 or a type 2. You will know your type but will not know who is the other person that share your type or who are of the other type. You and the other three subjects of the group must choose a number between 0 and 250 without knowing the decisions of the other members of the group.

The election of this number has some implications. The number you choose will have a different value depending on your type: if you are type 1 the value of the number is the chosen number multiplied by 22 and if you are type 2 is the chosen number multiplied by 16 (see table k*number). The values of the chosen numbers off the four members of the group are added and each one of the members receives a percentage of that sum, in concrete each one will receive 25% of the sum of the value of the chosen numbers.

On the other hand your chosen number causes a certain cost. As mentioned there are two types of participants in your group. Each type of participant has different cost associated to each possible number that you chose. This means that the type 1 participants have a cost for the chosen number that is equal among them but different of the cost that type 2 participants have for this number. **The cost of the number that you chose will be deducted directly of your payoff.**

In the moment that the experiment starts you will know which type of participant you are in the group and you can consult the cost table in the annex. In this table you can see the value and the cost that each number has for your type and for the other type.

You can also see that each number has a different cost. For the type 1 members the cost of the number is equal to the square of the chosen number divided by 20, while for the type 2 members it is equal to the square of the chosen number divided by 10. In the next table you can see an example of how to reed the table.

Example Cost Table :

Type 1 **Type 2**

K	Number	Value: (K*Number)	Cost of Number
22	2	44	0,2
22	5	110	1,3
22	15	330	11,3
22	20	440	20,0
22	50	1100	125,0
22	149	3278	1110,1

K	Number	Value: (K*Number)	Cost of Number
16	2	32	0,4
16	5	80	2,5
16	15	240	22,5
16	20	320	40,0
16	50	800	250,0
16	149	2384	2220,0

You can read your cost table by looking down the second column where you can find the decision numbers; the third column informs you of the value of this number and in the forth column you can check the cost of this number. For example, if you are type 1 and choose the number 15, the value of this number is 330 and has a cost of 11.3, while if you are type 2 and choose the number 15, the value of this number is 240 and has a cost of 22.5. Note that higher the number you choose higher its cost.

In resume, your payoff in EMU if you are a type 1 participant is calculated by the following formula:

Payoff type 1=0.25*(sum of the value of chosen numbers) – individual cost type 1

While if you are a type 2 participant, your payoff in EMU will be:

Payoff type 2=0.25*(sum of the value of chosen numbers) – individual cost type 2

Example of how your earning will be determined:

If, for example, you are a type 1 member and choose the number 20, your number has a value of 440. If each of the other members of the group chose a number of 15, one number (of the other type 1 participant) will have the value of 330 and the other two numbers will have a value of 240 (for the type 2 participants), therefore the total result is 440+330+240+240=1250 EMUs. The cost of your chosen number is 20. As every member of the group receives the same proportion of the total result (25%), your payoff will be: 0.25*1250-20= 292.5 EMU

Comprehension questionnaire:

1. Suppose that you are a type 2 member and choose a number of 5, the value of your number is _______ and the cost of your chosen number is _______. Suppose that the other type 2 member have chosen the number 50 and each of the type 1 members

have chosen the number 20, the total result is _________, and your payoff is ____________.

2. Suppose that you are a type 1 member and choose a number of 2, the value of your number is _________ and the cost of your chosen number is _______. Suppose that the other type 1 member has chosen the number 149, one of the type 2 members has chosen the number of 5 and the other has chosen the number of 50, the total result is _________, and your payoff is____________.

The experiment:

The experiment includes the decision situation just described to you. You will be paid at the end of the experiment based on the decisions you make. After the instructions are read aloud and all the participants have understood it, the experiment will start. You will see the first screen where you should insert some digits of your ID number in the correspondent field. In the next screen you will be asked to insert a number between 0 and 250, if you press OK you can see the value and cost of the number as long as the proportion (25%) of the value of your number that you will receive. You can use the help screen to make simulations in relation to the number that you and the others could choose. As you don't know which number the other will choose. If you press "calculate" you can see the value and cost of each of these numbers for each type of player. You can also see the payoffs of your simulation when pressing "see calculations". If you press "Decision" you turn to the decision screen. Your final decision will be validate when you press the "continue" button. In the next screen you will know the total result and your payoff (EMU).

Thank you for your participation. After finishing the experiment please wait until be called to collect your payment.

Appendix B:

Other tables and figures

Table 6 – OLS regression results for heterogeneous teams

	All Subjects [1]	*High skilled Type [2]*	*Low skilled Type [3]*	*Equal Treatment [4]*	*Proportional Treatment [5]*
Proportional treatment	6.59 (4.28)	34.77 (7.52)***	-21.58 (3.24)***		
High skilled type	67.44 (4.28) ***			39.27 (5.20)***	100.5 (6.56)***
Round	-1.25 (0.78)	-1.57 (1.37)	-0.94 (0.59)	-1.05 (0.95)	-1.45 (1.14)
One-shot Round	3.34 (8.60)	-11.75 (15.10)	18.43 (6.50)***	2.46 (10.44)	4.22 (12.80)
Intercept	31.54 (5.72) ***	87.83 (9.31)***	42.69 (4.30)***	44.70 (6.45)***	223.54 (12.12)***
Observations	528	240	240	240	240
R^2 Overall	0.3277	0.0888	0.2233	0.1889	0.4994

The dependent variable is effort. Standard errors adjusted for group clusters are given in parentheses.***significant at 1%; **significant at 5%;*significant at 10%;

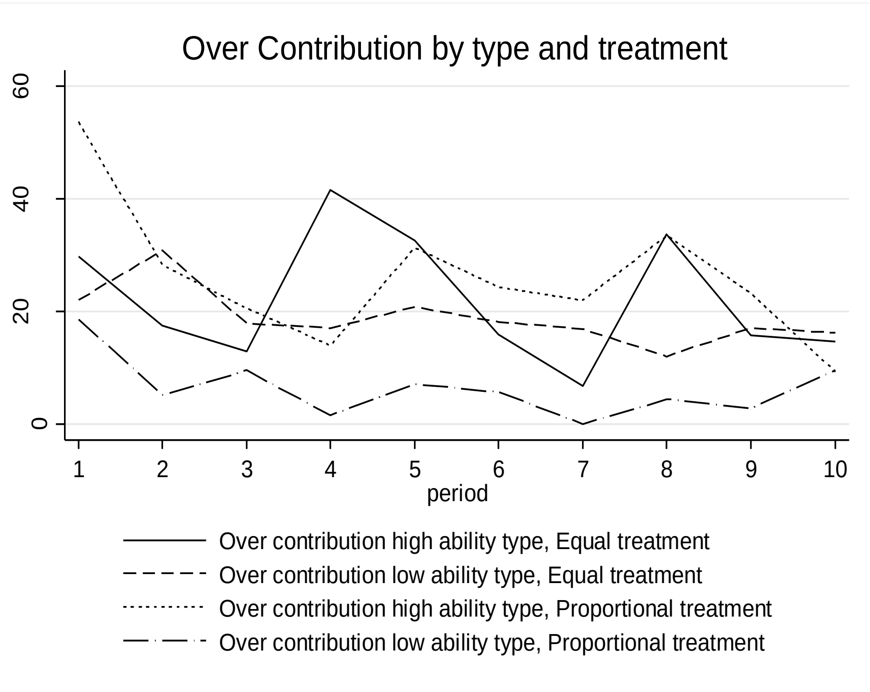

Fig. 5 - Average over-contribution

Chapter 4

Does Identity Affect Distribution Rules And Productivity Of Heterogeneous Teams? An experiment.”

1. Introduction

This paper examines experimentally how social identity affects distributional preferences and productivity of heterogeneous teams. The context studied is team production technology with self-management organization design and the heterogeneity focus is individual skills.

Self-management organization design implies that each collaborating party receives in return a share of the total output produced, and input contributions do not enter into the compensation function (no monitoring).

The relevance of this study is justified by the proliferation of production set ups with output based compensation practices (workers cooperatives, partnerships, self-managed production teams, profit sharing scheme, etc) even though standard economic theory predicts inefficiencies in these organization designs due to free riding behavior (Alchian and Demsetz, 1972; Holmstrom, 1982).

Self-managed teams have grown rapidly in popularity following their introduction in the 1960s along with the idea that teamwork is a key to productivity. In the 1980’s in the United Kingdom and United States alone almost 50 per cent of companies were using self-managed work teams within their organizational structure (Huczynski and Buchanan, 1985). This percentage grows to around 70 percent of companies in the Fortune 1000 and to 81 percent of US manufacturing companies in the 1990’s (Lawler et al., 1995). Because of their widespread use, research has been devoted to analyze how to increase productivity. However, little is known about output distributional rules among group members with different skills, in production settings with team production technology and self-management organization design.

This article aims to bridge this gap by answering three research questions: (1) What are the individual distributional preferences when they interact in an heterogeneous group? (2) Does induced group identity with communication change these preferences? (3) Does induced group identity affect effort supply and wealth creation?

Distributional preferences show up as individual or team sharing rule decisions that determine how joint output is allocated among them. By group identity we mean that individuals actions when collaborating in production consider the benefit of the group instead of self-benefit. An individual that is identified with the team cares about the wellbeing of other group members when making some actions. Finally, wealth creation is measured as the difference between the value of production and the inputs total opportunity costs.

Having heterogeneous inputs into the same team production technology makes sense, because it takes advantage of the combination of different backgrounds and experiences of team members (Hamilton, 2003, 2004; Lazear, 1998; Farrel and Scotchmer, 1988). Consider, for example, the range of abilities in university' research groups or in medical and lawyer partnerships. Deciding upon a distributional rule that doesn't damage personal relations and work motivation is a social and economic dilemma. Social identity and social preferences can play a determinant role in mitigate these conflicts. Nonetheless, research on the effects of social identity in redistribution in a team production setting has been scant.

To answer our research questions, we design a non-real effort experiment with two treatments, in the first no interaction is allowed, in the second identity is manufactured in a pre-stage game and communication is allowed in the first stage of a two-stage game. We induce identity as in Chen and Li (2009), where participants, randomly matched in different group colors, discuss for about 10 minutes which author, Picasso or Dali, painted some pictures we showed painted by them.

The game is the same in both treatments. Groups, composed by individuals that differ in skills, have to decide how to distribute the team production in a first stage, by simple majority rule, and make their contributions in a second stage. In the first stage they are given three options: an equal distribution rule; the second best sharing rule, which is proportional to members' skills and a median sharing rule that weights equal sharing and wealth maximization criteria, i.e. gives part to needs and part to skills. Therefore, the first treatment allows us to understand individual and team's level of preferences for equality. The second treatment allows us to study the effect of induced identity on those preferences.

Our results provide clear answers for our research questions. We show that: (1) when no interaction is allowed, individuals show selfish behavior in their choice of the sharing rule so that individuals with high (low) skills choose in higher proportion the second best (egalitarian) sharing rule that benefits them the most. (2) We find that communication and group identity formation changes distributional preferences favoring a more egalitarian sharing rule among the high skilled individuals. (3) Communication-group identity increases the effort contribution of low skilled individuals in equal sharing groups, with respect to those without group identity, but do not affect the input contributions of high skilled individuals, also compared with the contribution without identity.

Most of the research on team incentives considers symmetric members where equal sharing is common practice.(see for example Encinosa, et al., 2007, Farrel and Scotchmer, 1988). However, in teams composed by members who differ in skills or productivities, a distributional rule proportional to members' skills should be used to increase productivity (Chapter 3).

Some reasons for this apparent paradox are connected to theories of justice that incorporate a concern for the well-being of the least well-off members of the society. Examples are Rawlsian preferences for equality or the need principle, which calls for the equal satisfaction of the basic needs (see Konow, 2003 for an extensive review on theories of justice). Other reasons are connected with difference aversion theories supported by experimental evidence that suggests that some individuals dislike inequitable outcomes (Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000; Charness and Rabin, 2002) or fairness considerations (Akerlof and Yellen 1990). However, most of the difference aversion experiments consider homogenous subjects and/or equal split.

Social identity is considered a phenomenon that prompts actions that favour the group instead of self-maximization (Tajfel and Turner, 1979, Ashforth et al, 1989; Akerlof and Kranton 2000, 2005, 2008; Eckel and Grossman (2005); Chen and Li, 2009; Klor and Shayo, 2010). According to the social identity theory, if individuals are identified with the group they belong to, they will take actions that are congruent to the prescribed behaviour for the group, even if those actions depart from self-maximization and imply a monetary loss. However, group identity experiments mainly focus on ingroup versus outgroup interactions.

The results of this experiment show that communication and identity do not change the total wealth creation in production; the change towards more egalitarian output sharing rules induced by identity is followed up by an input contribution behavior that neutralizes the potential effects of more equal sharing rules in wealth created.

Our findings suggest that if individual get an intangible payoff from more egalitarian sharing rules then equal sharing rules increase welfare as the intangible payoff is at no cost from efficiency lost.

This paper contributes to management and economic literature by taking a novel approach that combines the social identity and the social preferences streams of research in a team production technology setting that allows for diversity.

The rest of the paper is organized as follows. Section II reviews the experimental literature on social identity. Following, section III described the experimental design along with its implementation. In section IV our hypotheses and conjectures on results are presented and our experimental results are described in section V. Section VI offers a discussion of our findings and a conclusion.

I. Social Identity Research in Experimental Economics

There are a growing number of economic experiments suggesting that natural group identity increase ingroup favoritism, which increases altruism and cooperation (Bernhard el al., 2006; Goette et al., 2006).

The study that more relates to ours is Chen and Li (2009), as also connect social preferences and social identity theories, Their results suggest that in allocation games induced social identity increases altruism and charity concerns towards members of their own group, decrease envy as well as increases the odds that individuals choose social welfare maximizing actions. Our experiment has clear differences from theirs. First, our setting is set to represent organizations, specifically self-managed teams, where individual profits are not directly comparable as contributions are not observable; Second, we allow subjects to vote on the distribution rule, which in turn will derive the payoffs; Third, and more importantly, we focus on members with heterogeneous skills; and finally we do not use ingroup/outgroup comparison, mainly due to our experimental setting.

Eckel and Grossman (2005), find that induced team identity in a repeated public good game increases cooperation limiting the individual free-riding problem normally observed in team games. However, once again, they focus on homogeneous subjects and use an equal distributional rule given exogenously.

Another study on social identity that is related to our work is Klor and Shayo (2010) minimal group experiment on the effect of social identity on preferences over distribution. They analyze the voting decisions on redistribution of tax regimes of two distinct natural groups that are randomly assigned gross incomes, majority rules. They find that in many cases, individuals forego monetary payoffs and vote for the tax rate that benefits their own group.

Therefore, this article differentiates from previous experimental evidence on social identity as it studies heterogeneous teams' behavior, both in terms of redistribution and effort decisions. Moreover, our analysis does not focus only on the effects of identity on distribution rules but also on efficiency considerations. Next, we present a theoretical explanation for teams' distributional rules, based on social identity, which we then test experimentally.

II. Experimental design and implementation

The goal of the experiment is to obtain evidence on whether distributional concerns and social preferences influence the behavior of people so that this behavior departs from the predicted one under the assumption that individuals are selfish and social concerns do not matter in production environments. If the observed behavior and performance departs from the benchmark (chapter 2) then we will examine if the departure is consistent with the predictions under the assumption that group identity and social preferences do indeed influence the effort decisions of group members in self-managed, output-sharing, organizational designs.

The experiment consists in a two-stage decision process where first individuals decide on how they will share the output from production and next they decide on the effort contribution. The two stages decision process is repeated, one time without identity treatment (VT) and the other time after the identity treatment (IT).

Along the experiment each production group will have five members, N=5. Three of the members are high skilled and two low skilled. Each group member has a vote and the output sharing rule is decided my secret majority voting. The level of skills for each of the high and for each of the low skilled individuals is the same so in terms of payoffs this symmetry implies that each high and each low skilled individual will expect the same payoff once the sharing rule is decided. Therefore all else equal in the choice of the sharing rule there is a natural majority of high skilled individuals whose interests should determine the chosen rule.

A. Experimental parameters

The production technology $F(q,a)$ and the opportunity cost functions $C_i(q_i a_i)$ are as described in the chapter 2. For the experimental implementation and Nash equilibrium predictions, the team production component of the technology, $k_i(\ )$ is given by the following expression:

$$k_i(q_i, q_{-i}) = q_i^{1/2}\left(q_i^{1/4} \prod_{i \neq 1} q_{-i}^{1/4}\right), \ (q_i;q_{-i})>1 \qquad (1)$$

The distinction between high and low skilled individuals implies is instrumented by setting q_{high}=10, for each of the three high skilled group members, and q_{low}=5 for each of the two low skilled members, in all the experiments.

Taking into account the general output sharing rule introduced above, the payoff of individual i is given by:

$$\pi_i = \left((1-\alpha)S_i^* + \alpha/5\right)\sum_i^5 k_i a_i - a_i^2/2q_i, \qquad (2)$$

With $\alpha \, \epsilon[0,1]$ and $k_{high\ skilled}$=24 and $k_{low\ skilled}$=17, for the functional form and selected q values.

The three proposed sharing rules the group members will vote on imply different values of parameter α that captures the weight given to the egalitarian sharing rule, α=1 (equal sharing), α=0, only efficiency matters (second best) and α=1/2, half and half. The solution for the Nash equilibrium that will serve as benchmark for comparing the results of the experiment for the three sharing rules requires first solving for the second best sharing rule, S_i^*. Following the solution process described in Chapter 2, the second best solution is $S{*}_i^H$=0.30, $S{*}_i^L$=0.05. This implies that under option A, equal sharing, S_i=1/5, the same for all members; under option B, what we call median proportional, S_i^H=0.25 for each of the high skilled subjects and S_i^L=0.125 for each low skilled subjects; and under option C, second best shares, S_i^H=0.30 for each of the high skilled subjects and S_i^L=0.05 for each low skilled ones. Table 1 summarizes the experimental parameters.

Table 1: Experimental parameters

Parameters	
Skill of high types	10
Skill of low types	5
k (value of number) high types	24
k (value of number) low types	17
Cost high	$a_i^2/20$
Cost low	$a_i^2/10$
Option A	20%
Option B - high skilled	25%
Option B - low skilled	12.5%
Option C - high skilled	30%
Option C - low skilled	5%

Table 2: Experimental predictions

Predictions			
	Equal Sharing	Median Proportional	Second Best
Nash Equilibrium effort			
High	48	60	72
Low	17	11	4
Expected payoff			
High	692	994	1337
Low	778	575	265
Total team profit	3631	4130	4540
Efficient effort			
High	240		
Low	85		
Team wealth	10085		

As expected, the Nash equilibriums for the output sharing self-managed organizations give lower welfare and lower input contributions than the first best. The second best is, by construction, the sharing rule with higher payoff. As we move from equal sharing to second best the high (low) skilled members contribute with higher (lower) input to joint production. Under the equal sharing low skilled get high pay off than high skilled even though the former contribute with lower input to production than the latter. If the correlation between input contribution and pay off is taken as an indication of fairness then the proportional and the second best sharing rules would be consider fairer than equal sharing. Equal output sharing is the sharing rule with more equal pay off for high and for high skilled individuals, while the second best sharing rule is the one giving less egalitarian outcome.

B. Experimental treatments and implementation

i) Treatments

As mentioned the experiment is designed to understand the effects of identity on subjects distributional preferences and on team efficiency taking into consideration the setup described previously. Thus, it has two treatments: the *voting treatment*, henceforward VT, where no interaction is allowed and the *identity* treatment, henceforward IDT, where the structure is similar to the VT but identity is manufactured in a pre-stage and communication allowed in the voting stage. We discuss in detail the design choices for induce identity in a separate subsection ahead. The VT is designed to help us understand the distribution preferences of members when there is no social interaction and serve as a control treatment to compare individual and group behavior under the IDT.

We divide the treatments in two settings: the one shot setting, where subjects vote and make decisions on effort in one round; and the 10 rounds setting, where subjects play the vote stage just in the first round and make decisions on effort for 10 rounds. The 10 rounds setting is partner matching. This division was based on two concerns. First, the one-shot setting will allow us to study distributional preferences without reputation and reciprocity considerations. On the other hand, a repetition of the contribution stage is important to form a higher degree of group cohesion and allow for "long-term" interaction. Therefore, the one-shot setting and the first round of the ten-rounds setting allow us to compare individual distributional preferences when matched with a group just for one time and when matched for ten rounds.

At the end of each session subjects fulfill a questionnaire were in addition to some demographic questions, they are asked about the level of fairness of the sharing rule decided by the group, their level of group attachment during the experiment and the effect of communication on voting and effort decisions. In the VT we omit from their questionnaire questions related with communication.

i) Implementation and Information conditions

As being a non-real effort experiment expressions like effort and cost of effort are substituted by expressions like number and cost of number and high and low skilled types are substituted by type 1 and type 2 subjects. In both treatments the instructions are read aloud[20]. Subjects are told that they will play the game for one round and that they will be randomly matched with four other subjects from the room, the group being composed by three type 1 (high skilled) subjects and two type 2 (low skilled) subjects and that they will be randomly selected to be type 1 or type 2 subjects but do no information about the identity of the other members of the group will be given. In the VT they are told that no interaction is allowed. They are told that they have to choose a number between 0 to 250[21], which has a cost and a value. Along with the instructions they are given cost tables where they can find the value and the cost correspondent to each of the possible numbers. Their payoffs are explained as being a proportion of the sum of the values of the numbers chosen by the five members of the group less the individual cost of the number. They are told that this proportion is decided on a first stage, majority rules, from a set of three options (A, B and C) and that if there is a tie the distribution rule will be determined randomly. After subjects fulfill some comprehension questions the team game starts. At the end of each round, subjects are informed about the sum of the value of the numbers of the group (team revenue) and their individual profit. No information is given about the numbers chosen (effort) by the others members of the group.

After the individual profit is displayed on the screen, they are told that the first part of the experiment is over and that their earnings in this part will be added to the gains in the second part. After receiving additional instructions for the second part subjects are randomly selected to be type 1 or type 2 and randomly matched to a different group that stays fixed for the 10 rounds (partner matching). They are told that they will play the same game but the decision number stage is repeated for 10 rounds under the distributional rule decided in the first round.

[20] Instructions in English for the identity treatment are in appendix A. Instructions in Spanish and cost tables are available upon request.
[21] They can use a help screen to make simulation of results for each of the sharing rules in the first stage and for the voted sharing rule in the second stage.

In the *IDT*, after subjects are randomly matched to a group color: Blue, Red, Yellow, Green and Fuchsia, participants observe a screen with eight painting pictures, four identified as being from Picasso and four from Dali. In a following screen, they observe two other pictures from the same artists but not identified, and they have to answer which artist painted those pictures. Although the answers are individual, subjects can communicate, through chat with the members of their group to give the correct answers. They earn a small amount of money for each of the correct answers. To the chat, members are identified by the group color and a number (for example Blue 3), however, they cannot further identify themselves or use inappropriate language. In a second part, they have to choose the sharing rule and can also communicate to decide the best option to vote. As in the VT, they just know what the majority voted, not individual choices and they cannot discuss the voting results, i.e. no communication is permitted after the result of voting. The third part is equal to the VT and no communication is allowed. Subjects play the one shot setting first and the 10 rounds setting afterwards, where they are randomly matched to another group color, which stays fix for the 10 rounds; play the pictures stage with different pictures from the same artists; communicate to vote only in the first round and make effort decisions for the 10 rounds under the same distributional rule decided in the voting stage.

ii) **Design discussion**

A couple of discussions relative to the experimental design are in order. The first is related to the process of enhancing group identity in the IDT. Manufacturing group identity in the laboratory is not a straightforward task. For this reason, we combine several actions, from week to strong identity, that have proved to produce group effects in previous experiments. Eckel and Grossman (2005) used several treatments to manufacture identity, between them assignation of subjects to a group color and participation on a group task before a team game experiment with face-to-face interaction. Although previous experimental evidence indicates that a simple assignment of subjects to a certain group by color or painting preferences produce the same group effects than random assignment, combining this treatment with a pre-game task with communication has produced strong group effects (Eckel and Grossman, 2005; Chen and Li, 2009). Therefore, in our experiment firstly, subjects are randomly matched to five different group colors and secondly, we use the same pre-game painting task with chat as in Chen and Li (2009). Although face-to-face treatments could create a higher sense of identity than communication through chat, it could also lead to many confounding and uncontrolled effects (Roth, 1995), therefore, we opt for communication through chat. Thirdly, we allow for communication in the voting stage for ten minutes. Social psychology experiments have shown that the most effective way for manipulate identity in experiments is by allowing discussion of the group dilemma (Orbell et al., 1988; Dawes et al., 1986; 1990; Brickman, 1987; Kerr and Kaufman-Gilliland, 1994). Although minimal group experiments, where subjects have to make decision concerning members of their own group (ingroup) and/or members from other group (outgroup), have shown that even a merely random matching induces to ingroup favoritism (Tajtel and Turne, 1979, Orbell et al., 1988) find that without discussion of the dilemma these effects are minimal. Furthermore, the analysis of the content of the messages can help us understand the effects of identity and communication in individual and group behavior. To further evaluate the effects of identity we adapt the Chen and Li (2009) final questionnaire to our setting. This will allow us to understand fairness consideration and to what extend group attachment and discussion of the group dilemma influenced participants' decisions.

III. Hypotheses

The experiment is designed to understand teams' decision making and test the validity of our theoretical explanation. Next we present the null hypothesis and our conjectures on results.

i) **Hypotheses:** Voting treatment

Hypothesis 1a: High skilled members vote for the second best sharing rule

Hypothesis 1b: Low skilled members vote for the equal sharing rule.

Assuming standard economic preferences, it is a dominant strategy for more productive members to choose second best sharing rules (α=0 in equation 1 and 2), whereas it is a dominant strategy for less productive members to choose equal sharing rules (α=1) since it maximizes their utility. Therefore, our null hypotheses are that the majority of individuals will show self-interest behavior. We do not expect to reject these hypotheses.

Hypothesis 2: In majority high skilled teams, the most voted sharing rule is the second best sharing rule.

i) Hypotheses: Effect of Identity

Hypothesis 3: Identity does not affect subjects' distributional preferences.

According to the standard economic theory, individuals are self-interested and identity should not have an impact on their decisions. However, following the theoretical argument of chapter 2 that preferences can be changed by the creation and manipulation of the social categories and prescription**s** we conjecture that induced identity will affect individuals decision on efforts. Therefore, we expect to reject this hypothesis.

Hypothesis 4: Identity does not affect teams' distributional rules. Thus, in majority high skilled teams, the most voted sharing rule is the second best sharing.

Following hypothesis 3, with or without induced identity teams composed by majority high skilled members will chose second best sharing rules.

Hypothesis 5a: Identity does not increases effort levels of high skilled players.

Hypothesis 5b: Identity does not increase effort levels of low skilled players.

According to the standard economic theory induced identity should not influence effort decisions. However, there is previous experimental evidence indicating that identity increases the effort level of team members (Eckel and Grossman, 2005) Additionally, a number of experiments provide evidence that communication increases cooperation (Farrel, 1995; Crawford, 1998; Blume and Ortmann, 2007).

Hypothesis 6: Identity does not increase team efficiency.

Following hypotheses 5, induced identity should not increase team efficiency. Nevertheless, as we conjecture that identity increase effort levels it should also increase efficiency. Thus, we expect to reject this hypothesis.

IV. Results

A total of 100 subjects were recruited from undergraduate courses in several disciplines (economics, literature, business, sociology, etc) by Orsee recruitment software at Universitat Autonoma de Barcelona. The experiment was designed in Z-tree software and lasted around 2 hours on average. All subjects received a 5€ participation fee and earn, on average, 14€ per subject. We conducted four sessions: one session per treatment in June 2011, and repeated both sessions in November 2011.

We first present the voting results analyzing team's distributional preferences and the effect of identity in those preferences. We then analyze the effect of voting decisions and induced identity on contributions and team efficiency. Following this, communication and post-experimental questionnaire analyses are presented.

A. Voting results

1) Individual distributional preferences

In this section we analyze the team voting decisions. Recall that participants could vote for option A, equal sharing; option B, median proportional or on option C, second best sharing rule. Each subject voted twice in each session, in the one shot setting and in the first round of the 10 rounds setting. As we do not find significant differences on voting decisions between the two settings (U-test p= 0.8474) we use both in the results report.

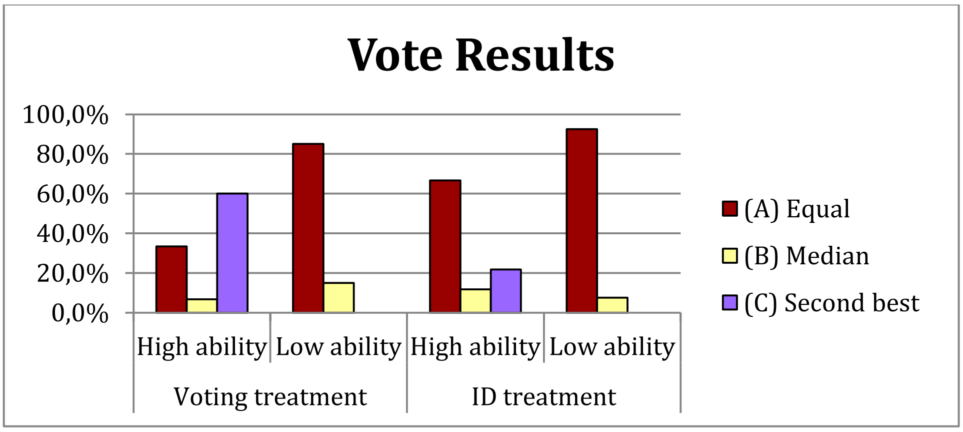

Figure 1. Percentage of votes by treatment and type

Figure 1 shows the voting decisions per type and treatment. It can be seen that in the VT 60 percent of the high skilled players vote for the second best (option C), 33 percent voted for the equal share (75 percent being females) and 7 percent voted for the median share; 85 percent of the low skilled participants vote for the equal sharing rule, 13 percent voted in the median share (all males) and only 2 percent voted in the second best.

Therefore, we observe that subjects exhibit standard economic preferences and make their decisions according to their dominant strategy. While the majority of high skilled members vote for the second best sharing rule (binomial test α=0.5, p= 0.077), the majority of low skilled members vote for the equal sharing rule (binomial test α=0.5, p= 0. 0.000) [22]. As expected we cannot reject hypothesis 1a or 1b that members prefer the compensation scheme that gives them better monetary payoffs.

Although these results are in line with our conjectures, we find a considerable number of high skilled subjects voting for equal sharing (33 percent) in the VT and heterogeneity on individual preferences. According to our theoretical explanation, in the groups test in the experiments, there are 67 percent of subjects whose identity (I_i) reflects self-interest, equity or social welfare concerns and 33 percent whose identity reflect preferences for equality, concern for the least well off or even advantage aversion[23] a la Fehr and Schmidt (1999). In what concerns the low skilled subjects, the high majority shows self-interest, equality concerns or disadvantage aversion. Nevertheless, we find 13 percent of subjects preferring the mix sharing rule, indicating some equity or social welfare concern. Although is quite difficult to disentangle the reasons behind the voting decisions, as one or all these reasons could be behind subjects decisions, the results support our theory that individuals level of egalitarianism depend of their personal identities, which can be quite heterogeneous taking in account the different social categories an individual might belong to (e.g. being a woman, a mother, a sports fan, a lawyer, an ecological activist, etc) and the different past experiments that form each individual in an unique personality. On the other hand, we have assumed that fairness considerations are context depend. Fehr and Schmidt (1999) argue that in an experimental context, individuals enter at the laboratory as equals, without knowing anything about each other and are given random roles. Because of that subjects could consider an egalitarian outcome as equitable. The post-questionnaire analysis ahead could give us some insights on this phenomenon. We then came back to this point.

Our results are in line with experiments on democratic choice of institutions as in Balafoutas et al. (2013). They use a sharing rule a la Sen (1966) in a public group experiment where three different subjects with different initial endowments have to vote on their preferred level of redistribution in each period, from equal to

[22] Fisher test confirms the significance of the results. .
[23] Individuals that would like to minimize differences in utility

proportional. Although this experiment is not directly comparable with ours, as in each period contributions are observable and voting is repeated, it is the closest experiment in the literature. Similar to our results, they find that the high majority of high endowment subjects prefer proportional and low endowment participants prefer more equal distributions. They also find that a few percentage of subjects deviate from selfish preferences. They attribute this behavior to inequality aversion motives. Nevertheless, in our context, where contributions are not observable and the proportional sharing rule is not on effort but on skills, inequality aversion is hardly probable to be the case. According to Mohnen et al. (2008), when contributions are not observable after each period (they called the nontransparent case), inequality aversion does not alter equilibrium levels of effort when compared to the case where individuals are purely selfish.

An interesting and clear result of the VT is the significant effect of gender in voting decisions (the gender coefficient is highly significant in a logit regression analysis - table 6 in appendix C). We find that 75 percent of the high skilled subjects that vote for equality were females. This is an indicator that belonging to other social categories matter for distribution preferences. This result contradict Balafoutas et al. (2013) as they do not find support for the effect of individual preferences on voting and find no significant differences in voting behavior of females. They argue that voting is only directly affected by their earning,

In the IDT we observe a significant difference in the voting decisions of high skilled members in comparison to the VT (Mann-Whitney test, p= 0.0003). We find that the percentage of votes in equal share increases from 33 percent in the VT to 67 percent on the IDT. However, we do not find a significant effect of identity on low skilled distributional preferences (Mann-Whitney test, p=0.2915). Therefore, we can only partial reject hypothesis 3.

While in the **VT** the proportion of self-interested[24] is 70 percent and the egalitarians[25] are just 20 percent, in the IDT the percentage of self-interested decreased by 29 percent (U-test, p=0.0040) and the percentage of egalitarians increased 50 percent (U-test, p= 0.0021).

Our theoretical explanation suggests that individuals can be affected by social identity. We consider that in the IDT the induced identity could have manipulated or

[24] Subjects that choose the sharing rule that lead them to a better payoff.
[25] High skilled that vote for equal sharing even decreasing their own economic wellbeing

even changed the prescribed behavior (**P**) for the team (**c_i**) and therefore affected individuals revealed preferences. Consider for example, a high skilled individual that had equity preferences but due to social interaction with the group, in the pictures stage and/or in the voting stage chat, changed her reveled preferences towards equality. The reason behind this decision is connected with the behavior she considers ideal (**P**)**,** or because is the social correct action, or because she became altruist towards her teammates or even because an implicit norm of equality emerged on the group. The communication and the pos-questionnaire analysis in appendix B and D could help to understand behavior under induced identity.

Our results on the effects of social identity are consistent to Chen and Li (2009) and Klor and Shayo (2010) in the sense that it seems to increase charity concerns for the least well off even at expense of monetary compensation. However, our findings contradict their results and the SIT (Tajfel and Turner, 1979) as it fails to induce social welfare-maximizing actions in favor of self-interest actions. Considering that induced identity should lead subjects to take non-selfish actions in favor of the group welfare, we expected to find a higher and considerable number of low skilled subjects choosing second best sharing rule or at least median sharing as the second best create a great amount of dispersion. However, this is not the case. It seems that in this setting, induced identity only induce to equality. It could be the case that this happens because there is a majority of high skilled members on the team. It would be interesting to analyze the effect of identity on majority low skilled teams.

2) Teams' distribution rules.

Figure 2 summarizes the voting results per groups. Interestingly, in the VT, the most voted sharing rule was the equal sharing with 11 out of 20 groups (55%) voting for it. There were 3 groups (15%) where the median share was chosen to be the distributional rule (determined randomly in two of them due to a tie) and there were 6 groups (30%) where the majority voted for the proportional sharing rule. We can reject hypothesis 2 that in teams mostly composed by high skilled members, the most voted sharing rule is the second best (binomial test, α=0.5, p= 0.058).

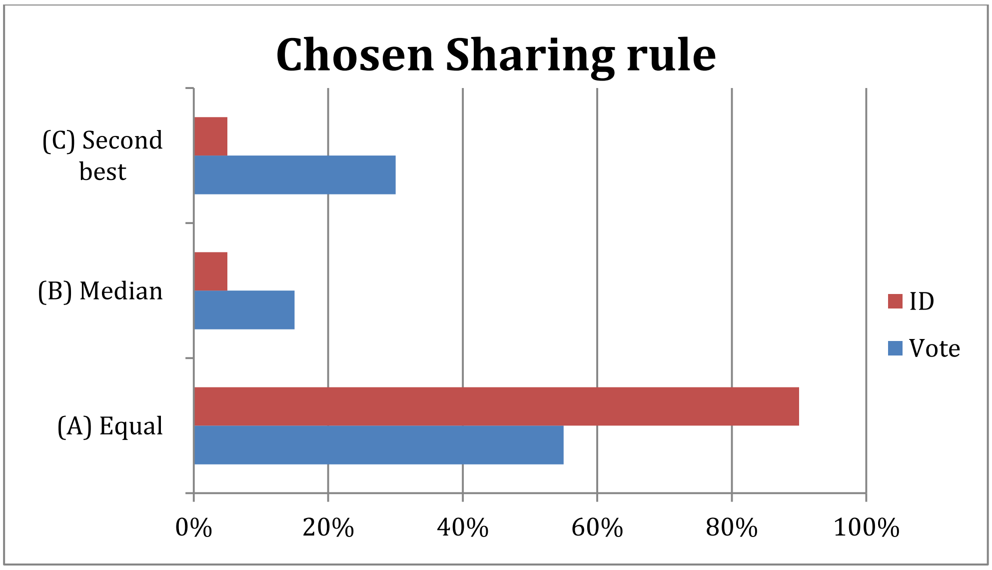

Figure 2: Group vote results

This is an unexpected result. Considering that only 33 percent of the high skilled subjects voted for the equal sharing. We consider that this is an effect of the low majority rule of the voting procedure. As the less skilled subjects vote strongly in favor of the equal sharing, in 50 percent of the teams at least one high skilled member had to vote for equal sharing. In a more detailed analysis, we find that in the VT the majority of groups reaches a decision by low majority (3 members) and that reaching a consensus is quite rare. In the cases where the team chose an equal distribution the decision was made by a low majority of two low skilled and one high skilled subject. The votes of low skilled on median share where in groups where the majority of high skilled vote for second best. With identity most of the group decisions were made by consensus or high majority (consensus of four members).

With identity, about 77 percent of the participants voted in the equal sharing, 13 percent voted in the proportional share and 10 percent voted in median share. Consequently, there was a significant increase of groups using equal compensation schemes (90 percent) (Mann-Whitney test, p=0.000). The percentage of groups that decide to perform under the second best distribution rule decreases by 100 percent (Mann-Whitney test, p=0.000) as the group performed under this compensation scheme was decided randomly due to a tie in the one shot setting. Therefore, as expected, we can reject hypothesis 4 that identity does not affect team's distributional rules[26].

[26] In appendix C regression analysis for voting decisions are presented.

Observation 1: Without social interaction, in majority high skilled teams, a low majority of groups (55%) decide to use equal sharing rules. With identity almost all groups (90%) decide to perform under an equal distribution rule. Therefore, team identity is a plausible explanation for the use of equal distributions in heterogeneous self-managed teams.

With group identity, and given the possibility of communication, we would expect a group norm to emerge accordingly to on the team objectives. If the team seeks a higher creation of wealth they would choose second best sharing rules (α=0), if the teams decides it is important to give part to need and part to skills, would choose an α=0.5. And if the team prefers to minimize differences in utility, even with a loss on wealth creation, would choose and α close to 1. However, an equal sharing (α=1) will minimize differences in utilities only if members have identical cost. In the case of heterogeneous teams on skills, where costs on effort are different, the minimal α^* is lower than 1 even for a difference aversion team. Notwithstanding, as we saw in the previous chapter the majority of teams decided for an equal sharing which damages team efficiency. Therefore, we would expect contribution to increase to a threshold that suppresses the efficiency damage that arises with the equal sharing rule.

B. Effort levels

In this section we analyze the effect that the voting decisions and identity have on actual contributions. In the VT we find that the majority of high skilled members exhibit standard economic preferences, i.e. choose second best sharing rules, however, the majority of groups chose an equal output sharing. On the other hand, identity induces high skilled subjects to choose more equal sharing rules. Next we analyze the effect of group decisions on subsequent individual contributions.

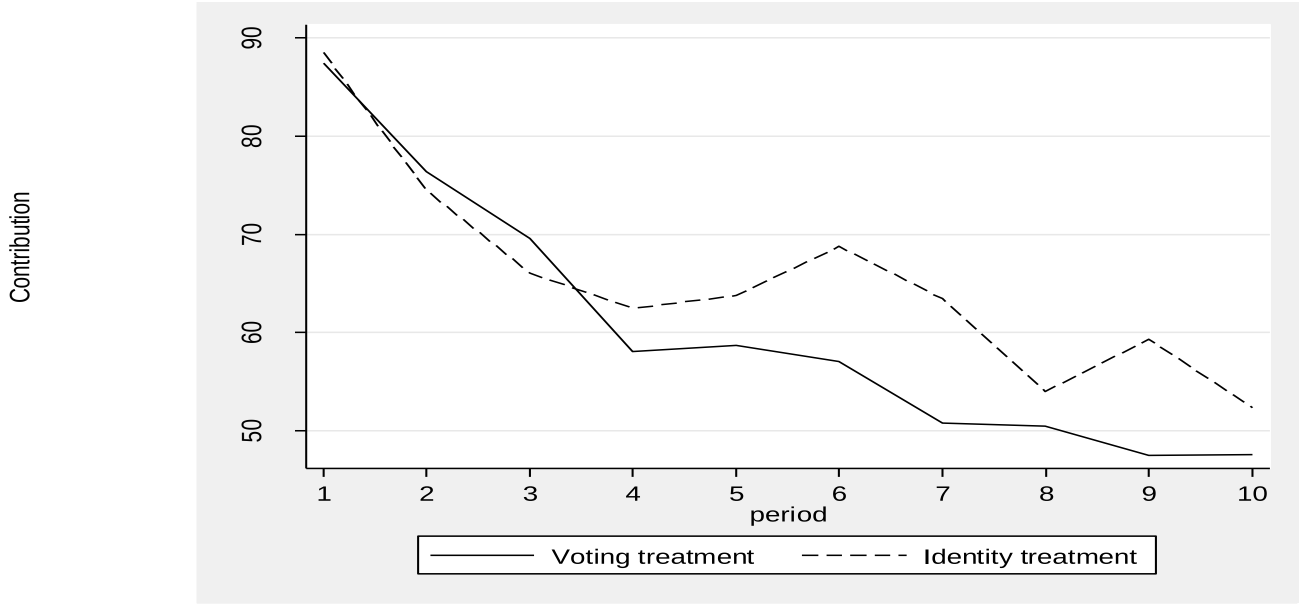

Figure 3a: Overall contribution by treatment

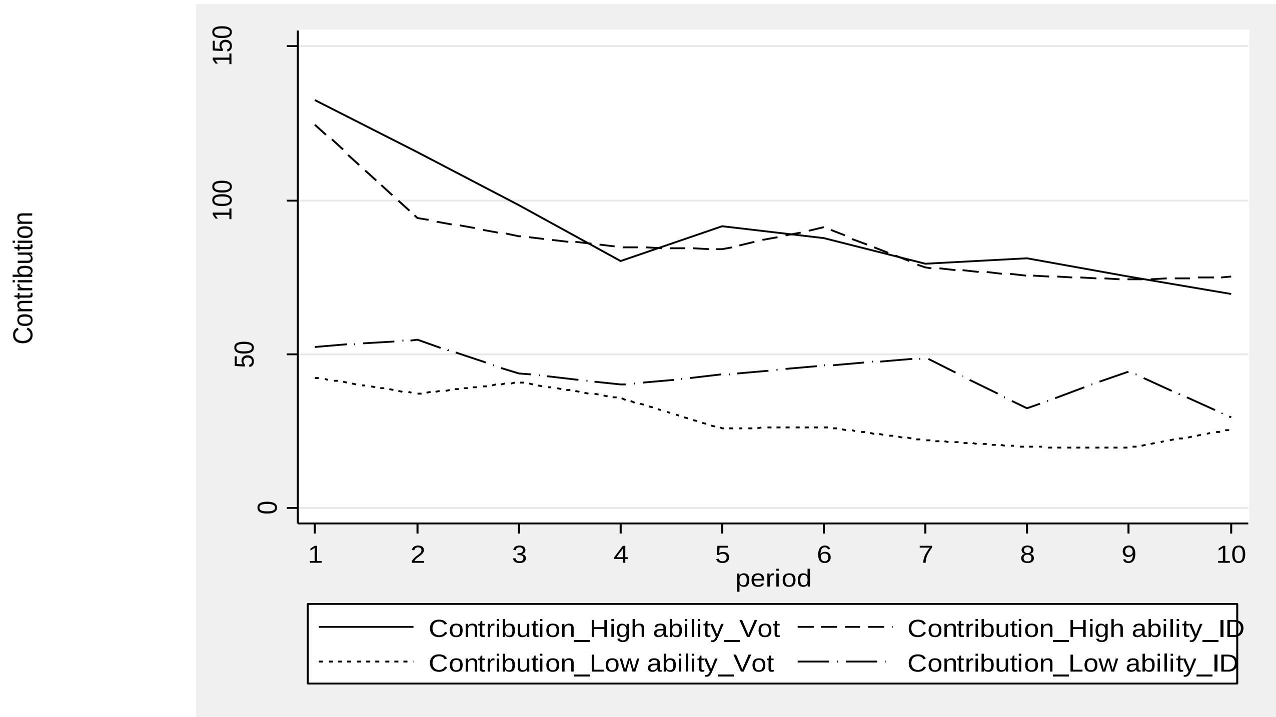

Figure 3b: Contribution by type and treatment.

Figure 3a shows the average contribution for each treatment[27]. It can be seen that contributions decrease over time (regression analysis in table 7, indicates a decreasing trend). It is clear that identity slightly increase effort decisions, however not significantly (Man-Whitney test, p=0.1736). Consequently, we do not find differences in individual profit (Utest, p=0.4497) or in the total team revenue (Utest, p=0.9988). Figure 3b shows contribution by type of subjects, as we can observe, there are no significant differences in contribution levels of high skilled members (Utest, p=0.6501), however, identity increases effort levels of low skilled members (Utest, p= 0.0025). Therefore, we cannot reject hypothesis 5a but we can reject hypothesis 5b. Moreover we fail to reject hypothesis 6 that identity increase team efficiency.

Observation 2: Team identity does not increase the effort levels of high skilled members in teams with a heterogeneous composition, but increases contribution of low skilled types.

This is result contradicts previous experimental evidence with identical members and equal split, where induced identity increases cooperation (Eckel and Grossman, 2005) as well as communication (Farrel, 1995; Crawford, 1998; Blume and Ortman, 2007; Bornstein et al., 1989; Brosig et al., 2003)

The effect of the different sharing rules decided by the group is each treatment is interesting to analyze, however, we do not have enough data to drive robust conclusions, as the high majority of groups decided to perform under an equal sharing rule. Therefore, we next analyze effort decisions under equal sharing rule. Nevertheless, we find some interesting results, which are reported in another version of the working paper for the interested reader.

i. Effort decisions under equal distribution rule.

Table 3 shows the predicted and average effort by treatment, analyzing differences according to members' individual voting decisions. The first two columns give the total average effort (predicted effort in brackets). The columns three to eight give the

[27] The data used to effort analysis is the ten rounds setting. Although we do not find statistical differences between the one-shot setting and the first round of the ten rounds setting in any of the analysis presented here, we consider more precise to present the results referent only to the ten rounds setting as the trend over time is worth of analysis.

average effort according to subjects voting decisions and column nine reports average effort when members do not have the option for voting (Chapter 3).

We can observe that both types of subjects exert an effort higher than predicted (Wilcoxon test p=0.0033 for both). More interesting, we find that with identity and an equal sharing rule the high skilled members decrease their effort levels, although not significantly (Man-Whitney test p= 0.4057) while low skilled members increase it significantly (Man-Whitney test p= 0.0126).

Table 3: Average effort by type and vote decisions

	Average effort Equal Sharing								
			(vote=equal)		(vote=median)		(vote=Second best)		Marreiros (2010)
	VOT	ID	VOT	ID	VOT	ID	VOT	ID	No vote
High members	77(48)	71	86*	76	n/a	86	63**	41	78
Low members	33**(17)	45	35*	46	15	18	n/a	n/a	39**

These results have an interesting effect on individual payoffs. While the high skilled members increase their individual payoff with identity (Man-Whitney test p=0.0284), the low skilled decrease it (Man-Whitney test p=0.0413). Figure 4a shows that in the VT and an equal sharing rule the low skilled members receive a higher individual payoff than their high skilled team mates (Wilcoxon text p= 0.0051), figure 4b shows that in the IDT the profit of high and low skilled are not significant different (Wilcoxon text p= 0.5751). Therefore, under an equal sharing rule, identity decreases dispersion on efforts and on individual payoffs (Mann Whitney test, p=0.0064; p=0.0197 respectively).

In what efficiency is concerned, we do not find that identity increases team efficiency under an equal sharing rule (Mann Whitney test, p=0.5453). Therefore we cannot reject hypothesis 6.

Observation 3: Under an equal sharing rule, identity does not increase team efficiency but equalizes individual profits

As identity leads to the majority of the groups deciding for an equal compensation scheme but not all members vote for it, we analyze individuals behavior when they vote for the sharing rule that ends up being the distributional rule decided by the group and when they did not. When the distribution rule decided by the group was the equal sharing and low skilled members vote for it, identity increases their effort level when compared to the VT (Mann-Whitney test: p=0.0527). However, surprisingly, we can observe that identity has a negative effect on high skilled members' effort levels. When they vote for the equal sharing and this is the sharing rule decided by the group, identity decreases contributions when compared to the VT (Mann-Whitney test, p= 0.0821). Regression analysis on individual effort confirms these findings.

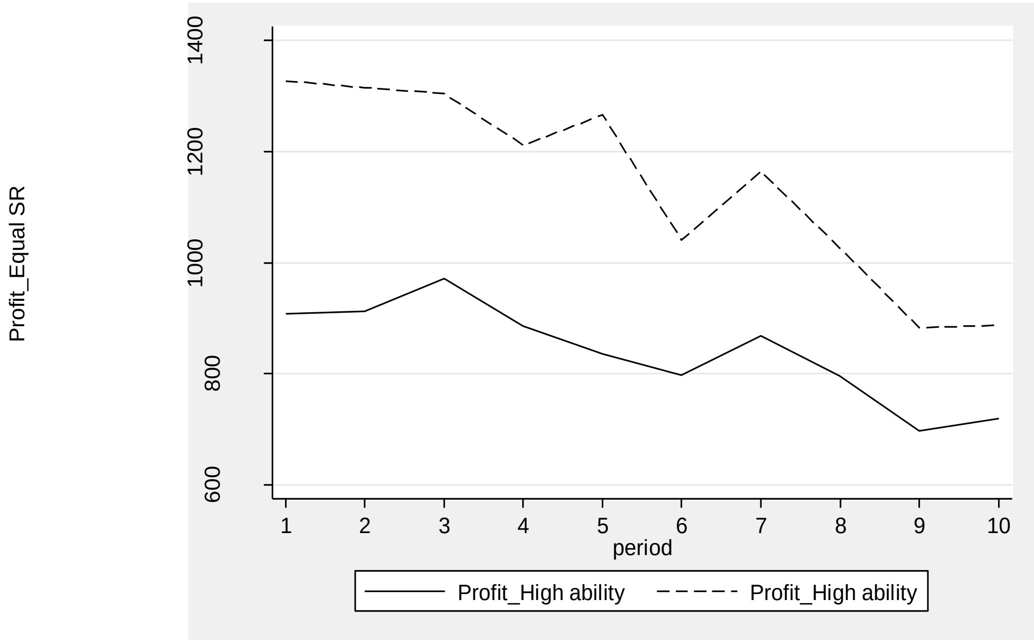

Figure 4a: Average payoff under equal sharing in the voting treatment

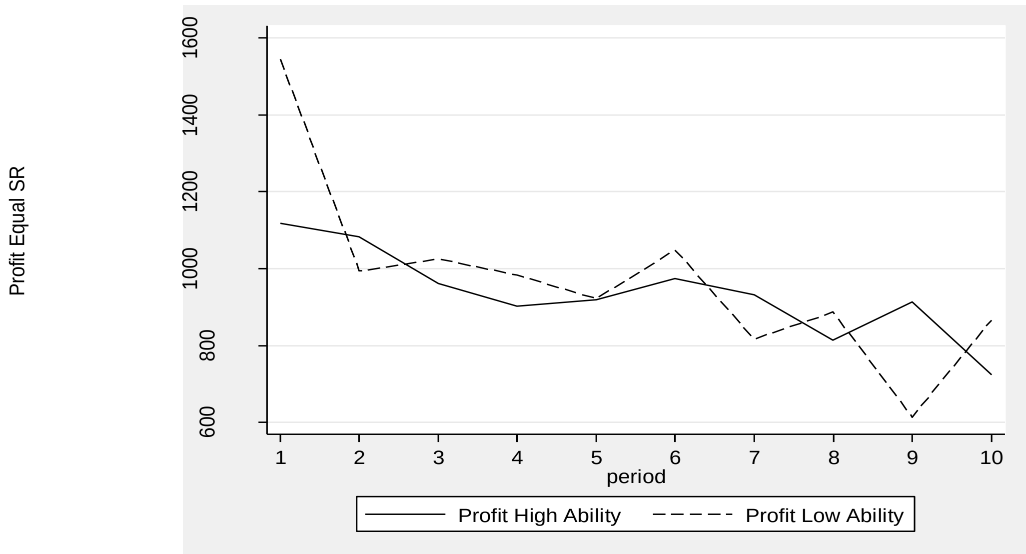

Figure 4b: Average payoff under equal sharing in the identity treatment

C. **Regression analysis.**

i) Effort

Table 7: Panel data regression on effort decisions – GLS

Effort	Overall (1)		Equal share (2)		Equal share High skilled (3)		Equal share Low skilled (4)	
Vote Sec_best	1.92	(5.62)	-13.96**	(5.66)	-14.93**	(6.72)		
Vote Median	18.01**	(7.28)	-43.07***	(9.65)	-24.10*	(12.62)	-29.99**	(14.38)
Treatment	23.65***	(3.94)	13.43***	(3.42)	2.26	(5.21)	27.76***	(4.74)
Type	51.12***	(7.33)	36.52***	(7.18)				
Majority_1	15.62***	(4 .77)	18.16***	(4.61)	10.28	(7.76)	14.10**	(5.88)
SR_Equal	-42.03***	(6.92)						
SR_Median	15.99	(11.19)						
Age	0.73*	(0.44)	1.87***	(0.38)	3.32***	(0.48)	-0.86	(0.82)
Gender	16.03***	(3.86)	19.22***	(3.65)	28.59***	(4.86)	11.88**	(4.73)
Num siblings	-5.67***	(1.79)	-0.01	(1.61)	-1.41	(1.79)	-0.74	(3.28)
Career	9.23**	(3.80)	19.11***	(3.93)	9.49*	(5.51)	8.31	(5.24)
Career year	1.87	(1.33)	1.64	(1.33)	-1.89	(2.04)	2.80	(1.75)
session	0.88	(3.57)	7.26**	(3.49)	19.32***	(5.07)	0.83	(5.73)
Period	-5.46***	(0.82)	-4.93***	(0.76)	-5.96***	(1.10)	-2.36	(2.28)
_cons	28.57*	(15.26)	-50.94***	(13.91)	3.12	(16.74)	-3.50	(23.14)
Period dummies	Yes		Yes		Yes		Yes	
Group dummies	Yes		Yes		Yes		Yes	
Number of obs	980		680		420		260	
Subjects	25		25		15		10	
R-sq (overall)	0.3655		0.3743		0.4942		0.4088	
Prob > chi2	0.0000		0.0000		0.0000		0.0000	

Standard errors are in parenthesis. ***, ** and * indicate significance at p=0.01, p=0.05 and p=0.10, respectively.

In this section, we analyze the determinants of effort decisions using regression analysis. In table 7 we report the estimation results of a panel data general least squares with random effects at the subject level. We regress the individual effort on voting decisions, using dummy variables (vote equal; vote median and vote proportional); a dummy to represent IDT (treatment); a dummy for high skilled players (type); a dummy to represent if the decisions were made by the majority of members of if there was a tie (Majority); dummies for the sharing rule decided by the group (SR_equal; SR_median; SR_proportional). We control for age; gender; number of siblings; career (if studying economics or not) and career year. We also control for session and include period and group dummies in all models. In model 1 we include all the data, in model 2 we analyze effort decision under the equal sharing rule, in model 3 we focus on the high skilled level of effort under an equal sharing and in model 4 we center our focus on low skilled level of effort under an equal sharing.

The general model (1) indicates that the effort performed by those that vote for the second best sharing rule does not differ from the effort of those that vote for the equal share. In contrast, those who vote for the median share perform a significantly higher effort than those who vote for the equal share. We observe that identity has a positive effect on effort decisions, as observed by the significant coefficient of "Treatment" variable. This result clearly confirms our conjecture 5 that identity increase effort levels.

Confirming the non-parametric results, we observe that high skilled types exert a higher effort than their low skilled teammates. How the distributional rule was decided has also an impact on effort level, we observe that when it was decided by majority (three, four or five members) subjects performed a higher effort than when there was a tie and the sharing rule was decided randomly. In relation to the demographic characteristics, we find that females and economics students tend to exert higher effort, in contrast, higher the number of siblings, lower the effort.

Most importantly, and corroborating our non-parametric results, we find that when there is an equal division of total profit the effort level is significantly lower than when the distributional rule is the second best (SR_Equal). No significant differences between the median share and the second best (SR_Median).

Considering this result we regress effort level when the distributional rule was the equal share (model 2). We find that, although effort is higher in the IDT, those who do not vote for the equal share (vote in the second best or in the median share) performed a lower effort than those who actually vote for the sharing rule decided by the majority of the group. This result is still highly significant when analyzing by type of subject (model 3 and 4), however, we can see that identity does not have an impact on high skilled subjects and does have it in low skilled' subjects. We find that, in contrast to low skilled, effort of high skilled types was not affected by the fact that the sharing rule was decided by the majority or due to a tie.

We also find a session effect in high skilled level of effort when the equal share was the distributional rule decided by the group. This is due to group effects, as when the group dummies were taken out of the model this effect disappears. Period has an effect in all models, confirming a well known effect on group experiments, where higher the period lower the effort level.

V. Discussion and Conclusion

Accordingly to standard economic theory heterogeneous teams should operate under a distributional rule that takes into account the differences in agents' inputs or skills. However, under non-hierarchical forms of organization, when members have to decide how to divide the total team output, social concerns may emerge as individuals could be conflicted between what is the best for them and what the group or even the society expects them to do.

In this paper we explore how these social concerns affect teams mostly composed by high skilled subjects in terms of distribution preferences and consequently on team efficiency. We ask if heterogeneous self-manage teams tend to choose equal sharing rules instead of a sharing rule that maximizes team welfare. And if so, we ask why: Are there social preferences that induce members to prefer equal distributions? Or is there some group identity formation that induces to these preferences for equality?

To answer these questions we provide a theoretical explanation based on social identity and test is experimentally. We compare two treatments based on a team production model. The control treatment, which we call the voting treatment, is designed to understand the distributional preferences of members without social interaction. The second treatment, which we call the identity treatment, is designed to understand the effects of induced identity in distributional choices and effort levels.

Our results indicate that in absence of social interaction subjects tend to vote for the distributional rule that leads them to better monetary payoffs. While the majority of the high skilled members vote for the second best compensation scheme, which gives them a higher share of the total team output, the low skilled members vote for an equal split. Nevertheless, we find some heterogeneity in preferences, as 30 percent of high skilled subjects show preferences for equality. We argue that in this treatment, subjects act in accordance with their perceptions of fairness, which are conditioned by their personal identities.

With induced identity the percentage of high skilled members that vote on the equal share increases from 30 percent to 70 percent. This result indicates that social identity has a strong impact on distributional preferences. We argue that with social interactions and communication, reveled preferences can change as the prescribed or ideal behavior for the team (social category) could be affected by team decisions. As the high majority of groups where identity was manufactured decide to operate under an equal distributional rule, identity can be an explanation for the use of equal splits in heterogeneous self-managed teams.

Surprisingly, we do not find that identity increases team efficiency when heterogeneous teams operate under an equal distribution of total output, as is the case with homogenous agents (Eckel and Grossman, 2005). Identity has a positive effect on low skilled subjects, increasing their effort level, however does not have an impact on high skilled performance. Moreover, we find that the high skilled members who do not vote on the sharing rule decided by the majority of the group highly decrease their effort level. We conjecture that they behave against the group goal as they feel as outsiders of the group. This result is consistent with Akerlof and Kranton (2005) theory that suggests that when members feel as outsiders they gain utility when acting against the group norms. Nonetheless, we find that identity equalizes individual payoffs. Therefore, we conjecture that difference aversion could be a consequence of group identity.

Our results confirm the three general consequences of identity in organizations suggested by SIT (Ashforth el al., 1989). First, identity induces individuals to perform actions consistent with relevant aspects of their identities. Second, it affects the outcomes associated with intragroup cooperation and fairness to the team and third, may also prompt internalization and adherence to group values and norms and engender homogeneity in attitudes and behavior (equality and profits equalization).

We also find that when groups operate under a proportional compensation scheme that weighs equal sharing and wealth maximization criteria, (the median sharing rule in our experiment) subjects tend to increase their effort level and team efficiency highly increases. This is consistent with Amartya Sen (1966) theory that an optimal allocation of resources should give part to needs and part to skilled. However just a few groups vote for it. More data on the effect on this type of sharing rules could be interesting.

A natural extension of this work is to test if the pictures stage alone or the communication stage alone also influences behavior, and if so to what extent. We conjecture that the results will be less evidence as we consider that without communication and socialization the effect of identity is lower. To increase the effect of identity, allow communication in all rounds of effort will be the nest step. We conjecture that it will increases high skilled levels of effort as in other studies on communication and identity (Eckel and Grossman, 2005). Other extension could be allowing for renegotiation of the sharing rule after the 10 rounds period to understand if the high skilled' subjects maintain their votes for equal share under identity as in Balafoutas et al. (2013).

Performing this experiment with natural identities would give robustness to these results, as well as majority low skilled teams. More data on a sharing rule that gives part to needs and part to skills would also be interesting.

In resume, the results of this paper are a contribution to better understand the black box of self managed teams, and it is again a reinforcement that social variables, as identity, influence team member's behavior in a way that their actions have more in consideration group effects than self interest.

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Appendices

A. Instructions *for the identity treatment*

You have been asked to participate in a study that analysis group decision making. During the experiment we will speak in terms of Experimental Monetary Units (EMUs) instead of Euros. Each participant will receive an initial endowment in EMU. You may earn an additional amount of money depending on your decisions in the experiment and others decisions. Your payoffs will be calculated in terms of EMUs and then converted to euros at the end of the experiment at a rate of 800 EMUs = 1 Euro. This money will be paid to you, in cash, at the end of the experiment. You will be given a set of instructions that will be read aloud to all participants. If you have any question, please raise your hand and one of the experimenters will go to you and your question will be solved.

The decision situation:

At the beginning of the experiment you and four other participants will be randomly assigned to your group. There will be 25 participants in the room that will be randomly assigned to the Blue, Red, Yellow, Green or White group. The identity of the other participants will not be revealed and you cannot interact with the other members of the group unless you are asked to do it.

In your group there are three participants that will be called of type 1, and two participants of type 2. You will be random selected to be a type 1 or a type 2.

This experiment has two parts. The first part has one stage and the second part has two stages. In the first part you have to answer some questions about paintings. The second part is a decision game where you have to choose a number and how to allocate the earning your group made between yourself.

Instructions for the first part:

In the first screen of the experiment you should introduce your ID number. In the next screen you will know to which group you were assigned (Blue, Red, Green, Yellow or White). Next you will have 2 minutes to study 8 images, the first 4 are painting from Picasso and the last 4 are paintings from Dali. Next you will see 2 pictures more, and you have to answer who painted these pictures. On the right you find a chat box where you can chat with the members of your group to help or be helped in given the correct answers. Please do not identify yourself and do not use inappropriate language. For each correct answer you will earn 200 UME.

Instructions for the second part:

As referred earlier, there will be two types of players in your group, the type 1 and the type 2. You will know your type in the second stage, but will not know who are the others who that share your type or who are of the other type.

In the **second stage** you and your team members will have to choose how to allocate the amount of money made by the group. You have three options, and have to choose only one. The option decided by the majority of the group will determine the distribution of your and others payoffs.

In the **third stage**, you and the other three subjects of the group must choose a number between 0 and 240 without knowing the decisions of the other members of the group.

The election of this number has some implications. The number you choose will have a different value depending on your type: if you are type 1 the value of the number is the chosen number multiplied by 24 and if you are type 2 is the chosen number multiplied by 17 (see table k*number). The values of the chosen numbers off the five members of the group are add and each one of the members receives a percentage of that sum, we will call this sum **RESULT**. This percentage corresponds to the option decided by the majority of the group in the second stage.

On the other hand your chosen number causes a certain cost. As mentioned there are two types of participants in your group. Each type of participant has different cost associated to each possible number that you chose. This means that the type 1 participants have a cost for the chosen number that is equal among them but different of the cost that type 2 participants have for this number. **The cost of the number that you chose will be deducted directly of your payoff.**

In the moment that the experiment starts you will know which type of participant you are in the group and you can consult the cost table in the annex. In this table you can see the value and the cost that each number has for your type and for the other type.

You can also see that each number has a different cost. For the type 1 members the cost of the number is equal to the square of the chosen number divided by 20, while for the type 2 members it is equal to the square of the chosen number divided by 10.

In the next table you can see an example of how to reed the table.

Example Cost Table

Type 1

K	Number	Value: (K*Number)	Cost of Number
24	2	48	0,2
24	5	120	1,3
24	15	360	11,3
24	20	480	20,0
24	50	1200	125,0
24	149	3576	1110,1

Type 2

K	Number	Value: (K*Number)	Cost of Number
17	2	34	0,4
17	5	85	2,5
17	15	255	22,5
17	20	340	40,0
17	50	850	250,0
17	149	2533	2220,0

You can read your cost table by looking down the second column where you can find the decision numbers; the third column informs you of the value of this number and in the forth column you can check the cost of this number. For example, if you are type 1 and choose the number 15, the value of this number is 360 and has a cost of 11.3, while if you are type 2 and choose the number 15, the value of this number is 255 and has a cost of 22.5. Note that the higher the number you choose the higher its cost.

Instructions for the first stage of the second part

After finishing the first part, the second part of the experiment will began. You will remain in the same group of the first part.

In the first stage of this part you will have to choose the distributional rule of the **Result** (sum of the value of the decision numbers choose by the five elements of the group). You have to choose between 3 options, knowing that the option decided by the majority of the group will determine your and others payoffs.

Option A:	Type 1: 30%
	Type 2: 5%
Option B:	Type 1: 20%

	Type 2: 20%
Option C:	Type 1: 25%
	Type 2: 12.5%

If the majority of members choose the option A, this means that each one of the type 1 members will receive 30 percent of the result, while each of the type 2 members will receive 5 percent of the result. If the majority of members choose the option B, all members receive 20 percent of the result, independent of the type. If the majority of members choose the option C, this means that each one of the type 1 members will receive 25 percent of the result, while each of the type 2 members will receive 12,5 percent of the result. From this percentage of the result it will de deducted the cost of the number.

You can use the chat box to communicate with the others members of the group. Note that you can only chat in this stage. In the next stage, where you have to decide the number, you will not be allowed to interact with your team mates.

You can also use a help screen to do simulations about your and others earning.

How to use the help screen:

You can use the help screen to make simulations en relation to the number you can choose and the number that the other could choose. As you don't know which number the other will choose, you can simulate typing a number between 0 and 240 in the correspondent field. If you press "calculate" you can see the value and cost of each of these numbers accordingly to the correspondent member. You can also see the final result of your simulation for each of the 3 options when press " see calculations". At the bottom of the screen you can see the sum of the value of the numbers that you simulate as long as the proportions that you and the other elements of the group could receive. If you press "Decision screen" you turn to the decision screen. Your decision will be validate when you press the "continue" button.

Instructions for the second stage of the second part

After the distribution rule have been decided by the majority of the group, you will see a screen where you will know which of the options will determine yours and others payoffs. You have to insert a number between 0 and 240 in the correspondent field, if you press OK you can see the value and cost of the number as well as the proportion of the result that you will receive. You can use the help screen in this stage, but you cannot communicate with your group.

Calculations of your payoffs:

Your payoff in UME depends of the distribution rule determined in the first stage of the second part:

Option A:

Payoff Type 1 = 0,30*Result-cost individual cost type 1

Payoff Type 2 = 0,05* Result-cost individual cost type 2

Option B:

Payoff Type 1 = 0,20*Result-cost individual cost type 1

Payoff Type 2 = 0,05* Result-cost individual cost type 2

Option C:

Payoff Type 1 = 0,25*Result-cost individual cost type 1

Payoff Type 2 = 0,125* Result-cost individual cost type 2

In the case you suffer losses you will receive a minimum capital that range from 5 to 2 euros, depending on how much you loss.

Example of how your earning will be determined:

If, for example, each one of the members of the group choose the number 15. For the type 1 members, the number has a value of 360 and a cost of 11,3. For the type 2 members the number has a cost of 255 and a value of 22,5. the result will be: 360*3+255*2=1590 EMUs.

If the option decided by the majority of the group was option A and you are a type 1, your payoff will be: **0.30*1590–11,3=465,7 UME**. If your are a type 2 members, your payoff will be: **0.05*1590–22,5=57 UME.**

If the option decided by the majority of the group was option B and you are a type 1, your payoff will be: **0.20*1590–11,3=306,7 UME.**. If your are a type 2 members, your payoff will be: **0.20*1590–22,5=295,5 UME.**

If the option decided by the majority of the group was option C and you are a type 1, your payoff will be: **0.25*1590–11,3=386,2 UME.** If your are a type 2 members, your payoff will be: **0.125*1590–22,5=176,25 UME.**

Comprehension questionnaire:

3. Suppose that you are a type 2 member and choose a number of 5, the value of your number is _______ and the cost of your chosen number is _______. Suppose that the other type 2 member have chosen the number 50 and each one of the type 1 members have chosen the number 20, the total result is _________, Suppose that the distributional rule decided was option A, then your payoff is ____________.

4. Suppose that you are a type 1 member and choose a number of 2, the value of your number is _________ and the cost of your chosen number is _______. Suppose that the other type 1 members have chosen the number 149, and the type 2 members have chosen the number of 5, the total result is _________. Suppose that the distribution rule decided by the group was the option B, then your payoff is____________.

Thank you for your participation. After finishing the experiment please wait at the computer in order to know your payoffs in euros and receive new instructions for the next experiment.

B. Communication Analysis

We have seen that identity has a strong effect on the distributional preferences of high skilled participants but not an effect on their effort decisions; in contrast, it has a positive effect on the performance of low skilled but no effect on their sharing preferences. In this subsection we analyze the contents of the communication to better understand what drives the voting results. Recall that in the IDT, in addition to the pictures stage, where subjects could freely chat to perform a simple task before the dilemma starts, subjects could discuss the distributional rule options through the chat in the voting stage.

Table 4: Categories for coding messages

Categories		Relative frequency [28] Code "1"	Percentage of subjects participating in category[29]		
			Type1	Type2	Total
C1	Proposal equal shares (Option A)	15%	43%	65%	52%
	Agreement	16%	28%	20%	25%
C2	Proposal second best share (Option C)	2%	10%	3%	7%
	Agreement	1%	1%	0%	0%
C3	Proposal of median share (Option B)	2%	7%	3%	5%
	Agreement	1%	3%	28%	3%
C4	Appeal to fairness	6%	13%	18%	20%
C5	Appeal to equity	3%	13%	18%	15%
C6	Appeal to not hurt low skilled members	3%	8%	20%	13%
C7	Appeal to the benefit of all members	5%	10%	23%	15%
C8	Refer to majority of high skilled	3%	17%	0%	10%
C9	Refer to selfish preferences	4%	13%	10%	11%
C10	Proposal to pact on numbers	12%	28%	25%	27%
	Agreement	2%	0%	3%	1%
C11	Proposal of numbers	13%	18%	20%	19%
	Agreement	8%	3%	5%	4%
C12	Appeal to commitment	1%	5%	3%	4%
	Group level (% of groups)				
	Group agree on Sharing Rule				75%
	Group pact Numbers				25%
	Group engage in friendly talk				10%

In the pictures stage, the high majority of the individuals participate in conversations about the paintings. To the communication analysis of the voting stage,

[28] The relative frequency of the categories is calculated dividing the number of times that the category was coded "1" from the total of messages coded as "1", which were 431 in total.
[29] In subjects analysis, we coded as "1" if the subject participated in the category and "0" if he didn't. Thus, column 3 (4) refers to the percentage of high skilled (low skilled) that participate in each category.

we developed and implemented a coding scheme for the messages content parallel to those implemented by Brandts and Cooper (2007) and Sutter and Strassmair (2009). To analyze the messages we developed 12 categories for the different types of statements and agreements as follows: First we establish a preliminary set of categories based on the conjectures presented and prior research. After reading a sample of the chat we added other categories that appeared to be relevant. Subsequently, one research assistant independently coded the chat, assigning the value of "one" if the message contained statements or arguments relative to a category and "zero" otherwise. The only information given to the coder was the instructions for the experiment, therefore he just had the information that participants on the experiment had. Finally the categories were then reconciled. In addition, we analyze if the group actually agreed on the sharing rule; if the group made a pact on which numbers they should choose in the following stage and if the group engaged in friendly talk outside the dilemma[30].

Table 4 lists the categories for coding, their description, the relative frequency that a category was coded as present (value=1) and the percentage of subjects that participate in conversations of the category (discriminated by type). The proposal to choose equal shares (C1); proposals to make agreements on the numbers to choose in the next stage (C10) and proposals on which numbers to choose (C11) were, by far, the most frequent categories. In the category of proposing equal shares (C1), about 15 percent of cases were proposals and 16 percent were agreements. This category was discussed in all the groups, where 77 percent of the subjects participated on it. About 65 percent of the low skilled players and 43 percent of high skilled participants propose the use of this distributional rule by the group. Nonetheless, we find that just in 55 percent of the cases the first member that proposes equal shares was a low skilled participant, being a high skilled subject that first makes this proposal in the remaining 45 percent of the cases. The proposals of equal sharing were backed up by arguments appealing to fairness (C4), equity (C5), not hurt the low skilled' subjects (C6) and arguments that the equal sharing is the one that benefit all (C7). Proposals of second best (present in 15 percent of the groups) and median share (present in 25 percent of the groups) made by high skilled, were contradict by low skilled with arguments appealing to fairness (C4), not to be selfish (C9) and not to hurt low skilled

[30] The coder was also asked to check for these group decisions.

subjects (C7). In 75 percent of the groups an agreement on the distributional rule was reached, which justifies the increase of consensus. About 80 percent of the high skilled subjects that engage in conversations about choosing equal shares (C1), either by proposing or agreeing with it, actually vote on the equal share.

We can see that 27 percent of the subjects propose to make a pact on numbers (C10), however, just 23 percent of subjects participate in conversations about reaching an agreement on the numbers to choose in the following stage (C11). Although 50 percent of the groups engage in these type of conversations (C11), just 25 percent of groups reach an agreement. About 60 percent of these groups comply with it. However, in 50 percent of those group subjects decrease their effort levels after the second period as not all members maintain the pacted level of effort.

C. Robustness checks:

i) Voting decisions

In this section, we analyze the determinants of voting on equal shares using regression analysis. The results essentially corroborate those obtained with the non-parametric tests reported previously and allow us to control for subjects' demographic characteristic and to understand the effect of the communication categories.

Table 6 presents the logit regression[31]. In the first model (all treatments) we can observe that in the IDT the odds of voting on the equal share increase as indicated by the significant coefficient for the "Treatment" dummy. This is consistent with our non-parametric results and adds support to our third conjecture that identity changes the distributional preferences of members.

Table 6: Logit regression: determinants on voting equal

Vote Equal	All treatments (1)		Voting treatment (2)		Identity treatment (3)	
Treatment	1.835***	(0.498)				
Type	-3.061***	(0.522)	-3.006***	(0.607)	-8.040***	(2.328)
Age	0.015	(0.051)	-0.025	(0.058)	0.800***	(0.260)
Gender	1.385***	(0.464)	1.907***	(0.601)	2.750***	(0.682)
Career	-1.107**	(0.452)	-0.590	(0.718)	-5.317***	(1.644)
Career year	0.079	(0.136)	0.246	(0.229)	0.038	(0.413)

[31] In this analysis we use the data of the one-shot setting and the first round of the ten rounds setting. We perform the same regressions using panel data and the results are similar.

Session	0.106	(0.592)	-0.699	(0.761)	-0.308	(1.111)
Period	-0.058	(0.438)	-0.096	(0.461)	3.447*	(1.486)
Gender*Type	0.657	(0.552)				
Num MSG Picture					0.136***	(0.050)
C1					5.321***	(1.600)
C2					5.848*	(3.026)
C3					-1.891	(1.641)
C4					-1.477	(1.094)
C5					-1.034	(1.166)
C6+C7					-1.693	(1.691)
C8+C9					2.736	(1.454)
C10+C11					2.935	(1.838)
C12					4.879**	(2.076)
Group agree SR					7.180***	(1.787)
Group agree Num					-8.841***	(2.863)
Cons	-5.060***	(1.354)	-4.460***	(1.641)	-21.673***	(6.568)
Number of Obs	196		100		96	
Prob > chi2	0.000		0.0001		0.000	
Pseudo R2	0.289		0.3227		0.6181	

Standard errors are in parenthesis. ***, ** and * indicate significance at p=0.01, p=0.05 and p=0.10, respectively. Dependent variable: Vote Equal=1 if subjects voted equal and Vote Equal=0 otherwise. Independent variables: Treatment=0 for the VTand Treatment=1for the IDT; Type=1 for the high skilled subjects and Type=0 for the low skilled; Gender=1 for females and Gender=0 for males; Career=1 if subjects study economics or business, Career=0 otherwise; Session=0 for the first sessions performed and Session=1 for the second sessions; Period=0 for the one shot setting and Period=1 for the first round of the ten rounds setting.

Low skilled types are more prone to vote on equal shares than high skilled types in both treatments as we can seen by the significant and negative coefficient for the "Type" dummy in model (1), (2) and (3). We can also see that there is a significant effect of gender on equality preferences. We can observe that being female increase the odds of voting equal, as observed by the significant and positive coefficient on "Gender" dummy in all the models. There is no effect on the interaction gender and type (Gender*Type) in model (1)), meaning that females vote more for equal shares independently of being high or low skilled type. We can also see that studding economics or business have a negative effect on choosing equal shares (Career). This is not an unusual result in experiments, as these students could be more aware of the existence of equilibrium outcomes. The significance of this variable disappears in the VT(model 2). Analyzing the IDT (model 3) we can see that the effect of type, gender and career is the same as in the VT , but age has now an effect. Older students tend to choose more equal shares. We can also observe that the higher the number of messages sent by subjects on the pictures stage higher the tendency to choose equal shares (Num MSG Picture). Also, participation on conversations about voting on equal shares (category C1) increases the probability of voting equal. The same effect happens on the category C2, which refers to proposals of voting on second best shares. We conjecture that this contradictory effect is observed because some of the few subjects that propose this sharing rule were convinced by the others to vote equal. Except for the appeal to commitment category dummy (C12), which increases the odds of voting equally, none of the other categories that were used to backup arguments on voting options have a significant effect[32]. The fact that the group reaches an agreement on the distributional rule also increases the probability of voting on equal shares. However, agreeing on the numbers for the next stage has a negative effect of voting equal. This could be justified by the fact that some groups that agree on the numbers decide to vote on the median sharing rule.

D. Post-experimental questionnaire analysis

Table 5: Post-experimental questionnaire

Questions [coding in square brackets]	Mean values					
	Voting treatment			Identity treatment		
	High skilled	Low skilled	All	High skilled	Low skilled	All
Set 1 (all treatments)						
Q1. Have you considered fair the decision made by the majority of the group in the second stage? [1="Fair"; 0="Unfair"]	0.73	0.50	0.64	0.80	0.70	0.76
Q2. In the second stage, when you had to choose the distributional rule, the fact of being in your group had any influence? [0="No"; 1="yes, I chose Option A"; 2="yes, I chose Option B"; 3="yes, I chose Option C"]	1.6	1.2	1.44	1.1	0.85	1
Q3. In the third stage, when you had to choose the number, the fact of being in your group influenced your decision? [0="No"; 1="yes, I chose a high number"; 2="yes, I chose a low number"]	0.87	1.1	0.96	0.9	0.75	0.84
Q4. In a scale from 1 to 10, please indicate the level of identification with your group during the experiment.	5.2	3.2	4.4	5.7	5.3	5.54
Set 2 (Identity treatment)						
Q5. In the second stage, when you had to choose the distributional rule, the fact of being able to communicate with the other				0.73	0.55	0.66

[32] Some of the categories that refer to the same type of arguments were added in the regressions analysis.

members of the group had any influence in your decision? [0="No"; 1="yes, I chose a more egalitarian distribution"; 2="yes, I chose a less egalitarian distribution"]						

After the experiment subjects answered individually several questions regarding their decisions during the experiment. Table 5 lists all the questions and their mean answers. The answers to question 1 (Q1) reveal that both high and low skilled members in both the VT and in the IDT considered fair the distribution rule decided by the majority of the group.

Analyzing by sharing rule, we find that when the sharing rule decided by the group was the equal split, around 75 percent of members found it fair, no significant differences between types or treatment. When the sharing rule decided was the second best share, about 60 percent of high skilled members found it fair and 67 percent of low skilled members found it unfair. This data is relative to the VT as in the IDT none of the groups voted for this distributional rule. When the sharing rule decided was the median share, in the VT about 67 percent of the high skilled and 50 percent of the low skilled found it unfair. As this sharing rule was determined randomly due to a tie in some groups, participants' answers could have been affected for this fact. In the IDT, 100 percent of the high skilled and 50 percent of the low skilled found fair that the majority of the group decided to use the median sharing rule. This sharing rule was chosen after the majority of the members of the group have agreed on the numbers to choose in the next stage. It seems that most of subjects considered the group decisions quite fair in both treatments. This could indicate that the choice of equal sharing by majority high skilled teams is due to a concern for the well being of the least well off and preferences for equality.

Concerning Q2, we find that the fact of being in their group influenced both high and low skilled in choosing equal sharing rule in both treatments. We find no differences between treatments (Mann-Whitney test: Overall: p= 0.1043; high skilled: p= 0.1832, low skilled: p= 0.3040). In this question we are measuring the effect of being in a group, without focus on induced identity. Accordingly to Tajfel and Turner (1979), just the fact of being in the same group can create group attachment and affect subjects decisions, even without interaction. This minimal group effect seems to be present here. We find the same effect on Q3, as being in their group influenced both high and low skilled in choosing a higher number. We find no differences between treatments (Mann-Whitney test: Overall: p= 0.5690; high skilled: p= 0.9283, low skilled: p= 0.3447).

Question 4 follows Chen and Li (2009), question on group attachment where subjects were asked to rank form 1 to 10 the level of identification with the group during the experiment. We find that overall the level of identification with the group increased in the IDT (U-test, p=0.0855). Surprisingly, the high skilled subjects have an average level of identification higher than 5 in both treatments and manufacturing identity does not have a significant effect on them (U-test, p=0.5040). In contrast, this effect is significant for the low skilled subjects (U-test, p=0.0411). This shed some light in our previous results, as some of high skilled subjects chose equal sharing even in the VT. Again, a minimal group effect seems to create a certain level of identity. For the low skilled members, this increase in the level of identity its consistent with their increase in effort supplied in the IDT.

Finally, regarding Q5, we find that communication influenced subjects voting decisions, especially of high skilled, but not as much as the simple fact of being in their group (Q2) (Wilcoxon sign-rank test: Overall: p= 0.0017; high skilled: p= 0.0266, low skilled: p= 0.0143). Therefore, we conjecture that the choice of equal sharing by the high skilled members both in the VT and in the IDT was due to a sense of group belonging. Induced identity with communication increased this sense of belonging and increased responsibility to behave as prescribed.

Chapter 5

Do we speak the same language? A field experiment on the determinants of team performance

1. Introduction

Some economic theories indicate that while heterogeneity in skills may enhance team productivity due to knowledge and information transfers (Hamilton et al., 2003), ethnic diversity may harm productivity due to large communication costs (Lazear, 1998; 1999). In a similar vein, some work on the economics of identity (Akerlof and Kranton, 2010) indicates that matching individuals within their race and gender social categories to perform a teamwork task may increase performance. The key question is whether communication costs can be completely overcome by language training. In other words whether there are non-language aspects of ethnicity that can actually harm the productivity of a team.

In this paper we provide new field experimental evidence to shed light on the impact of origin (international or domestic student status), ethnic, linguistic and gender heterogeneity on teams' performance.

We design a field experiment with random assignment to answer, in the context of our experiment, a few questions: (i) Do international teams perform worse than domestic? (ii) Does skill heterogeneity increases or decreases team performance? (iii) Are ethnically homogenous teams more productive than heterogeneous teams? (iv) Are mixed gender teams more productive than same gender teams? And finally v) Is native English language a sufficient factor to induce identity and increase performance?

The contest in which the experiment was conducted was a first year compulsory business class at The University of Sydney where a team and an individual task is part of the evaluation. Students face strong incentives, both individually and as a team, to perform this joint task. Both count for the annual average mark and they have to pass the signature to move to the second year. Moreover, those who fail have to take an intensive curse during the summer break.

To this aim, domestic and international students, were randomly matched into pairs resulting in groups with the same and different gender, language and ethnic background to perform the team task, the analysis of a business case study. We collected information about the team assignment and a following individual assignment mark, the final grade in the course, the tutors and class schedule of the students. Additionally we collected demographic data from a questionnaire, including age, gender, ethnicity, student origin (either international or domestic), country of birth, nationalities, year arrived in Australia if not born there and language (native, spoken at the home and spoken with friends).

We use native language as skills dimension, as English fluency is a fundamental academic skill for performing the task, both for understanding the case and writing the essay commenting it. As English is the language spoken in Australian, it is reasonable to expect a positive correlation between the ability to speak, understand and write in English and the student's performance. Differences in social and academic culture, academic aptitude or preparation, as well as inadequate language fluency, may all contribute to worse performance by foreign students (Bradley 2000, Cheng & Leong 1993, Stoynoff 1997, Zhang & Brunton 2007).

In our regressions we aim to explain team performance using the different heterogeneity dimensions as explanatory variables. Therefore, we divide our data in four groups accordingly to the four dimensions of heterogeneity we aim to study. Each group has three subgroups where two are homogeneous and one is heterogeneous. Thus, in the origin group we have the domestic, the Dom & Inter (one domestic and one international) and the international group. In the skills group we have the English Native Language (both have ENL), the ENL & NENL (one has ENL and the other does Not have ENL) and the NENL (none has ENL). In the Ethnicity group we have the Asian, the Asian & No Asian (one Asian and the other not) and the No Asian group. Finally, in the gender group we have the female, the mixed gender (one female and the other male) and the male group.

Our analysis shows that origin, ethnicity, skills and gender have a significant effect on team performance. Results indicate that heterogeneous teams indeed perform better than homogeneous international, NENL and Asian teams. However, we do not find significant differences between heterogeneous and homogeneous domestic, ENL and Non Asian teams The results on origin and skills are consistent with Foster (2012) who shows that both international students and Non English Speaking

Background (NESB) students perform significantly worse than other students in an empirical analysis of individual marks of the University of South Wales, Australia. Therefore these findings contribute to the analysis of international students in universities.

We find that ethnicity is still important when controlling for language skills. The homogeneous. Teams composed by No Asian members perform significantly better than the Asian groups, however not significantly better than the ethnic heterogeneous. This result suggests that when the language barrier is mitigated, the ethnicity has an effect. Having at least one Non Asian member is benefic for the team's performance[33].

We find that gender has a significant effect in team performance. Females and mixed gender groups perform better than males when controlling for origin, skills or ethnicity. These results confirm Hoogendoorn et al (2013) findings from a field experiment in young business teams in the Netherlands that mixed gender teams are more productive than male teams, in a field experiment with business teams. Their sample did no have enough female's teams to drive conclusions.

Our conjecture was that teams with heterogeneous origin, native languages, ethnicity or gender will perform worse than homogeneous teams. In contrast, we find that heterogeneous teams perform better than homogeneous international, Asian, No ENL and male teams. They perform similar to homogeneous domestic, No Asian, ENL and female teams. In fact in the cases where heterogeneity in origin and in skills are both present, heterogeneous teams perform better than homogeneous in general. This last result confirms the claim of Hamilton et al (2003, 2004) that skill heterogeneous teams are more productive than homogeneous teams with fewer skills.

One justification for this conjecture is social identity. Akerlof and Kranton (2010) claim that homogeneity in gender, race and language leads to better results. Experimental evidence indicates that subjects' actions towards others are significantly affected by their respective identities. Those that belong to the in-group are treated more favorably than those who belong to the out-group in many categories and contexts (see for example Avner Ben-Ner, 2009; Chen and Li, 2009; Goette at al. (2006); Fehr and Hoff, 2011; Charness el al. 2007).

[33] Note that in Australia the majority of the population is Caucasian, nonetheless there is a high percentage of Asians born there, due to an elevated degree of immigration from China, Vietnam and Malaysian.

Another justification for the expected bad performance of heterogeneous teams is discrimination. The literature identifies two types of discrimination, namely, statistical discrimination, i.e. performance-based, and tastes (Becker, 1957; Arrow, 1998, Heckman, 1998). Statistical discrimination argues that group members are treated better if their group is on average more productive. Taste discrimination argues that discrimination is the result of preference for one group.

We expected to find statistical discrimination from the English Native Language speakers towards the NENL speakers and therefore a lower performance of heterogeneous teams in relation to the homogeneous ENL. This conjecture is based on repeatedly claims from domestic students against working with internationals. Based on interviews with students at the University of Adelaide, Plewa & Sherman (2007) find that both local and international students with good language skills blame students with relatively poor language for the lack of creativity and slow progress in their groups. Nevertheless, we didn't find evidence of statistical discrimination as the heterogeneous teams performed similarly to the homogeneous.

We expected to find evidence of taste discrimination on origin, ethnicity and gender. Guillen and Ji (2011) find evidence of taste discrimination of domestic students towards international students in trust games. Slonim and Guillen (2010) find taste-based discrimination when subjects are allowed to select their partner's gender in a trust game. Therefore, we conjectured that teams with diverse ethnic and gender would perform worse than homogeneous teams. However, as in the previous results, we find that ethnic heterogeneity is positive when compared to Asian groups. Controlling for language this effect disappears and there is no evidence of taste discrimination. We also did not find evidence of taste discrimination on gender.

We belief that the lack of evidence of discrimination could be due to the random matching. Individuals are more likely to discriminate when having the option of choice.

Our results contribute to clear mixed results of previous experimental evidence. Some evidence suggests that ethnic heterogeneous groups are less cooperative, or less trustworthy, than homogeneous groups (Ferraro and Cummings, 2007; Fershtman and Gneezy, 2001). Hoffmann et. al (2007) confirm the existence of cultural differences in subjects' behavior in both intra- and international interactions when studying group behavior of Malaysian Chinese and UK subjects. Hoogendoorn and Praag (2012) findings from a field experiment in young business teams in the Netherlands indicate that a moderate level of ethnic diversity does not have an effect on team productivity, but a high ethnic diversity in the group composition has a positive impact on team performance. Hansen et al (2006) present empirical evidence of individual and team performance in a classroom of an United States private university. They do not find differences in the performance of teams with different racial composition from homogeneous teams.

Our study also provides interesting evidence in how heterogeneity affects the learning process as students performed a similar individual task weeks after the team class. In terms of team learning, which we consider positive when both subjects improve performance in the individual learning, we find that being in a domestic group, in an ENL or heterogeneous native language group increases the probability of team learning, as well as being in a female group. However, being in an Asian group slightly decreases it.

In relation to the effects of team heterogeneity in individual learning, we find that being previously in an international or heterogeneous group have a negative influence in individual performance. Similarly, being in a group where both or at least one member is NENL is not positive to individual mark. In contrast, being in a Non Asian group is positive to individual performance. Females are more productive individually if they were in a female group.

Our findings suggest that culture and language heterogeneity could increase team performance in cases where subjects have developed some cultural identity with the country they operate in. However, in the majority of cases, homogeneity leads to higher team productivity than heterogeneity. In the case of gender effect this is only true for female groups.

The rest of the paper is structured as follows. Section II and III describe the experimental design and the data. Section IV and V describe the methodology and results. Section VI presents main conclusions and discussions. An appendix containing data’s descriptive statistics and regression analysis tables concludes the paper.

2. Context and design

2.1. Context

The University of Sydney Business School offers a Bachelor of Commerce, which is very popular with international students coming mainly from China. All first year undergraduate students are required to take a subject called “Understanding Business” BUSS1001. This unit of study is the first of two junior core units aimed at introducing students to the internal and external contexts in which business operates in the twenty-first century. Critically for our experiment, it also aims to lay the foundations for effective communication (written and oral), critical analysis, problem solving, and team-work skills. During the semesters in which we run our experiment the assessment weights was as follows: participation (15%), essay (individual) (20%), case study (team work) (20%), and final exam (45%).

The experiment reported in this paper was conducted in the first semester of the Australian academic year 2012/13. The total number of students who finished the unit of study was 1234[34]. The students were randomly divided in 56 classes lead by 14 tutors (teaching assistants).

2.2. Design

We design a field experiment in the context described above. According to Harrison and List (2004), an ideal field experiment, is one where we are able to observe a subject in a controlled setting but where the subject does not perceive any of the controls as being unnatural and there is no deception being practiced.

The failure in our context was that the observation of the subjects’ actions were limited to the their evaluation, as only the tutors observe their behavior. Although not the ideal conditions, this context offers the possibility of manipulating the matching according to our desired criteria.

To this aim, we arranged with the unit of study coordinator and the head tutor to conduct a field experiment with the BUSS1040 students, with the objective of understanding how diversity affects teams’ performance and learning. To this aim, we decided that students would be randomly matched in pairs to perform a team task followed by the performance of a similar individual task. The task consisted in writing an essay about a case study analysis. We also agreed with the class director

[34] We do not have access to the exact number of students enrolled in the class at the beginning of the semester.

not to give much information about the experiment to the individual tutors effectively running the experiment in order to avoid experimenter effects as much as possible.

Two weeks, after the beginning of the semester the team task was announced and students randomly matched in groups. We delegate the implementation of the assignment to the tutors advising them to take in account that there should be enough groups where both students where domestic, both international and enough mix groups, the same for gender. The English native language and ethnicity was correlated to the international groups, thus we didn't mention it to the tutors. In Hoogendoorn et al (2013), a related paper on the effects of gender heterogeneity in teams, the implementation of the team members' assignation was also delegated to the cordinators of the undergaduate business program.

In each tutorial group, numbers were randomly allocated to students. Then the first and the last number were matched, then the second and the second last and so on (for example in a typical 12 students tutorial, the 12 was matched with the 1, the 11 with the 2, 10 with 3 etc.).

After groups were formed each pair of students filled out a demographic questionnaire with questions about age, gender, ethnicity, student origin (domestic or international), country of birth, nationality(ies), year arrived in Australia if not born there and language (native, spoken at home and spoken with friends)[35].

Students had three weeks to submit the essay. Weeks later, after receiving the team mark, they were assigned another case study, which they had to analyze individually. They had also three weeks to deliver it. Half of the content in the final exam was about the team case study. Therefore learning can be tested by looking at both the individual task and the final exam marks. We opt to use the individual task mark as it is similar to the team task and the examination variable is not present.

In relation to the incentives, instead of monetary, as in Hoogendoorn et al (2013), they consist in credit points, final grade and not fail the signature passing for the second year. As both the team and the individual task values 20% of the final grade, students are normally quite motivated to perform a good job in both tasks.

3. Data description

[35] See Appendix A for the full questionnaire

To create a data set, information on team and individual assignment mark; final exam mark; tutors and class schedule is merged with data from the demographic questionnaires. We first receive and introduced the questionnaires' information in the data set. The response rate to the questionnaires was sufficiently high: 1112 students, being 876 domestic and 236 international students. Secondly, we receive the team task mark for 1208 students. We cross the team mark data with the questionnaire data and finish up with a data set constituted of 972 students[36].

From the demographic questionnaire we constructed several group level variables, according to origin, native language, ethnicity and gender. The final sample in analysis is composed by 80% domestic students (779) and 20% international students (193). Most of the students in our sample were Asian or Caucasian and were born in Australia or in China. Nonetheless, around 20% of our sample represents subjects who were born in 50 different countries. Most of the students have more than one nationality and those born in China that asked for the Australia nationality lost their Chinese nationality[37]. Table 1 presents descriptive statistics for the variables used in the analysis and Table 2 shows the correlations at the individual level. We observe strong negative raw correlations between team mark and both international student origin and Asian ethnic. There is also a significant and negative correlation between team mark and the year the student arrived in Australia[38], class and tutor. We observe a strong positive correlation between team mark and the fact that the student was born in Australia, has English as native language and speaks it at home. Female and team mark are also positive correlated.

[INSERT TABLE 1 AND 2 AROUND HERE]

4. Methodology

To disentangle the effects of the different observable variables on team performance and determine if and which type of heterogeneity affects it, we use an ordinary least square (OLS) regression model.

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[36] Some students were matched in groups of 3, others did not fulfill the questionnaire properly and others withdraw. These cases were cleaned out of the data.

[37] This is a common practice in Australia. Many Chinese students that studied high school and college in an Australia institution ask for the Australian nationality.

[38] If born in Australia the arriving year is the birth year.

Although in field experiments is more common the use of individual data instead of group data (see for example Hasen et al, 2008; Goette el al. 2006), here we follow the methodological approach of Foster 2005. Similarly, we construct a pairwise estimating data set from the data described above, in which each observation represents two students who form a group. This is benefic to control for unobserved heterogeneity across subjects. (see Foster 2005 for a discussion of this estimation strategy). For robustness we run all the regressions in the individual data, clustered by groups.

The pairwise data consisted on 486 groups. We create group variables for team mark, class, tutor, origin and demographic characteristics of the group members. Table 3 shows the correlations between team mark and group types in the pairwise data. We can observe that international group; class and tutor have a negative correlation with team mark. On the other hand female group and English native language group have a strong positive correlation with team mark.

[INSERT TABLE 3 AROUND HERE]

To a more detailed analysis, we first divided groups by origin, language skills, ethnicity and gender. Table 4 presents the percentage of students in each group and table 5 describes the average team mark by group type.

[INSERT TABLE 4 AND 5 AROUND HERE]

In 313 groups both members where domestic students (64%), we call it domestic groups (G0); in 153 groups one member was a domestic student and the other an international student (31%), we call it Dom & Inter groups (G1) and in 20 groups both students were international (4%), we call it international groups (G2). 167 groups were composed by ENL speakers; 219 by both ENL and NENL and 100 groups were composed by NENL speakers. In 129 groups none of the students were Asian, in 233 there was mixed ethnicity and in 124 groups both were Asian. Finally, 106 groups were composed by females, 238 were mixed gender groups and 142 groups were composed by males.

To analyze more in deep the effects of origin, we next subdivide the data in seven subgroups interacting origin (international or domestic student status) with each of the other three heterogeneity dimension, skills, ethnicity and gender. This interaction between origin and the most common sources of heterogeneity is relevant to education and firms in general. Therefore, we subdivide the domestic group (G0) and the Dom & Inter group (G1) in 3 subgroups, according to English Native Language (ENL) or not (NENL): ENL (Both students ENL); NENL (Both students NENL); ENL_NENL (one ENL and the other NENL).

Although English Native Language and ethnicity are highly correlated (p=0.000), we considered important to also perform an analysis focused on ethnicity. Thus, we subdivide the domestic and the Dom & Inter groups in three subgroups accordingly to ethnicity (Asian and no Asian): Asian (Both students Asian); NoAsian (Both students no Asian); Asian_NoAsian (one Asian and the other no Asian).

Finally, we subdivide the groups by gender composition. Thus, we have the female group (FEM), the mixed gender group (MIX_Gender) and the male group (MALE).

5. Results

5.1. Main findings

To study the impact of group heterogeneity on group performance, we first analyze the relation between team performance and group characteristics. We model group performance as:

$$Team\ Performance_i = X_i\beta + Class + \varepsilon_i \qquad (1)$$

Subscript *i* is an index for each group. *Team Performance* is the group mark of the team task. X_i is a vector of variables that captures the dimensions of heterogeneity in the group i's characteristics, namely: origin, English native language, ethnicity and gender. We use three dummy variables to measure origin - the domestic, the Dom & Inter and the international group; three dummy variables to measure the composition of groups according to English native language – the ENL, the NENL and the mixed native language group; three dummy variables to measure the composition of groups according to ethnicity – the Asian, the No Asian and the mixed ethnic group; and finally three dummy variables to measure the gender composition of the group –

female, male or mixed gender group. *Class* is a vector of dummy variables to account for class fixed effects. Moreover, it accounts for the 14 different tutors as there could be variations in tutors' grading standers[39]. It is generally said is academia that the hour and the day of a class can affect both the students and the professors' performance.

Table 9 reports results from an ordinary least square model of group performance estimated on the pairwise data[40]. The first column presents the relation between team performance and the most relevant group characteristics. We can see that the groups composed only by domestic students and the Dom & Inter groups perform significantly better than the groups composed only by international students. However, we do not find significant differences between the domestic and the Dom & Inter groups' performance (ttesp p= 0.4376).

[INSERT TABLE 9 AROUND HERE]

We can also observe that native language and ethnicity do not have a significant impact, when estimated in the same model as international origin. As we can observe in table 2 and in table 3, group origin, ethnicity and native language are highly correlated. By the descriptive statistic we know that the high majority of international students are Asian with a native language different from English, thus we estimate each of the heterogeneity dimension to better understand the impact of each one.

The second, third and forth columns of table 9 present these estimation results, controlled by gender composition.[41] Model (2) confirms the significant results for origin of the baseline model (1). Model (3) indicates that groups composed by members whose native language is English perform better than those groups where neither of the members has English as native language, as well as groups with mixed languages. Nonetheless there are no significant differences between the ENL groups and the mixed native language groups (ttest p=0.8617). In model (4) we can observe that the groups composed by Asian students perform significantly worse than the No

[39] Although this is a quite interesting study, and we find significant results for both class and tutor, as it is not the main focus of the paper we do not analysis these effects in deep herein. Table 19 in appendix shows the team mark average for tutor by type of group.

[40] We perform OLS regression analysis using the individual data, clustered by groups and find similar results.

[41] Controlling by gender does not alter the estimation results, but increase the goodness of fit of the model.

Asian and mixed ethnicity groups. As in the other heterogeneity dimensions, no significant differences between the No Asian and the mixed group (ttest p= 0.5721). In model (5) we can observe that controlling for language skills the No Asian groups perform better than the Asian groups.

We can also see in table 9 that female and mixed gender groups perform significantly better than male groups, when controlling for other sources of heterogeneity. Nonetheless, model (6) indicates that without these controls, the gender effects are not significant. Female and mixed gender do not differ significantly (ttest p=0.7826).

From these results, we can conclude that there is an effect of skills, ethnicity and gender on team performance. However, is not clear how heterogeneity can actually affect groups. We next analyze team performance by subgroups differences.

5.2. Skills heterogeneity

Table 10 reports the OLS regressions obtained by the interaction between origin and native language dimensions of heterogeneity, controlled by gender group composition:

$$Team\ Performance_i = Status_i * ENL_i\beta + Gender_i\theta + Class + \varepsilon_i \quad (2)$$

[INSERT TABLE 10 AROUND HERE]

We can observe that the team performance is not significant different within the domestic (model 1) and the Dom & Inter group (model 2), when interact origin with native language composition. Between subgroups, model (3) confirms the result that the domestic and the Dom & Inter groups perform better than the international groups and ranks group performance. We can see that the more successful groups are the domestic groups with diverse native languages (gp02_ENL & NENL (Dom)). This group is also significantly better than the Dom & Inter groups (model 4). We can then conclude that heterogeneity in skills does not decrease performance, and can even increase it. Models (4) and (5) confirm that international groups perform worse and that diversity in skills (heterogeneous groups) do not hurts performance. These results do not confirm statistical discrimination, as if this was true, the heterogeneous groups would have worse performance. In turn it confirms that skills heterogeneity benefits teams' performance.

Although we have observed that ENL is highly correlated with ethnicity, as most of international students are Asian, we next analyze the interaction between origin and ethnicity.

5.3. Ethnicity heterogeneity

Table 11 reports the OLS regressions results estimated on the interaction between origin and ethnicity, controlled by gender group composition:

$$Team\ Performance_i = Status_i * Ethnicity_i\beta + Gender_i\theta + Class + \varepsilon_i \qquad (3)$$

[INSERT TABLE 11 AROUND HERE]

We can observe in model (1) that within domestic groups there are no statistical differences. Within the Dom & Inter groups we find that groups with diverse ethnics perform better than the Asian groups. No differences between the mixed ethnic and the no Asian groups (ttest p= 0.5675). This result again confirms the absence of taste discrimination. Between groups, we can see in model (3) that all subgroups perform significantly better than the international group, as in the previous models. Nonetheless, the ranking slightly changes. Domestic group without Asian students is the best group, which is also better than the Dom & Inter groups (model 4). The second worse group is the Asian heterogeneous, which is significant worse than the domestic group (model 5). We conjecture that these results are related to skills and thus, it is possible to find some statistical discrimination from the domestic Asians to the international Asians. Thus, we conclude that ethnic heterogeneity improves team performance when compared to gather minority groups.

We can see that the majority of the models indicate that female groups are significantly better than males groups and in some of the models, we observe that mixed gender groups are also better than men. We next analyze the interaction between origin and gender.

5.4. Gender heterogeneity

Table 12 reports the OLS regressions obtained by the interaction between origin and gender group composition.

$$Team\ Performance_i = Status_i * Gender_i\beta + Class + \varepsilon_i \qquad (4)$$

[INSERT TABLE 12 AROUND HERE]

Within domestic groups we can observe in model (1) that indeed female groups perform better than mixed gender and male groups. Mixed gender groups also perform significantly better than male groups among the domestic students (ttest p= 0.0430). Within the Dom & Inter groups we do not find significant differences in gender group composition (model 2). Between groups we can observe in model (3) that the more productive groups are domestic female groups, who perform significant better than the Dom & Inter groups on average (model 4). In model (3) we can also see that the male Dom & Inter groups do not perform significant better than the internationals on average. We can see in model (4) and (5) that the female international groups perform significantly worse that the Dom & Inter and the domestic groups on average.

We can then conclude that heterogeneity matters to performance. In each of the team heterogeneity dimension analyzed here, we find that heterogeneity does not harm performance and it can in fact increase it if the students fell as insiders (have adapt to the society). We next analyze to what extend it matters to learning and knowledge spillover.

5.5. Learning

5.5.1. Team learning

We consider that a team learns when both of its members increase their mark in the individual task, which is a similar case study. We observed that team learning happened in 54% of the cases, individual learning (just one member increase their mark) in 33% of the case and in 13% of the cases the team does not improve in the individual task (none of the members increase their mark). Thus, we can conclude that, in most of the cases, teamwork leads to an increase on individual performance. It is interesting to understand the group characteristics that increase the probability of success and the individual characteristics that better explain it.

We first model a logit regression for team learning considering the same team characteristics as in the previous models, using the pairwise data. Let L_{ij} represent the team learning, such that if both student i and student j improve their mark in the individual task, L_{ij}=1, else, L_{ij}=0. The model suggested here proposes that the probability of team learning depends on the incentives to increase their mark in relation to the team task mark (total) and on the characteristics of the group they were in the team task (X_i):

Prob (L_{ij}=1)=Prob (L_{ij}>=0),

$$Lij = Total_i \alpha + X_i \beta + Class + \varepsilon_i \qquad (5)$$

[INSERT TABLE 13 AROUND HERE]

Table 13 shows the relation between team learning and group characteristics. We can observe that lower the team mark is, higher the probability of both group's members increasing their individual mark. This is not surprising and indicates that lower the team mark, higher the incentives to work hard. In model (1) we can observe that working in a domestic, ENL, mixed native language or female group increases the probability of team learning. Analyzing by heterogeneity's dimensions, we can see that being in a domestic group (model 2), in an ENL or Dom & Inter native language group (model 3) increases the probability of team learning. Being in an Asian group slightly decreases it (model 4). We can see that when controlling origin and native language, being in a female group increases the probability of success, however, when just controlling for ethnicity or with no controls, we do not find any gender differences (model 5). Note that these results do not depart much from the team performance. As before, we then analyze team learning by subgroup, based on origin and native language, ethnicity and gender.

[INSERT TABLE 14 AROUND HERE]

Table 14 shows that within domestic there is no significant difference. Within Dom & Inter we can observe that working in a team where both students are ENL speakers highly increases the probability of learning success in comparison both with mixed language and NENL groups. Nonetheless, having at least one member in the group who is ENL is highly recommended to team learning. Note that these groups were the more successful in the team task. Between groups we can observe that working in any one of the domestic subgroups or in the ENL groups of the Dom & Inter group increase the probability of team learning (model 3,4 and 5). We cannot see significant differences between the mixed language and the NENL Dom & Inter subgroups and the international groups.

[INSERT TABLE 15 AROUND HERE]

Analyzing by ethnicity, we can see that as in the native language analysis, no differences within the domestic groups are found, in contrast, within the Dom & Inter groups we do not find significant differences. Between groups, we cannot observe significant differences between the Dom & Inter and the international groups, but we can see that working in any of the domestic groups increases the probability of team learning.

In terms of gender diversity, we can observe in the majority of the models of tables 14 and 15 that being in a female group increase the probability of team learning. In table 16 we analyze these differences according to origin subgroups. We can observe that within domestic groups, being in a female or even in a mixed gender group increase the learning probability in comparison with being in a male group. Within the Dom & Inter groups we can observe that being in a mixed gender group decrease the probability of success, when compared to the male group. Between groups, we can observe that working in female or mixed gender group increase the probability of success in comparison to being in an domestic male group, Dom & Inter or international group of any gender type.

[INSERT TABLE 16 AROUND HERE]

In the team performance models we find that heterogeneity increases, or at least does not damages team performance. However, in the team learning models we find that being in a heterogeneous group decreases team leaning in comparison to being in a domestic group and do not increases it in comparison to the international groups.

Thus, we can conclude that heterogeneity increases team performance but does not improve team learning.

5.5.2. Individual learning

To analyze which individual characteristics better explain success, we analyze the relation between individual mark and individual and group characteristics. We model it as:

$$Individual\ task_i = X_i\beta + Class + \varepsilon_i \qquad (6)$$

Where X_i represent the origin and demographic individual characteristic.

[INSERT TABLE 17 AROUND HERE]

Table 17 shows the results of an OLS regression model of individual performance estimated on the individual data (one observation per individual). We can observe that younger students, females and domestic students have higher propensity to individual learning. We can also observe that the team mark gained a few weeks before, have a positive signal in the individual task mark, which is straightforward. It is however interesting to analyze if and to what extend the group characteristics influences the individual mark, we model an OLS regression as:

$$Individual\ task_i = Status_i\beta + ENL_i\alpha + Ethnicity_i\delta + Gender_i\theta + Class + \varepsilon_i \qquad (7)$$

[INSERT TABLE 18 AROUND HERE]

In table 18 we can observe that origin and gender are the variables with more explanatory power. In model (1) we observe that being previously in an international or Dom & Inter group have a negative influence in individual performance (model 1 and 2). Females are more productive if in a female group and better than males (model 1,2,3 and 5). Being in a group where both or at least one member is has not English as native language is not positive to individual mark. This indicates that indeed English is a skill requirement. Finally we can observe that being in a Caucasian group is also positive to individual performance. Although Ethnicity and Native language are highly correlated this analysis is important, as we find that being in an Asian group does not influence significantly the results, just being in a Caucasian group. We conjecture that this result gives more weight to skill diversity than to ethnicity.

6. Conclusion and discussion

This paper presents evidence of the effect of heterogeneity on teams' performance. Our findings indicate that heterogeneity in origin (domestic & international), skills (English Native language (ENL) & NENL) and ethnicity (Asian & no Asian) have a positive impact on teams' performance in relation to homogenous international, NENL and Asian groups, respectively. However, we find no differences in performance of heterogeneous and homogenous domestic, ENL and no Asian groups.

These findings suggest that heterogeneous teams are highly recommended to mitigate the low performance observed in homogeneous minority teams, as international and Asian and also in homogeneous less skilled teams, because they do not perform worse than high skilled or majority (domestic and no Asian) teams. Our study also suggests that females and mixed gender teams perform equal but better than male teams.

These results are based on a field experiment conducted in the University of Sydney. The subjects' population consists of 972 first year business students, 57% ENL, 46% female and 49% Asian, randomly pared according to origin (international and domestic) to perform a team task. The data allow us to derive conclusions of different sources of heterogeneity interacting with the international and domestic origin. This interaction is quite relevant as the main findings suggest that international teams perform worse independently of gender, skills or ethnicity.

In terms of skills diversity we find that the more successful groups are the domestic ones with subjects with diverse native languages. These groups are also significantly better than the Dom & Inter groups. This indicates that skills' heterogeneity is positive to team performance, when there is origin integration. In terms of ethnicity we find that within Dom & Inter (domestic & international) the mixed ethnic groups perform better than the Asian groups, who perform worse than the homogeneous domestic groups. This result could suggest some statistical discrimination from domestic Asian towards international Asians, as in these groups the costs of communication, which could harm productivity in diverse teams (Lazear, 1998), should be low.

Finally, in relation to the interaction of origin and gender we find that within domestic groups mixed gender and male perform equal but worse than female domestic groups. We find no differences within the Dom & Inter groups. Between groups we find some evidence that females in domestic groups are the more productive, while the females in international groups present the worse performance. It seems that gender identity is highly positive in females, as claimed by Akerlof and Kranton (2010), however, this result is valid just when they are in their comfort zone, i.e., integrated in the society.

Our study also provides interesting evidence in how heterogeneity affects the learning process. In terms of team learning, which we consider positive when both subjects improve performance in the individual learning, we find that being in a domestic group, in an ENL or heterogeneous native language group increases the probability of team learning, as well as being in a female group. However, being in an Asian group slightly decreases it.

Therefore, we can conclude that high skills homogeneity and heterogeneity are benefic to team learning and productivity, as claimed by Hamilton et al. (2003). The positive results of domestic origin and female groups could be justified by high collective identification and the negative effect of Asian could be due to a low collective identification.

Van Der Vegt & Bunderson, (2005) found that in teams with low collective identification, diversity was negatively related to team learning and performance; where team identification was high, those relationships were positive.

Gender is normally known for inducing to strong identification. The results of the effect on Females could be due to a higher cooperation between them than men and they could also have it easier to bound with each other. Belonging to a domestic group is also a power source of identification as they are the “insiders” and the others are the “outsiders”. Being in an Asian group in a majority Caucasian country could lead members to feel as “outsiders” and therefore to a low team identification.

In relation to the effects of team heterogeneity in individual learning, we find that being previously in an international or heterogeneous group have a negative influence in individual performance. Similarly, being in a group where both or at least one member is NENL is not positive to individual mark. In contrast, being in a Caucasian group is positive to individual performance. Females are more productive individually if they were in a female group.

These findings suggest that although heterogeneity is positive to team performance as it mitigates the bad performance of low skilled and minorities, in the long run, it might harm individual learning.

Therefore, the main practical implication to education is that teamwork should be encouraged, as the vast majority of students increase their individual mark after performing the team task. In terms of heterogeneity, it is positive for team performance, however it could difficult individual learning.

The practical implications of this study to management and political economics are that it is indeed positive to have a higher or a balanced number of females in the firms. There is no indication of ethnicity discrimination, and ethnic heterogeneity can induce to personal development, which in turn might be positive to creativity and initiative. And finally, skills heterogeneity can also be positive due to information and skills transfer as well as might motivate low skilled workers to increase their performance.

The main limitation of this study is the high correlation between international, Asian and no English native language. An interesting follow up study should disentangle ethnicity and skills. Another limitation of this study is the external validity of these results to the labor market and organizational design, as the subjects are first year students and lack of labor experience. Nonetheless our findings are a good indicator of group behavior. Research with more experienced subjects would give robustness to the positive effect heterogeneity in teamwork.

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Appendix A

Please complete this short questionnaire about yourself.

1. SID:
2. How old are you in years (age):
3. Gender: Female Male
4. International or domestic student International Domestic
5. What is your country of birth?
6. What is/are your nationalities? (If you have more than one please describe)
7. What is your ethnicity? (mark as many as apply)

   ○ Caucasian ○ European ○ Indian

   ○ Asian ○ African ○ White

   ○ Latin ○ Indigenous ○ Black

   ○ Other (please describe)
8. What is your native language?
9. What language do you speak most often at home?
10. What language do you speak most often when talking to your friends?
11. If you were born in a country other than Australia, please indicate the year of your first arrival in Australia:

Appendix B

Tables

Table 1: Level variables

	Mean	N	SD	Min	Max
Origin (international =1)	0.20	193			
Gender (female=1)	0.46	450			
Ethnicity 1 (Caucasian=1)	0.34	331			
Ethnicity 2 (Asian=1)	0.49	481			
Country of birth 1 (Australian =1)	0.59	564			
Country of birth 2 (Asian =1)	0.16	153			
Native language (English =1)	0.57	553			
Language Spoken at home (English =1)	0.66	640			
Language Spoken with friends (English =1)	0.86	835			
Age*	19	910	2.24	17	45
Year of arriving to Australia**	1998	972	7.36	1970	2012
Team mark***	61.83	486	9.04	24	85
Individual task mark	66.76	972	12.12	0	88
Final exam mark (case study part) (out of 50)	30.64	972	8.44	0	47
Final exam mark (other part) (out of 50)	27.77	972	8.69	0	48
Final exam mark	58.42	972	15.89	0	92
Final mark	61.64	972	11.91	0	89

*There were just 10 students over 26

**Those born in Australia were treated as arriving in Australia in their birthday year.

***One observation per group

Table 2: Correlations individual data

	Total	International	Asian	Caucasian	Born_Au	EN_Nat_lg	EN_lg_home	Year in AU	Class	Tutor	Age	Gender
Total	1.00											
International	-0.06	1.00										
	0.07											
Asian	-0.06	0.42	1.00									
	0.08	0.00										
Caucasian	0.04	-0.34	-0.71	1.00								
	0.18	0.00	0.00									
Born_Au	0.06	-0.59	-0.43	0.39	1.00							
	0.08	0.00	0.00	0.00								
EN_Nat_lg	0.06	-0.47	-0.55	0.58	0.55	1.00						
	0.07	0.00	0.00	0.00	0.00							
EN_lg_home	0.06	-0.46	-0.56	0.48	0.44	0.60	1.00					
	0.07	0.00	0.00	0.00	0.00	0.00						
Year arrive AU	-0.07	0.76	0.47	-0.40	-0.76	-0.54	-0.49	1.00				
	0.02	0.00	0.00	0.00	0.00	0.00	0.00					
Class	-0.12	-0.08	-0.10	0.06	0.06	0.06	0.08	-0.06	1.00			
	0.00	0.02	0.00	0.07	0.08	0.07	0.02	0.05				
Tutor	-0.10	0.03	-0.01	0.02	-0.01	0.03	0.04	0.02	0.09	1.00		
	0.00	0.41	0.77	0.54	0.74	0.41	0.28	0.50	0.01			
Age	-0.01	0.18	0.04	-0.02	-0.22	-0.12	-0.11	-0.02	-0.03	-0.02	1.00	
	0.82	0.00	0.19	0.54	0.00	0.00	0.00	0.56	0.45	0.62		
Gender	0.05	0.14	0.17	-0.13	-0.10	-0.12	-0.13	0.14	-0.03	0.01	-0.04	1.00
	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.80	0.23	

Table 3: Correlation pairwise data

	Total	International group	Female group	Asian group	English Nat Lang group	Born AU group	Caucasian group	Class	Tutor
Total	1.00								
International gp	-0.08	1.00							
	0.09								
Female group	0.08	0.20	1.00						
	0.08	0.00							
Asian group	-0.07	0.43	0.17	1.00					
	0.11	0.00	0.00						
ENL group	0.08	-0.48	-0.13	-0.54	1.00				
	0.09	0.00	0.00	0.00					
Born AU group	0.08	-0.61	-0.12	-0.45	0.57	1.00			
	0.10	0.00	0.01	0.00	0.00				
Caucasian gp	0.06	-0.34	-0.11	-0.70	0.55	0.40	1.00		
	0.21	0.00	0.01	0.00	0.00	0.00			
Class	-0.12	-0.11	-0.04	-0.13	0.08	0.08	0.08	1.00	
	0.01	0.02	0.42	0.00	0.09	0.09	0.07		
Tutor	-0.10	0.04	0.01	-0.01	0.04	-0.01	0.03	0.08	1.00
	0.02	0.41	0.85	0.76	0.41	0.77	0.53	0.07	

Table 4: Percentage of students by subgroup variables:

Group Type	English Native Language		Gender		Ethnicity	
	NENL	ENL	Male	Female	Caucasian	Asian
Domestic	31%	69%	59%	41%	42%	38%
Dom & Inter	61%	39%	46%	54%	22%	66%
International	95%	5%	35%	65%	3%	93%
Total	43%	57%	54%	46%	34%	49%

Table 5: Team mark per type of group

	Average	Sta Deviation	Minim	Maxim	N
Domestic	62.22	9.12	24	85	313
Dom & Inter	61.53	8.67	40	80	153
International	58.15	10.03	41	80	20
ENL	62.21	9.60	35	85	167
ENL & NENL	62.37	8.42	24	80	219
NENL	60.03	9.24	37	80	100
No Asian	62.56	8.88	37	85	129
Asian & No Asian	62.01	8.84	24	81	233
Asian	60.75	9.52	37	80	124
Female	62.53	8.53	40	82	106
Mixed gender	62.24	8.96	37	85	238
Male	60.63	9.48	24	81	142
Total	61.83	9.04	24	85	486

Table 9: Relation between team performance and group characteristics - Pairwise OLS

	(1) Baseline	(2) Origin	(3) Native Language	(4) Ethnicity	(5) Language & Ethnic	(6) Gender
Domestic Group	4.98**	6.19***				
	(2.15)	(1.95)				
Dom & Inter Group	3.68*	4.72**				
	(2.1)	(1.98)				
ENL Group	0.15		2.36**		1.16	
	(1.36)		(1.08)		(1.29)	
ENL & NENL Group	1.21		2.43**		1.81	
	(1.2)		(1.05)		(1.17)	
No Asian Group	1.71			2.87***	(2.28)*	
	(1.33)			(1.10)	(1.32)	
Asian & No Asian Group	0.59			1.65*	0.98	
	(1.09)			(0.96)	(1.08)	
Female Group	2.49**	2.31**	2.03*	2.13*	(2.20)**	1.68
	(1.11)	(1.11)	(1.11)	(1.11)	(1.11)	(1.11)
FEM & Male Group	1.66*	1.45	1.29	1.53*	(1.54)*	1.1
	(0.92)	(0.91)	(0.91)	(0.92)	(0.92)	(0.91)
Constant	59.13***	60.00***	64.03***	63.45***	62.62***	66.63***
	(3.06)	(3.81)	(3.39)	(2.58)	(2.66)	(2.44)
Class Dummies	yes	yes	yes	yes	yes	yes
AjdR-sq	0.23	0.23	0.22	0.23	0.23	0.22
Obs	486	486	486	486	486	486

Table 10: Team performance and skills heterogeneity: Pairwise - Subgroups ENL/NENL

	Within				Between: Group comparison					
ENL	**Domestic (1)**		**Dom & Inter (2)**		**To International (3)**		**To Dom & Inter (4)**		**To Domestic (5)**	
gp01_ENL (Dom)	1.022	1.639			6.184***	2.014	1.402	1.001		
gp02_ENL & NENL (Dom)	1.520	1.731			6.977**	2.063	2.182**	1.084		
gp03_NENL (Dom)	0.000	(omitted)			4.530***	2.342	-0.253	1.567		
gp11_ENL (Het)			-0.874	3.082	4.049	3.016			-2.175	2.542
gp12_ENL & NENL (Het)			1.481	1.812	5.037**	2.064			-1.228	1.010
gp13_NENL (Het)					4.384**	2.264			-1.847	1.388
gp20 NENL (Int)					0.000	(omitted)	-4.747**	1.984	-6.226**	1.958
Female	3.662**	1.444	0.831	2.287	2.387**	1.113	2.365**	1.109	2.327*	1.111
Mix_gender	1.413	1.102	1.146	2.201	1.507*	0.915	1.501*	0.913	1.458	0.914
Constante	64.81***	3.939	62.688***	8.327	54.493***	2.389	64.488***	3.363	66.245***	3.274
Class Dummies	Yes		Yes		Yes		Yes		Yes	
AjdR-sq	0.23		0.2		0.23		0.23		0.23	
Obs	313		153		486		486		486	

Table 11: Team performance and ethnic heterogeneity: Pairwise - Subgroups Asian/NoAsian

	Within				Between: Group comparison					
Asian	**Domestic (1)**		**Dom & Inter (2)**		**To International (3)**		**To Dom & Inter (4)**		**To Domestic (5)**	
Gp01_Asian_Dom	0.000	(omitted)			5.091**	2.244	0.478	1.406		
Gp02_Asian_noAsian_Dom	0.574	1.485			6.026***	2.027	1.360	1.018		
Gp03_noAsian_Dom	1.510	1.548			6.764***	2.040	2.105**	1.079		
Gp11_Asian_Het			0.000	(omitted)	3.652*	2.189			-2.453**	1.254
Gp12_Asian_noAsian_Het			2.940*	1.680	5.071**	2.079			-1.051	1.077
Gp13_noAsian_Het			2.381	3.367	6.663**	3.223			0.485	2.705
Gp20_Int					0.000	(omitted)	-4.690**	1.986	-6.151***	1.952
Female	3.756**	1.445	0.892	2.259	2.444**	1.116	2.416**	1.113	2.333**	1.111
Mix_gender	1.591	1.115	0.960	2.202	1.644*	0.925	1.604*	0.922	1.488	0.915
Constant	65.203***	3.885	51.659***	8.838	59.855***	3.824	64.607***	3.374	66.098***	3.266
Class Dummies	Yes		Yes		Yes		Yes		Yes	
AjdR-sq	0.23		0.2		0.23		0.23		0.23	
Obs	313		153		486		486		486	

Table 12: Team performance and gender heterogeneity: Pairwise – Subgroups Female/Male

	Within				Between: Group comparison					
Gender	Domestic (1)		Dom & Inter (2)		To International (3)		To Dom & Inter (4)		To Domestic (5)	
female_Dom	0.000	(omitted)			7.620***	2.207	3.110**	1.357		
mix_gender_Dom	-3.639**	1.438			4.367**	2.048	-0.128	1.071		
male_Dom	-2.262*	1.364			5.9034***	1.990	1.398	0.998		
female_Het			0.000	(omitted)	4.804**	2.259			-0.788	1.441
mix_gender_Het			-0.826	2.273	3.705	2.420			-1.812	1.645
male_Het			0.095	1.824	4.617**	2.093			-1.019	1.072
female_Int							-5.859*	3.049	-6.997**	3.019
mix_gender_Int							-3.668	5.970	-4.716	6.001
male_Int							-3.585	2.735	-4.743*	2.738
Constant	69.688***	3.789	65.000***	7.745	61.746***	3.770	66.265***	3.320	66.837***	3.259
Class Dummies	Yes		Yes		Yes		Yes		Yes	
AjdR-sq	0.24		0.2		0.23		0.22		0.23	
Obs	313		153		486		486		486	

Table 13: Relation between team leaning and group characteristics - Pairwise Logit regression

	(1) Baseline		(2) Origin		(3) Native Language		(4) Ethnicity		(5) Gender	
Total	-0.276***	0.030	-0.261***	0.028	-0.264***	0.029	-0.242***	0.027	-0.239***	0.027
Domestic Group	1.037***	0.372	1.284***	0.335						
International Group	-0.361	0.812	-0.713	0.759						
ENL Group	1.648***	0.533			1.809***	0.434				
ENL & NENL Group	0.876**	0.449			0.818**	0.379				
Asian Group	0.638	0.506					-0.733*	0.397		
Asian & No Asian Gp	0.419	0.371					-0.182	0.328		
Female Group	0.914**	0.417	0.850**	0.408	0.795**	0.403	0.634	0.392	0.495	0.381
FEM & Male Group	0.353	0.354	0.390	0.343	0.279	0.334	0.249	0.334	0.132	0.325
Constant	15.929***	2.118	16.102***	2.036	16.336***	2.053	16.299***	1.990	16.043***	1.985
Class Dummies	yes		yes		yes		yes		yes	
Pseudo R2	0.43		0.42		0.42		0.39		0.39	
Obs	465		465		465		465		465	

Dependent variable: both improve in individual task: yes=1; No=0.
Origin group type (International=2); Ethnicity group type (Asian =2); Native language group type (ENL=2); Gender group type (female=2).

Table 14: Team learning and skills heterogeneity: Pairwise data - Subgroups ENL/NENL. Logit regression

	Within				Between: Group comparison					
ENL	**Domestic (1)**		**Dom & Inter (2)**		**To International (3)**		**To Dom & Inter (4)**		**To Domestic (5)**	
Total	-0.297***	0.042	-0.338***	0.079	-0.276***	0.030	-0.266***	0.029		
gp01_ENL (Dom)	0.748	0.631			2.395***	0.811	1.598***	0.394		
gp02_ENL & NENL (Dom)	0.236	0.650			1.843**	0.799	1.063***	0.408		
gp03_NENL (Dom)	0.000	(omit)			1.635*	0.895	0.885	0.563		
gp11_ENL (Het)			6.518***	2.369	3.388**	1.330			1.251	1.121
gp12_ENL & NENL (Het)			2.218**	0.957	0.968	0.791			-1.101***	0.372
gp13_NENL (Het)			0.000	(omit)	-0.230	0.867			-2.291***	0.564
gp20 NENL (Int)					0.000	(omit)	-0.753	0.762	-2.020***	0.771
Female	1.619***	0.575	-1.379	1.171	0.983**	0.421	0.893**	0.410	0.935**	0.419
Mix_gender	0.859*	0.450	-0.835	0.988	0.466	0.347	0.386	0.344	0.470	0.347
Constante	18.905***	2.909	21.897***	5.300	16.094***	2.058	16.413***	2.072	17.805***	2.107
Class Dummies	Yes		Yes		Yes		Yes		Yes	
Pseudo R2	0.44		0.52		0.44		0.42		0.44	
Obs	269		98		465		465		465	

Table 15: Team performance and ethnic heterogeneity: Pairwise data - Subgroups Asian/No Asian. Logit regression

	Within				**Between: Group comparison**					
Asian	**Domestic (1)**		**Dom & Inter (2)**		**To International (3)**		**To Dom & Inter (4)**		**To Domestic (5)**	
Total	-0.290***	0.041	-0.315***	0.079	-0.266***	0.029	-0.264***	0.029	-0.263***	0.029
Gp01_Asian_Dom	0.130	0.607			2.692***	0.902	1.983***	0.561		
Gp02_Asian_noAsian_Dom	0.008	0.429			1.946**	0.793	1.206***	0.383		
Gp03_noAsian_Dom	0.000	(omitted)			1.876**	0.799	1.117***	0.402		
Gp11_Asian_Het			-0.985	1.257	0.079	0.831			-1.965***	0.480
Gp12_Asian_noAsian_Het			0.104	1.233	1.038	0.807			-0.987**	0.408
Gp13_noAsian_Het			0.000	(omitted)	1.528	1.073			-0.463	0.838
gp20_Int					0.000	(omitted)	-0.743	0.764	-2.000***	0.767
Female	1.517***	0.570	-1.346	1.051	0.852**	0.415	0.790*	0.411	0.914**	0.412
Mix_gender	0.835*	0.457	-1.619*	0.982	0.389	0.354	0.331	0.351	0.444	0.347
Constant	18.908***	2.864	21.820***	5.353	15.869***	2.029	16.482***	2.072	17.537***	2.074
Class Dummies	Yes		Yes		Yes		Yes		Yes	
Pseudo R2	0.44		0.43		0.43		0.42		0.43	
Obs	269		98		465		465		465	

Table 16: Team performance and gender heterogeneity: Pairwise data – Subgroups Female/Male. Logit regression

	Within				Between: Group comparison					
Gender	Domestic (1)		Dom & Inter (2)		To International (3)		To Dom & Inter (4)		To Domestic (5)	
Total	-0.290***	0.041	-0.316***	0.081	-0.268***	0.029	-0.266***	0.029	-0.260***	0.029
female_Dom	1.532***	0.566			2.809***	0.875	2.122***	0.519		
mix_gender_Dom	0.845*	0.449			1.990**	0.786	1.326***	0.386		
male_Dom	0.000	(omitted)			1.180	0.801	0.499	0.399		
female_Het			-1.604	1.054	0.597	0.871			-1.212**	0.518
mix_gender_Het			-1.978**	0.973	0.491	0.793			-1.322***	0.397
male_Het			0.000	(omitted)	1.264	0.939			-0.547	0.603
female_Int							-0.610	1.189	-1.849	1.163
mix_gender_Int							-1.169	1.031	-2.321**	1.044
male_Int							0.000	(omitted)	0.000	(omitted)
_cons	18.891**	2.835	21.044***	5.490	16.289***	2.046	16.844***	2.059	17.850***	2.115
Class Dummies	Yes		Yes		Yes		Yes		Yes	
Pseudo R2	0.44		0.41		0.43		0.43		0.41	
Obs	269		98		465		464		464	

Table 17: Individual learning and individual characteristics.

	(1) Baseline		(2) Baseline	
Age	-0.394**	0.182	-0.395**	0.181
Female	1.572**	0.794	1.376*	0.790
International	-3.493***	1.136	-3.184***	1.131
Caucasian	0.843	1.024	0.775	1.017
ENL	-0.107	1.042	-0.155	1.034
Total			0.187***	0.050
Constant	77.334***	4.318	65.023***	5.408
Class Dummies	yes		yes	
R-squared	0.12		0.14	
Obs	972		972	

Table 18: Individual learning and group characteristics.

	(1) Baseline		(2) Origin		(3) Native Language		(4) Ethnicity		(5) Gender	
Dom & Inter Group	-1.834*	1.015	-2.467***	0.923						
International Group	-5.017**	2.237	-6.203***	2.049						
NO ENL Group	-1.869	1.463			-3.376***	1.136				
ENL & NENL Group	-0.814	1.091			-1.803**	0.926				
No Caucasian Group	-0.557	1.603					-2.751**	1.358		
Mix Ethnic Group	-1.031	1.462					-2.180*	1.317		
Female Group	2.338**	1.168	2.249**	1.164	1.935*	1.157	1.654	1.155	2.206**	1.037
FEM & Male Group	-0.202	0.960	-0.283	0.958	-0.438	0.956	-0.640	0.954	0.770	0.953
Constant	71.814***	2.745	70.846***	2.539	71.352***	2.568	69.786***	2.627	69.909***	2.446
Class Dummies	yes		yes		yes		yes		yes	
R-squared	0.12		0.12		0.11		0.11		0.1	
Obs	972		972		972		972		972	

Table 19: Team mark per tutor by type of group.

	Type of group						Total		
	Domestic		Dom & Inter		International				
Tutor	Tem Mark Average	N	Tem Mark Average	N	Tem Mark Average	N	Tem Mark Average	N	Number classes
1	62.12	33	59.88	8	56.00	1	61.55	42	5
2	61.17	12	56.80	5			59.88	17	2
3	64.54	13	62.40	15	62.00	2	63.30	30	3
4	60.97	37	63.64	11	62.00	1	61.59	49	6
5	66.86	14	67.80	5	58.00	1	66.65	20	2
6	67.76	34	66.19	21	65.17	6	66.97	61	7
7	62.07	15	63.86	7			62.64	22	3
8	54.00	4	66.00	4	62.00	1	60.22	9	1
9	60.35	46	56.82	22	53.67	3	58.97	71	9
10	66.92	13	68.00	7	56.00	1	66.76	21	2
11	57.29	55	56.74	27	45.00	1	56.96	83	9
12	68.44	16	66.90	10	53.00	1	67.30	27	3
13	66.60	5	67.00	1			66.67	6	1
14	61.44	16	58.10	10	47.50	2	59.25	28	3
Total	62.22	313	61.53	153	58.15	20	61.83	486	56