ESSAYS ABOUT SOCIAL CATEGORIZATION EFFECTS ON ECONOMIC BEHAVIOR

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The Essays

This collection of essays explores the interrelations of economics with social psychology. Its specific purpose is to foster an improved understanding of how man's social context influences economic behavior and incentives.

In particular, the three essays examine incentive effects of people's social categorizations, meaning their affiliations to social categories. Social categories are classes or divisions that result from arranging, segmenting, and ordering the social environment (Tajfel and Turner, 1986; Tajfel, 2010). Individuals use social categorizations to define themselves and others in social terms. The sum total of social categorizations used by an individual to define him- or herself in social terms is often referred to as this person's social identity (Turner, 1982). Accordingly, this work incorporates and considers a person's social identity as an important conceptual addition to social categorization.

The first essay analyzes the impact of social categorization on agents' incentives to provide cooperating inputs to a team production process. I extend Holmström's (1982) model of team production by incorporating agents' social category affiliations and present conditions under which we may observe a convergence of individual allocation preferences in a team. It is shown how agents' considerations about the salience of common social categorizations (i.e. of social groups) can influence individual free-rider incentives and the team's performance characteristics. The derived insights are discussed with regard to their implications for research topics such as organizational structure or group consolidation processes as in M&A.

The paper contributes to the pertinent (socio-)economic literature in that it proposes a general formal framework for group-related economic analysis. Its findings help synthesize observations from the experimental social group and identity literature (e.g., Charness et al., 2007; McLeish and Oxoby, 2011; Guala et al., 2013). The study aims to facilitate the analytical accessibility of social

group and categorization phenomena in economic research in general and team production research (e.g., Eckel and Grossman, 2005) in particular.

The second essay scrutinizes incentive effects of performance feedback in firms where agents socially categorize themselves along performance criteria. The study was published in Managerial and Decision Economics. Based on the work by Akerlof and Kranton (2000, 2008), the paper examines how work incentives of agents with category-specific performance identities may vary for different feedback configurations at the workplace. In a principal-agent model, I show that depending on the agent's identity type, the principal can use performance feedback to reinforce or undermine agents' identities and thereby lower the cost of incentive pay. Agents with high performer identities are predicted to discontinue work in the absence of identity-adjusted wages.

The paper introduces a social categorization rationale to the discussion of feedback-driven work incentives in the literature. The analysis helps motivate performance-enhancing effects of feedback (e.g., Alvero et al., 2001; Fedor et al., 2001), and it can explain cases of low work engagement in firms (Murphy, 2013). The work adds to a growing body of economic theory investigating the role of social identity in economics, pioneered by Akerlof and Kranton (2000).

The third essay, written together with my supervisor Roland Kirstein, was published in Economics Bulletin. In this paper, we analyze the optimal pricing of sports tickets in markets where spectators socially categorize themselves as fans of a focal sports team and identify with the team and its supporters. Our identity rationale suggests that repeated match attendance increases spectators' identification with the team, which in turn induces a rise in their willingness to pay for tickets. The paper derives conditions under which a profit-maximizing team has an incentive to temporarily price its match tickets below a short-term optimum level if the venue capacity is not binding. We discuss the potential of the model to explain permanently low ticket prices and optimal prices below maximum sell-out levels.

The paper helps explain cases of apparent underpricing in primary ticket markets, a phenomenon frequently reported in the sports economics literature (Fort, 2006). The identification rationale that is proposed in this paper adds to a body of potential explanations as to why producers may choose to underprice their products, including fairness considerations (e.g., Kahneman, Knetsch, and Thaler, 1986) or the signaling of popularity (Becker, 1991). The social identity approach may have particular merit in major sports leagues with media-hyped matches exposing spectators to a high-involvement social activity.

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ESSAY I

GROUP ENTANGLEMENT IN TEAM PRODUCTION

Group Entanglement in
Team Production

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Abstract

When people's group affiliations become salient, their behavior towards each other can change. Following the literature, this paper presents conditions under which we may observe a convergence of individual allocation preferences in a group, a phenomenon denoted in this work as group entanglement. A team production model is used to examine the implications of group entanglement for agents' incentives to provide cooperative inputs to the production process. It is highlighted that the existence of social groups in a team, and agents' salience considerations about these groups, can influence a team's performance characteristics. The work suggests managerial and organizational lessons of group entanglement in teams.

Keywords: team production; economic organization; social categorization; social group

JEL Codes: D23; L23

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1 Introduction

For decades, the economics of team production have been a prominent and challenging subject for researchers. In their seminal paper, Alchian and Demsetz (1972, p.779) specify team production as production "in which 1) several types of resources are used and 2) the product is not a separable output of each cooperating resource. [...] – 3) not all resources used in team production belong to one person." A metering problem in team production occurs because measuring the marginal productivities of inputs may either be impossible or more expensive than with other production types. A direct consequence of the metering problem is that compensation cannot be (perfectly) tied to individual performance, and free-rider incentives may thus arise. It is this inefficiency in team production that forms the economic problem addressed in this work.

Holmström (1982) was the first to provide a general proof that budget-balanced sharing contracts do not implement efficient efforts in equilibrium if agents are risk-neutral and choose their non-verifiable efforts simultaneously. Nevertheless, the literature features a number of very insightful approaches to the team production problem and its variants: for example, Rasmusen (1987) shows that sharing contracts may implement efficient equilibrium efforts if agents are risk averse; Strausz (1999) demonstrates how sharing rules can solve the free-rider problem if team production is sequential; and Kirstein and Cooter (2007) derive conditions for which team profits are higher under internal anti-sharing than under budget-balanced sharing.

This work approaches teams from a socio-psychological perspective and examines implications of different (social) group structures in teams on individual work incentives. It acknowledges the role that people's social group affiliations may play in their decisions to allocate resources. Following a large body of socio-psychological and economic studies, conditions are presented under which we may observe what will be referred to in this study as group

entanglement: a convergence of the allocation preferences of individuals in a group insofar as a mutual group-related interest is adopted.

Group entanglement phenomena have been a very consistent finding in the (socio-)economic and identity literature (e.g., Eckel and Grossman, 2005; Charness et al., 2007; Guala et al., 2013). The present study develops a formal framework that helps to unify a number of themes from the literature. The aim is to foster the analytical accessibility of group entanglement phenomena in economic research in general and in team production research in particular. The paper contributes to the analysis of the free-rider problem in teams in that it offers a socio-economic rationale for variations in team production output. It is argued that *salience considerations* in a team with regard to agents' social group affiliations can alter individual work incentives if group entanglement is present. This study is particularly related to the work by Eckel and Grossman (2005), who examine the free-riding behavior of group-affiliated subjects in a repeated-play public goods game framed as a team production problem.

The remainder of the work is organized as follows. The next chapter reviews the relevant literature. Chapter 3 uses important socio-psychological terms and concepts to develop a formal framework for group-related economic analysis. Chapter 4 applies the framework to a group-contingent model of team production and examines implications of group entanglement for agents' work incentives. Chapter 5 concludes.

2 Literature

Socio-psychological and economic studies have provided many valuable insights into behavioral implications of group affiliation and group awareness. Section 2.1 introduces the relevant experimental literature. Section 2.2 presents the corresponding theories.

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2.1 Behavioral Phenomena in Groups

2.1.1 Minimal Group Studies in Social Psychology

Social psychologist Henri Tajfel was among the first researchers to study implications of arbitrary group distinctions for (inter)group behavior. In his seminal experiment (1970), Tajfel assigned subjects to either one of two distinct groups after they had completed a given task. Following the completion of the task, the subjects were informed that their division into groups resulted from an assessment of their performance based on some trivial criterion. For example, in one treatment, the assignment was said to be based on participants' expressed preferences for either Klee's or Kandinsky's paintings, whereas in a second treatment, the subjects were said to be categorized according to their tendency to over- or underestimate the number of dots displayed on a screen. After being expressly made aware of their group assignment, individuals were taken one-by-one to separate rooms and asked to allocate monetary rewards to two other subjects. The two potential recipients of the rewards were kept anonymous to the giving person with the exception of a single attribute: their group affiliation (e.g., "Reward for member no. 74 of the Kandinsky group").

The findings were striking. Subjects allotted significantly more money to members of their own group than to members of the other group. Tajfel thus concluded that favoring one's own group (or the *ingroup*) was the deliberate strategy that the participants used to make allocation choices.

Subsequent experiments (e.g., Tajfel et al., 1971; Tajfel and Billig, 1973) demonstrated that ingroup favoritism—the propensity to favor one's own group over another group with respect to behavior or evaluation—prevails even in the absence of social interaction, (economic self-)interest conflicts or a history of hostility between groups. Tajfel and Billig (1973) observed that categorization *per se* was sufficient to trigger ingroup-supportive behaviors, even given an openly random and anonymous assignment of individuals to

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such *minimal* groups.[1] The methodology employed to examine the minimal conditions required to induce ingroup-supportive responses has come to be known as the minimal group paradigm (MGP) in social psychology.

Inspired by the groundbreaking studies of Henri Tajfel and colleagues, social psychologists have continued to replicate the original results through numerous follow-up experiments (for reviews, see, e.g., Brewer, 1979; van Knippenberg and Ellemers, 1990). Similarly, these results have led economists to heed this subject in more recent times. Indeed, economists have made many valuable contributions in analyses of the above type of behavioral peculiarity and have shown increasing interest in the implications of group affiliation for individual decision-making (e.g., Akerlof and Kranton, 2000, 2005; Eckel and Grossman, 2005; Charness et al., 2007; Chen and Li, 2009; Benjamin et al., 2010; Chen and Chen, 2011; McLeish and Oxoby, 2011; Guala et al., 2013). The next section reviews economic studies that serve well in identifying and testing some of the key drivers of group-supportive behavior as observed in Tajfel's minimal group experiments.

2.1.2 Group Salience Research in Experimental Economics

Social psychology's minimal group studies have long gone unnoticed by experimental economists, who have turned their attention to this subject only relatively recently. With the analytical emphasis on the drivers of ingroup-supportive behavior, much research has been conducted to test the impact of people's group affiliations on their cooperative tendencies. The findings attest that individual behavior that benefits one's own group or its members can be observed even if that behavior runs counter to one's economic self-interest.

Experimental results indicate that subjects who are matched with other ingroup members—even if this is done randomly or based on trivial criteria—

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[1] Tajfel et al. (1971) conceived of a set of conditions required for minimal group classification, including no face-to-face interaction between the subjects or the preservation of anonymity in group membership.

exhibit relatively higher levels of cooperation in teams (Eckel and Grossman, 2005); contribute more to the provision of public goods (Guala et al., 2013); vote in favor of tax rates that benefit their group rather than maximizing their own financial payoff (Klor and Shayo, 2010); offer more money to respondents in ultimatum games (McLeish and Oxoby, 2011); and show greater propensity to cooperate in the prisoner's dilemma game (Charness et al., 2007).

Although these observations have merit in that they sustain a behavioral consistency, the underlying studies point to a central insight: the importance of group salience in triggering ingroup-supportive behavior. In general, a group becomes more salient when the existence of a group structure is brought to its members' attention. Framing a repeated-play public goods game as a team production problem, Eckel and Grossman (2005) find that team cooperation increases if the random assignment of subjects to teams is accompanied by means that foster group salience. Accordingly, diverse actions, such as the use of group identification marks (e.g., colored tags) or the inclusion of group tasks prior to the team production stage, are taken to promote group salience.

In a related study, Charness et al. (2007) examine the behavioral effects of group affiliation in battle of the sexes and prisoner's dilemma games. They observe that mere categorization is not sufficient to induce ingroup-supportive responses during these games. However, such an effect on individual behavior is found to become increasingly strong and significant as group membership becomes increasingly salient. Group salience is raised by allowing a player's ingroup to watch (as a passive audience) as the player makes decisions or by providing immediate feedback to the player's ingroup regarding the outcome of a game. The authors conclude that group salience is a necessary condition for group affiliation to produce a behavioral effect.

McLeish and Oxoby (2011) manipulate the salience of existing group structures before having subjects play the ultimatum game. Individuals are found to be more cooperative when a common group affiliation is made salient prior to the game than in a situation in which the distinctiveness of the players

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is primed. Investigating along similar lines, Chen and Chen (2011) provide evidence that free-riding incentives in a minimum-effort game are weaker for subjects matched with ingroup members when groups are made salient to them. For that, subjects with common group affiliations are allowed to communicate with each other via online chat in a preliminary stage of the experiment.

Using a two-person public goods game, Guala et al. (2013) find that knowing oneself to be matched with another ingroup member does not induce higher cooperation levels if subjects are told that their respective other lacks information about her counterpart's group affiliation. However, consistently positive effects on cooperation among ingroup members are observed when group affiliation is common knowledge. Guala et al. thus conclude that theories aiming to explain these behavioral patterns must necessarily include mutual beliefs concerning the salience of a group.

2.2 Theories of Group Behavior

The findings outlined in the previous sections are frequently motivated by the concept of social identity. This concept forms an integral part of the so-called *social identity approach*. The social identity approach, which originated in social psychology, refers to the joint contributions of two related theories known as social identity theory and self-categorization theory.[2] According to this approach, a person's sense of self follows from different levels of identity, namely, personal identity and social identity. Whereas the former concerns a person's categorization as a single individual, social identity relates to a number of social selves that are derived from particular social categories or groups of which the individual perceives herself to be a member and with which she identifies (Turner et al., 1987). Social identification may be described as "the perception of oneness with or belongingness to some human aggregate" (Ashforth and Mael, 1989, p.21); it lets individuals personally experience a

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[2] See Haslam (2004) for a comprehensive discussion.

group's failures and vicariously partake in its accomplishments and successes (Katz and Kahn, 1978).

The development of *social identity theory* traces back to Henri Tajfel's minimal group experiments in the early seventies. Accordingly, social identity theory (Tajfel and Turner, 1986) evolved from the observation that intergroup discrimination and ingroup favoring behavior do not necessitate a conflict in group interests. Instead, individuals' mere perceptions of belonging to distinct groups can suffice to induce such behavior. The observations by Tajfel and his colleagues had not been anticipated by the influential social psychological theories that dominated at the time, particularly *realistic conflict theory* (RCT, Sherif et al., 1961). The essential hypothesis of the realistic group conflict theory is that "real conflict of group interests causes intergroup conflict" (Campbell, 1965, p.287). However, with regard to Tajfel's findings, RCT is silent because it scrutinizes intergroup hostility and competition over scarce resources while neglecting relevant processes that are antecedent to ingroup identification and the development of group or social identity. Because the results of the minimal group studies could not be explained by RCT or other theories, they called for novel approaches.

Social identity theory, as developed by Henri Tajfel and John Turner, assumes that individuals seek a positive self-concept and thus strive for a positive social identity, which may be obtained as a result of more favorable social comparisons between the ingroup and relevant outgroups. Accordingly, the theory suggests that group members will seek to make their ingroup more positively distinct along value-laden comparative attributes and characteristics. Hence, ingroup-supportive behavior corresponds to the perceived status of the group and arises from an attempt to positively differentiate one's own group from relevant outgroups (Tajfel and Turner, 1986). A generalization of social identity theory, in terms of both social relation and context, is provided by what has come to be known as *self-categorization theory*. Developed by social psychologist Turner and colleagues (Turner, 1982; Turner et al., 1987), self-

categorization theory embeds social identity principles in a model of individual self-abstraction. The theory describes the cognitive transition that individual beings may experience when they are confronted with different social stimuli. That is, depending on the social context, a person may *categorize* herself, for example, as a unique individual with a salient personal identity or as an interchangeable group member with a salient social identity. The particular circumstances that trigger such changes in people's self-concepts form the core research object of the self-categorization theory.

The concept of identity was introduced into the standard neoclassical framework of economics relatively recently. Akerlof and Kranton (2000, 2005, 2010) pave the way and discuss the economic implications of people's (social) identities in research areas such as organizations, education, labor and poverty. They suggest that models of behavior that include identity considerations can improve our understanding of economic outcomes in the areas of, for instance, demography, violence, and retirement decisions. Akerlof and Kranton (2000) argue that individual behavior is influenced by social identity, which, in turn, is determined by affiliations to different social categories such as gender, age cohorts, organizations or workgroups. The authors propose a utility function that incorporates social identity as a relevant argument and illustrate ways in which action-specific gains or losses in identity may affect preferences over actions and, thereby, individual behavior. In particular, it is argued that people have identity-based payoffs and may experience disutility to the extent that their own and others' behaviors, physical characteristics, or other attributes do not match category-specific ideals.

In related works, the identity-enhanced quantitative framework is used to examine work incentives at firms. For example, in demonstrating how agents' effort choices may depend on whether they adopt insider or outsider identities in their workgroup, Akerlof and Kranton (2008) derive recommendations for a principal's optimal supervisory regime. Also, Peiss (2017) derives conditions under which the existence of different performance identities at the workplace

may influence the firm's optimal configuration of compensation and feedback instruments.

3 Group Entanglement

In the previous chapter, evidence was presented showing that people's awareness of particular group affiliations can trigger group-supportive actions or responses that may manifest in increased levels of cooperation. It has been noted that for group affiliation to have a behavioral effect, individuals have to recognize a prevailing group structure. As groups become salient, we may find behavioral particularities on the part of group members that are ascribable, for example, to their pursuit of a positively distinct group status (e.g., Tajfel and Turner, 1986) or to group-specific norms and prescriptions (e.g., Akerlof and Kranton, 2000).[3] The extent to which the existence of salient groups affects behavior may differ across groups and group members. In this respect, studies have demonstrated that the salience of groups can be manipulated (e.g., Eckel and Grossman, 2005; McLeish and Oxoby, 2011).

3.1 Conceptual Framework and Terminology

Following much of the literature outlined in the previous chapter, this work suggests an analytic approach to the subject of behavioral particularities in groups, which emphasizes descriptive rather than interpretational elements. Whereas norms and social status considerations are acknowledged as potential motivators behind the observed group phenomena, the group entanglement approach proposed in this work aims to facilitate quantitative accessibility to the subject.

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[3] An example for the latter is found in Yopyk and Prentice's (2005) study, in which student-athletes performed differently on a math test depending on whether their student identity, their athlete identity or no identity was made salient to them. Other studies providing related empirical evidence include Steele and Aronson, 1995, and Hoff and Pandey, 2006.

Group entanglement refers to a convergence of allocation preferences of individuals who share a common group affiliation. This convergence of individual preferences may be conducive to the achievement of superior group performances measured along value-laden attributes and characteristics. It is suggested that conditions exist under which the allocation preferences of group members become *entangled,* insofar as members of the group adopt a mutual, group-related interest. If the resulting preference convergence is sufficiently strong, it may manifest itself through the types of behavior presented in the previous chapter. Following the literature, we can single out recurring elements and situational circumstances that typically precede group entanglement. First, we note that group entanglement necessitates that individuals share a social categorization or, in other words, that individuals are affiliated with a common *social category.* In the spirit of the work by Tajfel and Turner (1986, p.15) and Tajfel (2010, p.17), we define such categories as follows:

D1.   Social categories are classes or divisions that result
from arranging, segmenting, and ordering the social
environment.

Social categories are ubiquitous because they describe our social selves. Examples of social categories may range from fairly comprehensive category types, such as gender, nationality, religion, or age cohort, to more specific or exclusive ones, such as departments or work groups, particular fanbases, or even random classes, as in minimal group experiments (e.g., Tajfel and Billig, 1973). It is the existence of affiliations to common social categories among individuals that distinguishes groups from *social groups*. Whereas a group may merely refer to a number of things or people who are located or gathered together, a social group implies that group members share a common social categorization. Thus, groups are not always social groups, whereas the reverse always holds true.

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We follow Turner (1982, p.36) who assisted in the development of social identity and self-categorization theory and conceptualizes a social group as

D2. […] a number of individuals who have internalized the same social category membership.

Although a common social categorization among individuals and, thus, the existence of a social group is necessary for group entanglement phenomena to be observed, empirical and experimental studies have shown that it may not be sufficient (e.g., Eckel and Grossman, 2005; Charness et al., 2007; McLeish and Oxoby, 2011). Instead, the literature has identified *group salience* as a key condition for whether a common social group affiliation influences individual decision-making. Investigating channels through which group salience can be manipulated, Charness et al. (2007, p.1341) suggest the following specification of group salience, which is adopted hereafter:

D3. […] a group is salient if members of the group recognize its existence and they also believe that other group members recognize it.

Charness et al. note that "a group can be more or less salient depending on several features of the environment" (2007, p.1341). In particular, it may well be the case that group salience perceptions differ among group members. Individual beliefs about the salience of a social group play a vital role and may become subject to information asymmetry with regard to the prevailing group structure (e.g., Guala et al., 2013). Thus, it is useful to establish the notion of the subjective salience of social groups, which relates to individual salience perceptions rather than to an aggregate salience state in the sense of D3. The transition from subjective salience beliefs on the individual level to the more inclusive, group-wide salience state is addressed in the next section.

The above specifications with regard to social categories, social groups and respective salience considerations help to formalize the group entanglement approach proposed in this work. Unlike social identity theory, this approach does not center on the importance of intergroup settings or structures as the explanatory elements of ingroup-supportive behavior by the group members. Instead, the main catalyst of preference convergence in a social group is taken to be the salience state of the social group. Following this reasoning, intergroup structures, or the perception of outgroups, as the drivers of group-supportive behavior are subsumed under the present approach and reclassified as potential channels through which group salience can be increased.

3.2 Social Group Measures

Let $X = \{x_1,...,x_m\}$ be the set of social categories x_k, $k = 1,...,m$, and let $I = \{1,...,n\}$ be a set of individuals $i = 1,...,n$. Moreover, let $X_{(i)}$ be the set of social categories that individual i adopts and let $I_{(x_k)}$, in turn, contain the individuals who affiliate with social category x_k.[4]

This basic notation, in tandem with D1, D2, and D3, allows us to make precise distinctions between groups and social groups in terms of this work. Table 1 displays an exemplary corresponding scheme. Formally, we may refer to a group of individuals, described by set I, as a social group with respect to a social category x_k if I and $I_{(x_k)}$ are equal sets, that is[5]:

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[4] Hence, groups consist of individuals who may well be members of a multitude of social (sub-) groups.

[5] Equivalently, we may say that individuals $i \in I$ form a social group with respect to x_k given $x_k \in \bigcap_i X_{(i)}$.

	1	2	...	n	$I_{(x_k)}$
x_1	+	−	−	+	$\{1, n\}$
x_2	+	+	+	+	I
$\vdots$	−	−	−	−	$\{\ \}$
x_m	−	+	−	+	$\{2, n\}$
$X_{(i)}$	$\{x_1, x_2\}$	$\{x_2, x_m\}$	$\{x_2\}$	$\{x_1, x_2, x_m\}$	

Table 1. Groups, social groups, and social categories.

Note: We identify, for instance, the group I as a social group with respect to the social category x_2. Moreover, individuals 1 (2) and n form a social group with respect to the social category x_1 (x_m). In contrast, we also find group members who do not form social groups with regard to particular social categories, such as the individuals 1 and n for the social category x_m.

$$I_{(x_k)} = I. \tag{1}$$

Let $\dot{I}_{(x_k)} \subset I_{(x_k)}$ be the subset that contains only those x_k-affiliated individuals who consider the social group $I_{(x_k)}$ to be *salient*. We may describe the *degree of salience* of the social group $I_{(x_k)}$ (with respect to a social category x_k) using the following index:

$$\Phi\left(I_{(x_k)}, \dot{I}_{(x_k)}\right) := \frac{\left| \dot{I}_{(x_k)} \right|}{\left| I_{(x_k)} \right|}. \tag{2}$$

Obviously, (2) implies that the proposed measure is only defined for *social* groups.[6] The index describes the salience of a social group that is composed of a particular set of individuals. It counts the number of all individuals who are positive that the scrutinized set of people forms a salient social group and then relates this number to its theoretical maximum.[7]

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[6] This is the case because the cardinality of the empty set is always zero.
[7] It should be noted that although every subgroup of a social group also forms a social group with respect to the same social category, the respective salience measures may certainly differ

4 Teams and Social Groups

In this chapter, conditions are presented under which free-rider incentives in teams occur, giving rise to Holmström's (1982) inefficiency result. Previous insights are used to highlight incentive implications of group entanglement.

4.1 Setup

Consider n homogenous and risk-neutral agents. Agents, indexed as i, simultaneously exert non-verifiable efforts $e_i \geq 0$ to produce and share a joint monetary output $y(e)$, where $e = (e_1,...,e_n)$ is the effort vector.[8] Assume that $y(e)$ is strictly increasing and differentiable with $y_i' > 0$, $y_i'' < 0$, $y(0) = 0$ and with non-negative cross-partials. Further, let $\upsilon_i(e_i)$ denote an agent's private effort cost, and assume that $\upsilon_i(e_i)$ is strictly increasing and differentiable with $\upsilon_i' > 0$, $\upsilon_i'' > 0$, $\upsilon_i(0) = \upsilon_i'(0) = 0$. Suppose that agents' utility functions take the following form:

$$u_i = b_i - l_i, \tag{3}$$

where b_i and l_i denote agent i's private benefit from and cost of contributing to the team production. Let $s_i = s_i(y)$ denote the share of output that agent i receives after that outcome is realized and, for simplicity, assume a symmetric sharing contract with equal shares, i.e. $s_i = y(e)/n$.

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in value. If, for example, none of the individuals $i = 2,...,n$ in table 1 was aware of 1's x_2-categorization, then $\Phi(\mathrm{I}; x_2)$ would amount (or be very close) to zero. However, that would not exclude the possibility of $\Phi(\{2,...,n\}; x_2)$ taking a relatively high salience degree.

[8] A typical cause for non-verifiability of inputs in team production is a lack of ability to attribute the team output to individual contributions by the team's members. Accordingly, Alchian and Demsetz (1972) characterize team production using the notion of positive cross partials of production output with respect to individual inputs.

4.2 Free-Rider Incentives in Teams

For $b_i = s_i$ and $l_i = \upsilon_i$ we can restate agent i's utility function such that

$$u_i = s_i(y(e)) - \upsilon_i(e_i) = \frac{y(e)}{n} - \upsilon_i(e_i) \tag{4}$$

With *budget-balanced* and differentiable sharing rules, that is,

$$\sum_{i=1}^{n} s_i(y) = y, \text{ and hence } \sum_{i=1}^{n} s_i' = 1, \text{ for all } y, \tag{5}$$

Holmström (1982) has shown that no efficient Nash equilibria can be reached. If e^* is the effort vector that maximizes team profits $y(e) - \sum_{i=1}^{n} \upsilon_i(e_i)$, Pareto optimality implies that

$$y_i' = \upsilon_i' \tag{6}$$

for all agents, where $y_i' \equiv \partial y(e_{-i}^*, e_i)/\partial e_i$. However, maximization of (4) yields the FOC

$$s_i' y_i' = \upsilon_i', \text{ and hence } \frac{y_i'}{n} = \upsilon_i' \tag{7}$$

for all agents. Thus, for (6) and (7) to coincide, $s_i' = 1/n = 1$ has to hold for all $i = 1,...,n$, which, however, would contradict (5) for $n > 1$.

Result 1. *(Holmström's Theorem) There exist no budget-balanced sharing rules that induce players with preferences (4) to choose e^* in the equilibrium of the game.*

4.3 Group Entanglement in Teams

4.3.1 One Team, one Social Group

Using the definitions and notations introduced in chapter 3, X denotes the set of social categories x_k and I the set of agents under scrutiny. The set $I_{(x_k)}$ contains all x_k-affiliated agents while $\dot{I}_{(x_k)} \subset I_{(x_k)}$ contains only those x_k-affiliated agents who regard the social group $I_{(x_k)}$ as salient.

Consider a team production process with the team members $i = 1,...,n$. Suppose that the team members affiliate with the team as a social category and thus form the social group $I_{(x_T)} = I = \{1,...,n\}$. Building on the literature results presented earlier, agents' preferences may now, unlike in the previous section, also depend on salient social group affiliations.

Assume that an agent's private benefit b_i and cost l_i from partaking in team production are salience-dependent and can be restated as

$$b_i = a^{\lambda_i} s_i, \tag{8a}$$

$$l_i = \frac{\upsilon_i}{a^{\lambda_i}}, \tag{8b}$$

$i = 1,...,n$, where $\lambda_i = \lambda_i\left(\dot{I}_{(x_k)}\right)$ is binary with $\lambda_i = 0$ for $i \notin \dot{I}_{(x_k)}$ and $\lambda_i = 1$ for $i \in \dot{I}_{(x_k)}$. Parameter $a \geq 1$ reflects responsiveness to social group salience. We speak of *group entanglement* among agents for $a > 1$.

Result 2. *Under assumptions 8(a, b) and with group entanglement ($a > 1$), the team output of homogeneous agents who form a social group $I_{(x_k)}$ is higher when the corresponding salience index $\Phi\left(I_{(x_k)}, \dot{I}_{(x_k)}\right)$ is higher.*

Proof. See appendix 1.

4.3.2 Social Group Multiplicity

With group entanglement in place it is interesting to examine economic implications of social group multiplicity in a team. In this context, social group multiplicity in a system refers to the coexistence of two or more salient social groups, each of which traces back to a different social category.[9] We use the previous results to identify economic tradeoffs of multiple social groups in a team.

Unlike in section 4.3.1, assume that team production is now carried out in a system of multiple teams. For simplicity, consider the two teams A and B, whose members produce outputs y_A and y_B, and form the social groups $I_{(x_A)}$ and $I_{(x_B)}$, respectively. Suppose that team production occurs not only within A and B, but also between the teams' members. Thus, A and B together form a team C, with all agents from A and B forming the social group $I_{(x_C)}$. Total output is described by

$$y_C = y(y_A, y_B, y_{AB}), \qquad (9)$$

$$\text{with } \partial y_C / \partial y_j > 0, \ \ \partial^2 y_C / \partial y_j^2 = 0,$$

where total output is assumed to be separable in y_j, $j = A, B, AB$. We then introduce the concept of *salience equivalence* in teams of multiple social groups: In a team consisting of two social groups, i.e. $I = I_{(x_A)} \cup I_{(x_B)}$, where $\Phi_A = a$ and $\Phi_B = b$, the *salience equivalent* $\Phi_C = c$ is the (theoretical) index value of a single collective social group $I = I_{(x_C)}$ in the team for which outputs of the one-group setting and the two-group setting are equal.

For the sake of argument, we assume the responsiveness-to-salience parameter a to be constant in value across all social groups $I_{(x_k)}$, $x_k \in X$. For $a > 1$, this *symmetric* group entanglement assumption serves to establish a

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[9] Hence, the term does not refer to social (sub)groups of the *same* underlying social category.

	Team A member	Team B member
Team A member	y_A	y_{AB}
Team B member	y_{AB}	y_B

Table 2. Attribution of outputs y_k within and between A and B.

useful benchmark configuration characterized by an indifference regarding the identity of social groups.[10] We write the next result:

Result 3. *In a team with output as in (9) and symmetric group entanglement among all agents, the salience equivalent of two perfectly salient ($\Phi_k = 1$) and disjoint social groups* $\mathrm{I}_{(x_A)}$ *and* $\mathrm{I}_{(x_B)}$ *can take a value below unity.*

Proof. See appendix 2.

Result 3 helps to economically motivate different social group structures in teams as well as alterations thereof, e.g. through consolidation or priming processes, by adding a salience rationale to output-related economic analysis.

4.4 Managerial and Organizational Lessons

In cases where the salience of a social group induces group entanglement on the part of its group members, we can draw implications with relevance for a variety of economic research problems. In particular, with teams featuring salient social groups, research insights can be derived regarding organizational structure, consolidation processes such as mergers and acquisitions, and the boundaries between firms and the market.

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[10] The question of whether agents who share multiple salient social groups at the same time may display different (e.g. stronger) group entanglement behavior cannot be answered here.
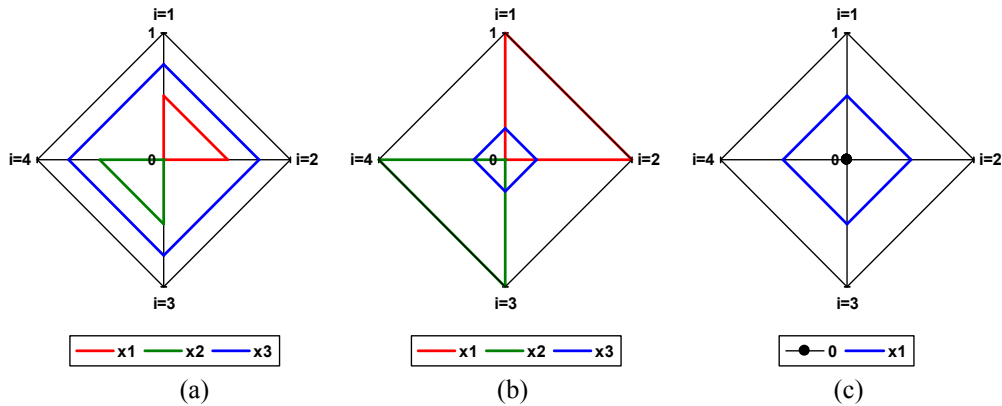
Fig. 1. Exemplary saligrams of social group structures in four-person assemblies.

4.4.1 Priming Social Groups

Teams can accommodate several social groups because individuals often share more than one social categorization. It readily follows that within a nexus of social affiliations, some social groups typically remain latent, whereas others may become salient and coexist in a group of people. When team agents hold multiple social categorizations we encounter the possibility of *priming* social groups. Priming describes the act of increasing the salience of particular groups relative to others. The level of salience is not a rigid attribute of social groups; instead, it is subject to change and can be manipulated. In view of ubiquitous social groups, it is useful to examine implications of social group priming for organizations or assemblies that are team based in the spirit of the previous analysis. In the presence of group entanglement, priming can assume an instrumental role in fostering cooperation. If group entanglement is a sufficiently important phenomenon, it is easy to recognize the role of priming as an organizationally relevant and managerial tool.

Consider, for example, the interplay of two different teams of workers contributing to the production of a good. For simplicity, assume that team *red* consists of two experts who are responsible for the research and development

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of a new and innovative component of the good, whereas team *green*, which also consists of two individuals, is in charge of turning team red's prototype component into an economically manufacturable part of the good. Obviously, a successful production of the final product depends on the output of the red team and the output of the green team. At the same time, we can imagine that the interplay of the individuals across the teams is equally vital to a successful outcome. In a group structure such as the one presented above, facilitating the group entanglement among all individuals, for example by priming a common social group, may be useful for enhancing the overall team output.

The saligram (a) in Figure 1 depicts an exemplary social setting for the four individuals that helps to pinpoint this rationale. The saligram describes the social group structure for a given set of individuals i: it displays common social groups with respect to different social categories x_k. In addition, it indicates the salience degree of these social groups as measured by $\Phi \in [0,1]$, with a group's salience increasing as we move away from the center of a saligram. In Figure 1 (a), the two individuals 1 and 2 (3 and 4) of team red (team green) form a social group with respect to the social category x_1 (x_2).[11] The two social groups are moderately salient among their members. In a case where there exists a third social category with which the four team members are affiliated, priming the respective social group may induce greater cooperation among them through group entanglement. In Figure 1 (a), x_3 represents such a social category.

4.4.2 Merging Social Groups

Given the existence of myriad social categories and groups in our social environment, we may encounter situations in which group consolidation and integration processes influence individual behavior. With group entanglement

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[11] These categories may, for example, correspond to common educational roots, workgroup ties, or other colloquial classifications and group distinctions that have evolved in the milieu of the firm's labor force.

being present in teams, such processes can impact a team's performance. In particular, sudden or crude attempts to break up and replace established ties to specific social groups in the wake of group consolidations may yield counter-intentional performance effects. If mergers impair pre-merger group structures such that perceptions of common affiliations and salience beliefs are distorted, then adverse output effects may be triggered.

The saligram in Figure 1 (b) illustrates an exemplary group structure for two teams, which consist of two individuals each, that have been subject to a merger aimed at combining their formerly independent work efforts. Assume that before the merger took place, the two individuals 1 and 2 (3 and 4) of team red (green) had established a social group with respect to the social category x_1 (x_2). After the consolidation of the two teams, differences in the social group structure might be evoked. For instance, formerly low or moderate group salience levels could experience a surge in the presence of the new out-group. Although this change might elicit higher cooperation levels in the two original teams, it may likewise constitute an obstacle to entanglement-induced cooperation surges between them. In another scenario, consolidation of the teams might give rise to the emergence of an additional, inclusive social group with respect to a third social category x_3. If the three social groups coexist, it may result in a situation in which none of the three groups are markedly salient or display salience advantages over the others.

The deliberations in this section suggest implications for positive and normative analysis in economics. Arguably, one of the most prominent fields of application in organizational and economic research concerns the subject of mergers and acquisitions (M&A) of firms and, in particular, the failure of such. M&A failure rates have been consistently high over the decades, with most M&A studies reporting failure rates of at least 50 percent (and in some cases up to 80 percent), depending on the failure definitions, indicators, and research approaches employed by the authors (e.g., Bruner, 2002; Straub, 2007; Weber et al., 2013). However, these high failure rates are accompanied by peak M&A

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deal values and ever-recurring M&A waves in the global market (Westenberg et al., 2015). In cases where M&A activities generate interferences with pre-M&A social group structures, the group entanglement approach in this work may help motivate socio-economic failure causes.

4.4.3 Creating Social Groups

Group entanglement in teams suggests further economic implications which concern the existence or emergence of social groups. Indeed, increasing a social group's degree of salience may in some situations be undesirable and, even if desired, use up valuable resources. Nevertheless, in light of the previous discussion one may well conceive of cases in which the gains of doing so, for example in the form of higher cooperation tendencies among team members, outweigh the related costs. In these situations, it becomes apparent that a social group can be a good.

The saligram in Figure 1 (c) addresses the type of situation in which the initial social group structure does not display (salient) social groups among the individuals under scrutiny. If this state was attributed to a lack of common social categorizations, priming would be of no avail. Yet, if the existence of a social group produced value, incentives might arise to facilitate its emergence. The creation of a commonly held social category, such as x_1 in the saligram (c), is a conceivable response in respective scenarios.

Although social groups emerge for different reasons and on multiple occasions, economic incentives may well play their part in these processes. In teams, implications of group entanglement for organizational manifestation and structure exist. Alchian and Demsetz (1972) propose that a residual claimant who monitors team members' inputs can induce more efficient production and give rise to the emergence of the classical firm. Group entanglement as a socio-economic approach to team production may offer another motivation behind the emergence of firms. Albeit being highly conjectural, one interpretation of

the deliberations above is that the formation of a firm can as well be viewed as the creation of a social category. The decision to carry out economic activities in a firm and not across markets then acknowledges organizational advantages with respect to the social group structure among all resource owners.

5 Conclusion

This work pursues a socio-psychological approach to team production. It emphasizes the role that the (social) group structure in a team may play for agents' incentives to provide inputs to the production process. Following the literature, the concept of group entanglement is introduced to the analysis to describe phenomena that can be characterized by a convergence of allocation preferences of individuals who share common social group affiliations.

Using a model of team production, Holmström's inefficiency theorem (1982) is derived, and economic implications of group entanglement processes in teams are discussed. It is highlighted that the existence of social groups, and team members' considerations about the saliency of these groups, can influence a team's performance. A salience measure is proposed to facilitate quantitative analyses of behavioral phenomena in groups in general and teams in particular.

The implications of group entanglement in teams are multi-faceted. In particular, organizational and managerial interventions involving the priming, merging or forming of social groups may distort a team's social group structure and alter work incentives if group entanglement is present. Taking into account these insights may help form socio-economic recommendations whenever the institutions or incentive mechanisms in place do not factor in preferences that are driven by people's social group affiliations.

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Appendix 1 (Proof of Result 2)

A (Individual incentives under group entanglement, $a > 1$)

The optimization problem of $i \in \mathrm{I}$, with $\mathrm{I} = \{1,...,n\} = \mathrm{I}_{(x_T)}$, is $\widetilde{e}_i = \arg\max[u_i]$ where

$$u_i = b_i - l_i = a^{\lambda_i} s_i(y(e)) - \frac{\upsilon_i(e_i)}{a^{\lambda_i}}. \tag{10}$$

Maximization of (10) with respect to e_i yields the FOC:

$$a^{2\lambda_i} \frac{y_i'}{n} = \upsilon_i'. \tag{11}$$

Given (11), we distinguish the three configurations A1), A2) and A3):

- A1) $i \notin \dot{\mathrm{I}}_{(x_k)} \rightarrow \lambda_i = 0$: (11) replicates (7).

- A2) $i \in \dot{\mathrm{I}}_{(x_k)} \rightarrow \lambda_i = 1$; $a = 1$: (11) replicates (7).

- A3) $i \in \dot{\mathrm{I}}_{(x_k)} \rightarrow \lambda_i = 1$; $a > 1$: (11) requires, c. p., higher effort $\widetilde{e}_i$ to hold than under A1) and A2) since $y_i', \upsilon_i', \upsilon_i'' > 0$ and $y_i'' < 0$.

B (Salience-contingent equilibrium output)

Let $\widetilde{y} \equiv y(\widetilde{e}_1,...,\widetilde{e}_n)$ denote equilibrium output where $\widetilde{e}_i : b_i' = l_i'$ follows from individual optimization according to (11). With n identical agents there are $n+1$ salience-contingent equilibria $\widetilde{y}_{|\dot{\mathrm{I}}_{(x_k)}|}$ to distinguish:

$$\left|\dot{\mathrm{I}}_{(x_k)}\right| = 0: \quad \widetilde{y}_0 = y(\widetilde{e}_1,...,\widetilde{e}_n) \quad \text{where } \forall i \notin \dot{\mathrm{I}}_{(x_k)},$$

$$\vdots \qquad\qquad \vdots \qquad\qquad\qquad \vdots$$

$$\left|\dot{\mathrm{I}}_{(x_k)}\right| = n: \quad \widetilde{y}_n = y(\widetilde{e}_1,...,\widetilde{e}_n) \quad \text{where } \forall i \in \dot{\mathrm{I}}_{(x_k)}.$$

Using **A1) - A3)**, the following configuration-specific relations must hold:

- $a = 1$: $\widetilde{y}_{k-1} = \widetilde{y}_k = \widetilde{y}_{k+1}$, $k = 1,...,n-1$,

- $a > 1$ (*group entanglement*): $\widetilde{y}_{k-1} < \widetilde{y}_k < \widetilde{y}_{k+1}$, $k = 1,...,n-1$.

From (2) follows that for $\Phi\left(\left|\dot{I}_{(x_k)}\right|\right)$,

$$\Phi(k-1) < \Phi(k) < \Phi(k+1), \ k = 1,...,n-1. \qquad \square$$

Appendix 2 (Proof of Result 3)

Production occurs in a three-team setting with total output (9). Agents of team A (B) produce y_A (y_B) and form the social group $I_{(x_A)}$ ($I_{(x_B)}$). Production involving efforts from both A and B agents yields output y_{AB} (Table 2). A and B together form the team C, with all agents from A and B forming the social group $I_{(x_C)}$. Assume symmetric group entanglement among all agents.

For the sake of argument, we utilize Φ as a continuous salience measure. For that, we define I on the interval $[0,1] = \{i \in R \mid 0 \le i \le 1\}$ and function $f(i) = 1$. Denote $|I| \equiv F(1) - F(0)$ and $|\dot{I}| \equiv F(z) - F(0)$, $z \le 1$, with $F(i) = \int f(i)di = i$. Hence, $\Phi = z$, where $z \in R$ marks the share of agents who consider a given social group as salient.

Configuration 1: $(\Phi_A, \Phi_B, \Phi_C) = (1,1,0)$ with $\Phi_k \equiv \Phi\left(I_{(x_k)}, \dot{I}_{(x_k)}\right)$

For $\Phi_A = 1$ and $\Phi_B = 1$, Result 2 has it that equilibrium outputs $\widetilde{y}_A^1$ and $\widetilde{y}_B^1$ assume their salience-contingent maximum levels. With $\Phi_C = 0$ and disjoint

social groups $I_{(x_A)}$ and $I_{(x_B)}$, the equilibrium output $\tilde{y}^1_{AB}$ does not take its salience-contingent maximum level. The total output is $\tilde{y}^1_C = y(\tilde{y}^1_A, \tilde{y}^1_B, \tilde{y}^1_{AB})$.

Configuration 2: $(\Phi_A, \Phi_B, \Phi_C) = (0,0,1)$

For $\Phi_C = 1$ and with symmetric group entanglement, Result 2 has it that $\tilde{y}^2_A$, $\tilde{y}^2_B$ and $\tilde{y}^2_{AB}$ assume their salience-contingent maximum levels. The total team output reads $\tilde{y}^2_C = y(\tilde{y}^2_A, \tilde{y}^2_B, \tilde{y}^2_{AB})$, where $\tilde{y}^2_A = \tilde{y}^1_A$, $\tilde{y}^2_B = \tilde{y}^1_B$ and $\tilde{y}^2_{AB} > \tilde{y}^1_{AB}$.

Juxtaposing the configurations, we see that $\tilde{y}^2_C > \tilde{y}^1_C$. From Result 2 follows that $\tilde{y}^0_C < \tilde{y}^1_C < \tilde{y}^2_C$, with $\tilde{y}^0_C$ denoting total output if $(\Phi_A, \Phi_B, \Phi_C) = (0,0,0)$.

Because $\Phi(z)$ is continuous and differentiable on $z \in [0,1)$, particularly $(d\Phi/dz) := \lim_{h \to 0}(\Phi(z-h) - \Phi(z))/h > 0$, we use Result 2 to infer that there is a profile $(\Phi_A, \Phi_B, \Phi_C) = (0,0,1-\varepsilon)$, $\varepsilon > 0$, for which the total output equals $\tilde{y}^1_C$. □

ESSAY II

PERFORMANCE FEEDBACK AND MORAL HAZARD IN FIRMS: AN IDENTITY APPROACH

Performance Feedback and Moral Hazard in Firms: An Identity Approach

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The paper proposes a social identity approach to performance feedback in firms, where agents value the feedback they receive as a means to help reinforce identity-related performance prescriptions. The theory explains the performance-enhancing effect of feedback that is frequently reported in the literature and helps motivate cases of low work engagement in firms. The paper demonstrates that both identity-consistent and identity-inconsistent feedback can lower the cost of incentive pay to the firm. Copyright © 2015 John Wiley & Sons, Ltd.

1. INTRODUCTION

In a recent survey of 100 US corporations about performance management systems and related practices, companies reported that, on average, 93% of their employees receive periodic performance appraisals (Lawler *et al.*, 2012). The great relevance of feedback as a management tool in organizations has likewise sparked a very rich and long-lasting discussion about the influence of feedback on (work) performance, including research topics in psychology (e.g., Payne and Hauty, 1955; Kluger and DeNisi, 1996), education (Hattie and Timperley, 2007), management (e.g., Fedor *et al.*, 2001; Kuhnen and Tymula, 2012), and organizational behavior (e.g., Prue and Fairbank, 1981; Alvero *et al.*, 2001). While the tenor is that feedback is effective in that it generally wields a performance-enhancing effect, there is also evidence suggesting that this effect can be mitigated (Earley, 1986) or reversed so that feedback debilitates performance (Kluger and DeNisi, 1996).

In spite of the frequent use of performance feedback in practice and its potential to induce desired behavior, a recent study by Murphy (2013) brought to light that actual employee engagement and work efforts in firms may often become subject to adverse feedback effects. In particular, the findings indicate that feedback that fails to hold people accountable for poor performances or recognize their high performances creates a motivational rift at work: valuable 'high performers' tend to reduce their work effort and question their continued affiliation with the company, whereas the firm's less capable workers turn out to be more engaged than their peers.

This work aims to explain some of the observed effects of performance feedback on individual work incentives and studies implications for a firm's optimal choice of management policies. I follow the social-psychology literature and examine the role that individuals' social identity, that is, the perception of themselves in social terms, may play in the decision to exert effort. In particular, it is assumed that in the firm, workers categorize themselves along performance criteria. For instance, some workers may adopt a high performer identity in the work group or firm as opposed to other workers who are seen as average

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performers. In this respect, performance feedback can serve to reinforce a worker's performance identity. It is suggested in this study that the prospect of receiving performance feedback may influence a worker's performance identity and, thus, the work incentives. Whereas feedback that complies with given identity-related prescriptions reduces losses in identity, non-compliant feedback is likely to increase these losses.

In the spirit of the seminal work on identity in economics by Akerlof and Kranton (2000, 2008), a reduced-form model is constructed to describe the incentive effects of feedback on an agent's effort choice. It is shown that, depending on the type of performance identity that is adopted by an agent, the principal may decide to use feedback as an instrument to reinforce that identity. The model predictions are in line with empirical findings and help better understand potential interdependencies between different management policies.

2. PRINCIPAL–AGENT MODEL OF PERFORMANCE FEEDBACK AND IDENTITY

2.1. Setup

Suppose that agents can influence a firm's revenues by choosing either one of two actions, which are un-verifiable by the principal and correspond to different effort levels e, with $e \in \{e^l, e^h\}$, $e^l < e^h$. With respect to their performance characteristics, agents can be of two types: High-potential agents may, in addition to exerting effort, affect the outcome by choosing to apply a non-verifiable task-specific skill $s \in \{0, 1\}$; average agents are unable to do so. The firm's revenues are verifiable but random and can be either high, X, or low, x. Let (1) describe the firm's expected revenues:

$$E(e, s) = \begin{cases} x \; if \; e = e^l \\ q(s)X + (1 - q(s))x \; if \; e = e^h, \end{cases} \quad (1)$$

where $0 < q(0) < q(1) < 1$. Here, $q(1)$ denotes the probability of the high outcome if skill is applied and $q(0)$ otherwise.

2.2. Agent's Utility

Assume an agent's preferences can be described by a utility function as in (2):

$$U = \ln y - (e + f(s)) - t_C \cdot g(C, \varepsilon). \quad (2)$$

Accordingly, individuals are risk averse, derive utility from their income y and disutility from effort and skill, where $f(s)$ describes the agent's private cost of the latter; thus, let $f(1) > f(0) = 0$.

It is the last term in (2) that describes the agent's identity motive. We assume that agents adopt a performance identity C at their workplace, which is exogenous in our model, and obtain some performance evaluation ε that may contradict or reinforce this identity. In particular, suppose agents perceive themselves as either high performers or average performers, hence $C \in \{H, A\}$, and obtain feedback $\varepsilon \in \{H, A, L\}$. Here, $\varepsilon = L$ indicates feedback exposing an agent as low performer.

Following Akerlof and Kranton (2000), we consider that identities entail identity-specific prescriptions or ideals, the non-compliance with which causes agents with C-type identity losses in utility, denoted as $t_C \geq 0$. Accordingly, assume that recognition of an agent's identity type is such a prescription.

Let $g(C, \varepsilon)$ in (2) govern these preferences and return a (non-) compliance value $g \in \{0, 1\}$, which is conditional on whether the feedback is identity-consistent or not:

$g(C, \varepsilon)$:	$\varepsilon = H$	$\varepsilon = A$	$\varepsilon = L$
$C = H$	0	1	1
$C = A$	1	0	1

2.3. Monitoring and Performance Feedback

Because the principal can verify the revenues generated by an agent but cannot contract for the agent's action itself, a problem of moral hazard may arise. Suppose that besides paying the agent revenue-dependent wages, the principal can choose to appoint a supervisor who provides agents with feedback on their performances. If appointed, the supervisor (imperfectly) observes an agent's action, whereas his cost of verification is prohibitively high. For simplicity, let the feedback be accurate and provided at no cost: if the feedback policy is adopted, the supervisor provides either positive feedback ($\varepsilon = H$), negative feedback ($\varepsilon = L$), or no feedback ($\varepsilon = A$) to the agent.[1]

Assume that positive feedback (negative feedback) is given to the agent if exactly two events occur: the supervisor observes (i) skill (low effort) on the agent's part; and (ii) high (low) revenues.[2] Accordingly, an agent who applies skill receives positive feedback with probability $pq(1)$, and an agent who shirks receives negative feedback with probability r, where p and r

denote exogenous probabilities of the supervisor being able to detect skill and low effort, respectively. Whenever the aforementioned conditions for positive and negative feedback are not met, no feedback is provided to the agent.

2.4. Type-Dependent Incentives Disregarding Identity Motives

We assume that the principal wants the agent to exert high rather than low effort. The principal can incentivize the agent to exert high effort and, if a high-potential agent, to apply skill, by paying her revenue-dependent wages. Let agents receive w when revenues are low and W when revenues are high. Hence, the principal's expected profits are[3]

$$\Pi = q(s)(X - W(s)) + (1 - q(s))(x - w(s)). \quad (3)$$

In the absence of identity-related terms entering the agent's utility function, the participation and incentive compatibility constraints read

$$q(s)\ln W(s) + (1 - q(s))\ln w(s) - \left(e^h + f(s)\right) \geq u, \text{(PC)}$$
$$(4)$$

$$q(s)\ln W(s) + (1 - q(s))\ln w(s)$$
$$- \left(e^h + f(s)\right) \geq \ln w(s) - e^l \qquad \text{(IC1)}$$
$$(5)$$

and

$$\ln W(1) - \ln w(1) \geq f(1)/(q(1) - q(0)), \qquad \text{(IC2)}$$
$$(6)$$

where u denotes an agent's outside option, (IC1) describes the incentive to exert high rather than low work effort, and (IC2) describes the incentive of high-potential agents to apply skill rather than to abstain from it. When the constraints (PC) and (IC1) are binding, we get[4]

$$w = \exp\left[u + e^l\right] \qquad (7)$$

and

$$W(s) = \exp\left[u + e^l + \left(e^h + f(s) - e^l\right)/q(s)\right] \qquad (8)$$

as equilibrium wages for agents without performance identities. Together with (IC2), Eqs. (7) and (8) imply that high-potential agents will choose to apply high effort and skill if $f(1)/(f(1) + e^h - e^l) < (q(1) - q(0))/q(1)$. Furthermore, if (IC2) does not hold, the

principal may increase the bonus to induce agents to apply skill if this is profitable.

2.5. Type-Dependent Incentives and Performance Identity

With agents who adopt a performance identity in the firm, we consider the identity term in (2). The principal's expected profits are

$$\Pi = q(s)(X - W_C(s)) + (1 - q(s))(x - w_C(s)). \quad (9)$$

Let us first examine the incentive implications for an agent who lacks the ability to apply skill s and, by assumption, adopts an average-performer identity. Here, the participation and incentive compatibility constraints are

$$q(0)\ln W_A + (1 - q(0))\ln w_A - e^h \geq u \qquad \text{(PC.A)} \quad (10)$$

and

$$q(0)\ln W_A + (1 - q(0))\ln w_A \qquad (11)$$
$$- e^h \geq \ln w_A - e^l - r t_A. \qquad \text{(IC.A)}$$

Analogously, we state the respective constraints for a high-potential agent who, by assumption, adopts a high-performer identity:

$$q(s)\ln W_H + (1 - q(s))\ln w_H - \left(e^h + f(s)\right) \qquad (12)$$
$$- (1 - q(s)p(s))\, t_H \geq u, \qquad \text{(PC.H)}$$

$$q(s)\ln W_H + (1 - q(s))\ln w_H - \left(e^h + f(s)\right)$$
$$- (1 - q(s)p(s))\, t_H \geq \ln w_H(s)$$
$$- e^l - t_H, \qquad \text{(IC1.H)}$$
$$(13)$$

and

$$\ln W_H(1) - \ln w_H(1) \geq (f(1)$$
$$- q(1)p\, t_H)/(q(1) - q(0)). \quad \text{(IC2.H)}$$
$$(14)$$

2.5.1 Identity-Ignorant Firm. A principal who is unaware or disregards an agent's identity will not consider the identity-related terms in Eqs. (10) to (14) and, therefore, has no incentive to have identity-related performance feedback provided to the

agent.[5] Instead, the principal will choose to pay wages as in (7) and (8).

However, when (PC.A) and (IC.A) bind, it follows that

$$w_A = \exp\left[u + e^l + rt_A\right], \tag{15}$$

and

$$W_A = \exp[u + e^l + (e^h - e^l)/q(0) \\ + (1 - 1/q(0))\, rt_A)]. \tag{16}$$

Also, when (PC.H) and (IC1.H) bind, we get

$$w_H = \exp\left[u + e^l + t_H\right], \tag{17}$$

and

$$W_H(s) = \exp[u + e^l + (e^h + f(s) - e^l)/q(s) \\ + (1 - p(s))\, t_H] \tag{18}$$

as wages for the case where (IC1.H) is the tighter incentive constraint.[6]

For $p, r \overset{!}{=} 0$, we see that the identity-ignorant wages in Eqs. (7) and (8) equal their counterparts in (15) and (16) and, thus, meet the incentives of agents with average performer identities to stay with the firm (PC.A) and work in the principal's interest (IC.A). In contrast, the wages in Eqs. (7) and (8) are too low to satisfy (PC.H) and (IC.Hx). In particular, these wages do not incentivize the agent to stay with the firm.[7] These insights establish our first result.

Proposition 1:
Agents with high-performer identities prefer to discontinue their work in the absence of identity-enhanced performance compensation.

2.5.2 Identity-Contingent Incentives. With the identity-adjusted wages in Eqs. (15) to (18), we can evaluate the wage differential necessary to elicit high effort and skill. The differences in log wages are $\ln W_H - \ln w_H = (e^h + f(1) - e^l)/q(1) - pt_H$ and $\ln W_A - \ln w_A = (e^h - e^l)/q(0) - rt_A/q(0)$, where the former difference refers to agents with high-performer identities and the latter one to agents with average-performer identities. We write the next result:

Proposition 2:
For agents who adopt average (high) performer identities, a higher detection probability r (p), *ceteris paribus*, lowers the cost of incentive pay to the principal.

In particular, for agents with high-performer identities, we note that w_H in Eq. (17) is independent of p. It readily follows then from Proposition 2 that if eliciting

skill is profitable, the principal has an incentive to have peak performances recognized.

For agents with average-performer identities, both the wages w_A and W_A depend on the detection probability r. In view of Eq. (9), the profit-maximizing r^* is subject to the following trade-off:

$$\frac{\partial \Pi}{\partial r} = -\left(q(0)\frac{\partial W_A}{\partial r} + (1 - q(0))\frac{\partial w_A}{\partial r}\right), \tag{19}$$

where $\partial W_A/\partial r < 0$, $\partial^2 W_A/\partial r^2 > 0$, and $\partial w_A/\partial r > 0$, $\partial^2 w_A/\partial r^2 > 0$.

Using (19), together with Eqs. (15) and (16), we derive the following result:

Proposition 3:
Negative feedback lowers operational profits if the required increase in the identity-adjusted fixed wage is prohibitively high; formally,

$$\left(\frac{\partial w_A}{\partial r} > -\frac{q(0)}{1 - q(0)}\frac{\partial W_A}{\partial r}\right)\bigg|_{r=0} \to r^* = 0. \tag{20}$$

The result also implies that incentives for the principal to have feedback provided to the agent arise if the cost-saving effect of r in (20) is relatively high. In such a case, negative feedback would be profit-enhancing. Irrespective of the scenario, however, we note that even under the assumption that feedback can be provided to the agent in a cost-free manner, the latter's anticipation to obtain feedback, which is possibly identity inconsistent, may cause disincentive costs.

3. DISCUSSION

It has been demonstrated that performance feedback can help align the interests of agents with those of the principal. Whereas positive feedback serves to reinforce high-performer identities, negative feedback may undermine agents' identities and, thereby, reduce incentives to shirk.

It is important to stress the differences of the present approach to related models of work incentives and feedback, perhaps most notably to the work by Bénabou and Tirole (2003). In their model, feedback serves to affect an agent's self-esteem given the principal has some private information about the agent's ability or talent. Unlike in models of self-esteem, self-confidence (Bénabou and Tirole, 2002), and ego-utility (Köszegi, 2006) where agents only have beliefs

about their capabilities or lack vital information that would allow for proper evaluation, agents in our model know their abilities and tasks. Moreover, agents know their identities and want to comply with identity-specific prescriptions. Identity itself is not deprived, yet it can be undermined if agents obtain feedback that is in conflict with their identity-specific prescription, and it can be reinforced if the feedback matches this ideal.

Identity-adjusted wages may seem to be a rather strong assumption at first sight. In particular, a worker's performance identity may not be a piece of information that is costlessly available to a principal. On the other hand, it is not untypical of working relationships that individual performance aspirations within the workforce come to light: for example, when employee A exhibits her propensity toward work excellence by completing her work once again ahead of time, whereas employee B who may be even as capable as A values time spent socializing and thus misses yet another deadline. According evidence and suchlike indications of performance aspirations can help to fine-tune optimal compensation requirements and impact the outcome of individual remuneration negotiations.

4. CONCLUSION

The paper proposes an identity approach to feedback and work engagement in firms. Implications of different types of supervisory policies for work incentives are derived for situations in which agents adopt an identity that rests on performance considerations at their workplace. The examination draws on an extensive body of socio-psychological and economic studies demonstrating that social categorization, even when it is induced randomly, influences individual behavior in light of identity-related prescriptions.[8]

I consider an agent's social identity with respect to work performance as an argument in the utility function, thus, following the work on identity in economics by Akerlof and Kranton (e.g., Akerlof and Kranton, 2000, 2008). In terms of the model, it is shown that the possibility of agents adopting performance identities at work can induce a principal to provide performance feedback to agents. The principal may do so with the aim to either reduce an agent's losses in identity for work behavior that is desired by the principal or increase these losses for such performances that are in conflict with the principal's interest.

The theory of identity-dependent performance feedback contributes to the body of literature examining the boundaries between firms and markets. The present analysis suggests that labor transactions within the firm differ from transactions across markets and that the former takes place in a wide nexus of social relations and identity-related prescriptions. In this regard, the firm is not a contractual construct that is not inherently different from ordinary market contracting (e.g., Alchian and Demsetz, 1972). In contrast, the firm as economic organization typically surrounds its workforce with multiple sources of social identification that are absent in market exchange.

NOTES

1. The reader may think of the supervisor as a random machine in the given setting. We, therefore, exclude from our analysis scenarios, which trace back to the pursuit of own interests or opportunism by the supervisor.
2. Including the event (ii) as a condition is not critical for the quality of the results but proves useful to avoid potential credibility problems of feedback. For example, workers might object to cases where some of them are rebuked in the event of a low work outcome while others are praised instead.
3. These profits do not include the costs of supervision, which we consider to be fixed.
4. The constraints must bind in equilibrium (e.g., Gintis, 2009, p.167). The intuition is that wages that violate PC (IC) induce the agent to leave the firm (exert low effort). On the other hand, if the constraints are overfulfilled, the principal can always lower the wage a bit, and the offer will still be incentive compatible.
5. Apart from a complete waiver of feedback, other forms of performance feedback that fail to signal an agent's performance identity, such as random commendation or excessive praising, may as well be regarded as identity-ignorant in terms of the model.
6. Again, if IC2.H does not hold for the wages (17) and (18), the principal may increase the bonus payment to the agent if this would raise the firm's profits.
7. Consistent with this prediction, Murphy (2013) reports that the failure of direct leaders to hold their employees accountable and recognize their accomplishments is a key predictor as to whether a company's high performers will quit or stay with the firm.
8. The seminal experiments conducted by Tajfel (1970) and Tajfel et al. (1971) are widely recognized as the starting point of the corresponding research program that is typically referred to as the social-identity approach.

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Essay III

Optimal Ticket Pricing In Professional Sports: A Social Identity Approach

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Optimal ticket pricing in professional sports: a social identity approach

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Abstract

A frequently observed phenomenon in professional sports is apparent underpricing of tickets. The concept of social identity may explain this pricing behavior without giving up the assumption of profit-maximizing behavior. Repeated match attendance increases spectators' identification with the team and their willingness to pay for attendance. In this paper, we set up a model to analyze a profit-maximizing team's optimal pricing decision including such spectator identification. Conditions are derived under which incentives to underprice arise.

1. Introduction

Studies in the field of sports economics regularly find evidence for ticket underpricing in spectator sports. For instance, Krautmann and Berri (2007) present a recent list of articles reporting inelastic ticket pricing in a variety of professional sports leagues, including studies on the Major League Baseball (Fort & Quirk, 1996), the National Football League (Depken, 2001), and the Spanish First Division Soccer League (Garcia & Rodriguez, 2002). Further evidence of ticket pricing in the inelastic range of demand is reported for US basketball (NBA), English soccer, Scottish soccer and English cricket (Fort, 2006).

The economic literature proposes different potential explanations as to why producers may choose to underprice their products. Kahneman, Knetsch, and Thaler (1986) emphasize the role of fairness. Facing a surge in demand, a firm that decides to raise the price in the absence of increased costs may suffer from a reputation for being exploitative. However, the authors note that transaction terms presently considered unfair gradually gain acceptance in the market, an effect that cannot rationalize persistently low prices. Becker (1991) suggests that the existence of excess demand serves as a signal for popularity, therefore increasing customers' willingness to pay (WTP). Yet, while the indication of popularity may play a role in other product markets, the need for additional signaling of popularity appears doubtful for many nationally televised and media-hyped matches in major sports leagues.

Courty (2003) categorizes event ticket buyers into two groups: "busy professionals" realize only close to the event date whether they can attend, whereas committed "diehard fans" wish to secure tickets well in advance, albeit only at a comparably lower price. Courty concludes that profit-maximizing event promoters abstain from raising prices in the primary market because they cannot effectively clear the market given the dichotomy of customers' commitment ability and the lack of price competitiveness in the broker-dominated secondary market. Eichhorn and Sahm (2010) rationalize the existence of underpriced event tickets by assuming the price to be an instrument a two-product monopolist uses to reach a favorable type distribution of spectators characterized as being more cheerful. Provided an enhanced atmosphere among spectators exerts a positive externality on demand in a second related product market, as in the market for sponsorship contracts, the monopolist may maximize aggregate profit from both markets by setting the lower ticket price. While the authors do not examine the role of intangible goods for the emergence and development of demand in the ticket market itself, we take up this aspect and analyze its implications for the ticket pricing decision.

In this paper, we provide a different rationale for apparent underpricing in the primary ticket market by considering the role of social identity in building spectator demand. In line with empirical evidence, we propose that the experience of sports matches affects spectators' consumption choices by eliciting an increased WTP for attendance. The approach thus shares common elements with models of habit formation (e.g. Pollak, 1970). Spectators are assumed to experience a shift in their preferences over time toward attending matches, which rests on social identification motives. Following this rationale, we develop a model to explain ticket underpricing in tandem with the assumption of profit-maximizing behavior on the part of the sports team. Conditions are derived under which incentives to underprice arise.

The remainder of this paper is organized as follows. In the next section, we motivate a social identity approach to ticket underpricing and review empirical evidence. In the section that follows, we introduce a model to formalize the suggested rationale and derive a profit-maximizing team's optimal pricing decision. The last section concludes the paper.

2. A Social Identity Approach to Underpricing

In this paper, we suggest that the (repeated) experience of sports matches increases the individual WTP for attendance over time. This rise comes from the process of identifying with the team and its supporters. In this light, teams that underprice their tickets can increase a spectator's frequency of match attendance and thereby maximize long-run ticket revenues. This *group identification effect* in spectator sports then suggests an immanent investment character. It may incentivize team owners to forgo myopic short-term gains if an increase in future revenues can be induced by an amount which more than offsets the initial sacrifice.

The theoretical basis for this line of reasoning has its origin in the social psychological literature. According to *Social Identity Theory* (SIT), individuals define themselves in part by their social identity. Social identity relates to multiple social selves that derive from the particular social categories or groups that an individual perceives herself to be a member of and identifies with (Tajfel & Turner, 1979). Ashforth and Mael (1989, p.21) define social identification as "the perception of oneness with or belongingness to some human aggregate." Identification with a social group allows the individual to vicariously partake in the group's accomplishments (Katz & Kahn, 1978). In the given context, we argue that spectators tend to categorize themselves as and identify with the members of a focal group composed of the team and its supporters (i.e., "I am a supporter of this team"). Match attendance thereby serves as a means to establish group contact and affects individuals in social terms.

There is ample evidence in the pertinent literature suggesting that higher identification with a focal group is associated with more group contact in terms of frequency and duration (e.g. Bhattacharya et al., 1995; Gwinner & Swanson, 2003; Mael & Ashforth, 1992; Wann & Branscombe, 1993). By repeatedly attending a team's matches, spectators affiliate with a peer group of like-minded supporters and participate in an intensive, immediate, and highly involving activity exposing them to a paramount sense of group identification.

Gwinner and Swanson (2003) show that the number of contacts individuals have with their favorite NCAA football team is antecedent to perceived team identification. According to Dutton, Dukerich, and Harquail (1994), more contact with an organization increases the attractiveness of a member's social identity and leads to a higher degree of identification with the organization. Sutton et al. (1997) argue that group identification is strengthened by factors such as visibility of affiliation, group-specific rituals, shared goals, or common symbols, all constituting essential ingredients of sporting events. Previous studies in the fields of sport marketing and sport psychology have found that group identification, in turn, results in more frequent group contact and group supportive behavior.[1] Wann (2006, p. 365) reviews the related literature and concludes that "[…] not only is level of team identification a significant independent predictor of game attendance, it may well be the most powerful factor." For instance, Wann and Branscombe (1993) find that individuals high in identification with their focal basketball team are willing to invest greater amounts of money in tickets. Fisher and Wakefield (1998) find that higher team identification among professional hockey fans results in individuals attending more matches regardless of whether, as fans, they are affiliated to a successful hockey team or to an unsuccessful one. Similarly, Mahony et al. (2002) identify spectators' level of attachment and identification with their favorite J. League soccer team as the strongest predictor of frequency of match attendance.

We argue that group contact increases a spectator's identification with a team and its supporters. Higher levels of identification, in turn, bias the consumption preferences toward match attendance. In the following, we introduce the proposed group identification effect into the ticket pricing problem, describing that the WTP for attendance, and to seek contact with the focal group, is likely to be increasing in the number of matches experienced.

3. The Model

3.1 The Demand for Tickets

Suppose that a potential spectator determines to consume a bundle of goods τ and γ at time t. Denote τ_t as the number of matches that the individual attends in the given period and γ_t as the number of units of an alternate leisure good. The number of matches that can possibly be attended in a given period is limited to $\hat{\tau}_t$, hence, $\tau_t \leq \hat{\tau}_t$. We assume that a spectator's utility can be described by a Cobb–Douglas function.

Assumption 1. A spectator maximizes her utility described by the function

$$U_t = \tau_t^{\alpha_t} \gamma_t^{(1-\alpha_t)},$$

(1)

which is subject to the budget constraint $M \geq p_t \tau_t + q \gamma_t$, where M is a constant budget, p_t denotes the ticket price in period t, and q is the price of the alternate good. In addition, we assume that α_t in (1) has the following properties:

Assumption 2. $\alpha_t = \alpha_t(n_{t-1})$ with $\dfrac{d\alpha_t}{dn_{t-1}} > 0$, $\dfrac{d^2\alpha_t}{dn_{t-1}^2} < 0$, and $\alpha_t \in (0,1]$,

(2)

where $n_{t-1} = \tau_{t-1} + n_{t-2}$ denotes the aggregate number of matches the individual has attended in previous periods. We define $a \equiv \alpha_t(0)$ for the situation without prior match attendance, and assume that α_t is increasing in n_{t-1} and converging to a given saturation level $\overline{\alpha}$. Hence, we let previously attended matches influence the present consumption choice. Accordingly, $d\alpha_t / dn_{t-1} > 0$ describes the proposed group identification effect in our model.

Lemma 1. *Under assumptions (1) and (2), and for $\alpha_t < p_t \hat{\tau} / M$, the individual ticket demand is strictly increasing in the number of previously attended matches.*

Proof. Taking the Lagrangian $L = U_t + \lambda(p_t \tau_t + q \gamma_t - M)$, and using first-order conditions for τ_t, γ_t, and λ yields the *unconstrained* ticket demand $\dot{\tau}_t = \alpha_t M / p_t$. From $\tau_t \leq \hat{\tau}_t$, it follows that the individual ticket demand in period t is given by

$$\tau_t = \min\{\alpha_t(n_{t-1})M / p_t, \hat{\tau}_t\}.$$

(3)

With $d\alpha_t / dn_{t-1} > 0$, equation (3) implies $\partial \tau_t / \partial n_{t-1} > 0$ for $\alpha_t < p_t \hat{\tau}_t / M$. □

3.2 The Pricing Problem

A team owner's objective to maximize ticket profits is governed by the choice of the optimal ticket price vector $P_T^* = (p_1^*,...,p_T^*)$.[2] Any costs linked to the pricing decision are considered negligible for the marginal analysis. The team's overall profits from ticket sale are given by $\Pi = \sum_{t=1}^{T} \delta^{t-1}\Pi_t$, where δ is a positive discount factor. We first scrutinize the case where the venue capacity does not become a binding constraint. Hence, periodic profits are

$$\Pi_t = p_t \sum_{i=1}^{N} \tau_t^i \,, \tag{4}$$

where τ_t^i is added up over N spectators and denotes the individual ticket demand in period t.[3] For simplicity, suppose that ticket demand originates from two types of consumers: *fans* and *casual spectators*. The assumption of diminishing returns in (2) is accentuated as follows: Fans represent $(1-z)N$ of all spectators and have a high WTP, that is, $\alpha^F = 1$. On the other hand, casual spectators represent zN of all spectators and have a low initial WTP, that is, $\alpha^C < 1$, and $d\alpha_t / dn_{t-1} = b$, where b denotes the constant *group identification factor*.[4]

Without loss of generality, assume that the budget is equal to unity and the maximum supply of matches to be a constant. Setting $N = 1$, and using equation (3), the T-period pricing problem takes the following form:

$$P_T^* = \arg\max\left[\sum_{t=1}^{T} \delta^{t-1} p_t \left(z\tau_t^C + (1-z)\tau_t^F\right)\right] \quad \text{s.t.} \quad \tau_t^i(p_t) \le \hat{\tau} \,, \tag{5}$$

where $\tau_t^i = \alpha_t^i / p_t$, $\alpha_t^C = a + bn_{t-1} < 1$, and $\alpha^F = 1$.

The first period marks the starting point characterized by a situation where no matches were attended beforehand. In later periods, however, casual spectators may experience a shift in consumption preferences dependent on the number of previously attended matches and the size of the group identification factor b.

3.3 The Optimal Ticket Price Disregarding Spectator Identification

To solve the above problem, it is useful to first define critical price levels that follow from the capacity constraint. Hence, let p_t^i denote the highest price in t at which the ticket demand of spectators is still equal to the upper bound, that is, $p_t^i = \max\{p_t | \tau_t^i = \hat{\tau}\}$. Using (3), it follows that $p_t^C = \alpha_t^C / \hat{\tau}$ and $p^F = \alpha^F / \hat{\tau}$ in every period. Hence, $p_t^C < p^F$ for $\alpha_t^C < \alpha^F$.

The analysis of the implications of spectator identification for the optimal ticket pricing policy is conducted by first identifying the price level that would be set by a profit-maximizing team in the absence of identification motives among spectators, that is, in a situation where $b = 0$. This ticket price then serves as the benchmark when we proceed to determine the profit-maximizing ticket price in a situation where b takes a positive value. Following this course, the next result is expressed in Lemma 2:

Lemma 2. *In the absence of spectator identification, profits are maximized by setting the ticket price equal to* p^F.

Proof. See appendix A1.

Hence, the myopic price that would be charged in disregard of identification motives equals $p_t^{My} = p^F$. The corresponding price vector is given by $P_T^{My} = P_T^F = \left(p_1^F, ..., p_T^F\right)$.

3.4 The Optimal Ticket Price with Spectator Identification

Having determined the myopic ticket price, we need to examine if and how the introduction of a positive identification factor b may affect the optimal pricing decision. For that, the impact of the price choice on profits in $t = 1,..,T$ is derived. Lemma 3 summarizes the effects:

Lemma 3. *In the presence of spectator identification, the relationships (a) to (c) hold:*

$$(a) \quad \frac{\partial \Pi_t}{\partial p_t} > 0 \quad \text{for } p_t \leq p^F, \text{ and } \frac{\partial \Pi_t}{\partial p_t} \leq 0 \quad \text{for } p_t > p^F,$$

$$(b) \quad \frac{\partial \Pi_t}{\partial n_{t-1}} \geq 0,$$

$$(c) \quad \frac{\partial n_{t-1}}{\partial p_{t-k}} \leq 0 \quad \text{for } k = 1,...,t-1.$$

Proof. See appendix A2.

Lemma 3 indicates that raising the price in t increases profits in that same period if the price does not exceed p^F. The results in (b) and (c), taken together, imply that a price increase in the current period may reduce future ticket revenues through a corresponding decrease in the number of matches experienced by casual spectators. We write the following lemma:

Lemma 4. *An increase in the current ticket price may reduce ticket profits in future periods; formally,* $\partial \Pi_t / \partial p_{t-k} \leq 0$ *for* $k = 1,...,t-1$.

Spectator identification may lead to a situation where relatively low prices can be beneficial for the team. If raising the current price results in higher present ticket profits but induces a reduction in future profits, thus outweighing the present gains, then the team has an incentive to refrain from such a price increase. Let p_t^* be the price a profit-maximizing team sets when the identification factor b takes a positive value. The next result is obtained:

Proposition 1. *With spectator identification, it is never optimal to set ticket prices other than* p_t^C *or* p^F; *hence,* $p_t^* \in \left\{p_t^C, p^F\right\}$.

Proof. See appendix A3.

The optimal ticket price may lie below the myopic price if spectator identification is present. It is worth analyzing the conditions under which a profit-maximizing team has an incentive to set the lower of the two prices. The parameter configurations that pinpoint the optimal pricing decision are stated in Proposition 2.

Proposition 2. *The optimal periodic ticket price* $p_t^*(b,\delta)$ *equals* p_t^C *and, thus, falls below the myopic price* p^F *if the group identification factor* b *is sufficiently high; more formally,*

$$
p_{T-m}^* = \begin{cases}
p_{T-m}^C & \text{if } \Omega_m(b) > \dfrac{1-z}{z}, & \text{for } m = 1,...,T-1, \\[2mm]
p^F & \text{if } \Omega_m(b) \le \dfrac{1-z}{z}, & \text{for } m = 1,...,T-1, \\[2mm]
p^F & \text{for } m = 0,
\end{cases}
$$

with $\Omega_m \equiv \sum_{n=1}^{m} \left[\sum_{k=n}^{m} \dfrac{(k-1)!}{(n-1)!(k-n)!} \delta^k b^n \hat{\tau}^n \right].$

Proof. See appendix B.

Proposition 2 asserts that there exists a threshold $\Omega(b)$ in every decision period that governs the pricing decision, and that is strictly increasing in the group identification factor. When the threshold exceeds the fan-to-spectator ratio it is optimal to set $p_t^* = p_t^C$; otherwise $p_t^* = p^F$ is optimal. $\Omega(b)$ is increasing in δ. Thus, for a given identification factor, stronger discounting reduces the incentive to underprice as the resulting gains in future profits lose in value.

3.5 Discussion

While Proposition 2 explains temporary underpricing, it does not explain ticket underpricing in all periods given the finite time horizon under consideration. If we consider an infinite time horizon, however, and assume that $\alpha(n_{t-1})$ converges to its limit as n approaches infinity, p^C can become the permanent optimum. Lemma 3 offers a sufficient condition for this result to hold.[5] Accordingly, $P_\infty^* = P_\infty^C$ holds if, in every period t, the one-time revenue gain in t from setting p^F instead of p_t^C falls below the value of the infinite series of revenue losses resulting in all future periods.

The presented formal analysis scrutinizes the case in which the given venue capacity does not become a binding constraint. The proposed identity-based rationale may, however, also help to explain optimal ticket prices below the maximum sell-out level, for example, in a market that is characterized by potential spectators with very different individual saturation levels $\overline{\alpha}$. In particular, prices even below the maximum sell-out level may attract spectators whose identification is still low, e.g. $\alpha(i)$, but with the potential to increase to much higher levels when compared to other already saturated spectators, such that $\alpha(i) < \overline{\alpha}(j) < \overline{\alpha}(i)$. Ticket prices that are just too high to attract and stimulate such high potentials in the market may fail to maximize long-term revenues from ticket sale.

4. Conclusion

The object of this paper was to examine the impact of spectators' identification with a sports team and its supporters on the ticket pricing decision in the primary ticket market. Following the concept of social identity, the presented model has established a link between spectators' visiting frequency and the valuation of match attendance to explain ticket underpricing.

The findings indicate that the optimal periodic ticket price level in the primary market may well lie below the short-term revenue maximizing price if match attendance increases spectators' group identification and induces a rise in their WTP for tickets. While the analysis investigates the unifying effect of social identification, the experience of clamoring or hostile spectators may as well cause resentment, an effect that can interfere with the process of social identification and at times lead to social self-exclusion of spectators. In such cases, it may be difficult to stimulate the identification process that is proposed in our analysis.

In view of its seemingly universal relevance in spectator sports, the concept of social identity on the part of spectators may bear relevance to understanding inelastic ticket pricing in a variety of sports leagues.

Notes

1. Wann (2006) provides a comprehensive overview of studies investigating the impact of team identification on match attendance and spectators' consumption preferences.

2. Unlike periodic prices, ticket price vectors are indicated by a capital letter. For instance, the vector P_t contains all prices up to period t, that is, $P_t = (p_1,...,p_{t-1}, p_t)$.

3. Notice that lower indices indicate the point in time, whereas upper indices indicate the individual or group-specific context of a variable.

4. We therefore restrict the domain to $0 < b \leq (1-a)/n_{T-1}$. While the results do not depend on this assumption, it is useful to simplify the formal analysis. One interpretation of this specification is to consider $\alpha_t(n_{t-1})$ over a sufficiently small interval of its domain where $d^2\alpha_t / dn_{t-1}^2 \cong 0$, thus, implying a finite time horizon.

5. Note that Lemmas 3, 4, and Proposition 1 remain valid under the infinity assumption.

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Appendix A1 (Proof of Lemma 2)

The critical prices are used to restate (5): As $\alpha_t^C = a + bn_{t-1}$, and $\alpha^F = 1$, it follows for $b = 0$ that $p_t^C = a/\hat{\tau}$ and $p^F = 1/\hat{\tau}$.

With $\Pi = \sum_{t=1}^T \delta^{t-1}\Pi_t$ and demand $\tau_t^i = \alpha_t^i / p_t$ (Lemma 1), profits in t are:

$$\Pi_t = \begin{cases} p_t\hat{\tau} & p_t < p_t^C, \\ za + (1-z)p_t\hat{\tau} & \text{for} \quad p_t^C \le p_t \le p^F, \\ 1 + z(a-1) & p^F < p_t. \end{cases} \quad (A.1)$$

Profits are strictly increasing in p_t on $[0, p^F]$. As $\Pi_t(p_t) = 1 + z(a-1) \;\forall\; p_t > p^F$, periodic and overall profits are maximized by setting $p_t \ge p^F$, where the lowest price p^F serves as the benchmark for subsequent analysis. □

Appendix A2 (Proof of Lemma 3)

The critical price levels are used to restate (A.1): As $\alpha_t^C = a + bn_{t-1}$, and $\alpha^F = 1$, it follows for $b > 0$ that $p_t^C = (a + bn_{t-1})/\hat{\tau}$ and $p^F = 1/\hat{\tau}$.

With $\Pi = \sum_{t=1}^T \delta^{t-1}\Pi_t$ and demand $\tau_t^i = \alpha_t^i / p_t$ (Lemma 1), profits in t read:

$$\Pi_t = \begin{cases} p_t\hat{\tau} & p_t < p_t^C, \\ z(a + bn_{t-1}) + (1-z)p_t\hat{\tau} & \text{for} \quad p_t^C \le p_t \le p^F, \\ 1 + z(a-1+bn_{t-1}) & p^F < p_t, \end{cases} \quad (A.2)$$

where $n_{t-1} = \tau_{t-1}^C + n_{t-2}$.

(a) As $(1-z)\hat{\tau} > 0$, Π_t is strictly increasing in p_t on $[0, p^F]$, is nonincreasing for $p_t > p^F$.

(b) Since $b > 0$, Π_t is increasing in n_{t-1} for $p_t \ge p_t^C$, and independent of n_{t-1} for $p_t < p_t^C$.

(c) As $n_{t-1} = \tau_{t-1}^C + n_{t-2}$, we use the insight from (3) that $\partial \tau_t / \partial p_t \le 0$. With $\partial n_{t-1} / \partial \tau_{t-1}^C > 0$ and $\partial n_{t-1} / \partial n_{t-2} > 0$, it holds that $\partial n_{t-1} / \partial p_{t-k} \le 0$ for $k = 1, ..., t-1$. □

Appendix A3 (Proof of Proposition 1)

Proof of Proposition 1 is given by showing that **(i)** to **(iii)** hold true:

(i): $\quad \forall p_t < p_t^C: \ p_t^* \neq p_t$

(ii): $\quad \forall p_t > p^F: \ p_t^* \neq p_t$

(iii): $\quad \forall p_t \in (p_t^C, p^F): \ p_t^* \neq p_t$

(i) $[0, p_t^C)$:

From (A.2) we know that $\partial \Pi_t / \partial p_t > 0$ on $[0, p_t^C)$ as $\hat{\tau} > 0$.

Moreover, $\partial \tau_t^C / \partial p_t = 0$ holds since $p_t^C = \max\{p_t | \tau_t^C = \hat{\tau}\}$. Therefore, $\partial n_{t-1} / \partial p_{t-k} = 0$, and $\partial \Pi_t / \partial p_{t-k} = 0$, for $k = 1, \dots, t-1$. Hence, $\forall p_t < p_t^C: \ p_t^* \neq p_t$

(ii) (p^F, ∞):

Lemma 3(a) states that $\partial \Pi_t / \partial p_t > 0$ for $p_t \leq p^F$ and $\partial \Pi / \partial p_t \leq 0$ for $p_t > p^F$. That is, the strictly positive price effect is limited to the price interval $[0, p^F]$.

Lemma 4 states that $\partial \Pi_t / \partial p_{t-k} \leq 0$ for $k = 1, \dots, t-1$. The latter effect is strictly negative for $p_t > p^F$ where $\Pi_t = \Pi_t(n_{t-1})$. Hence, $\forall p_t > p^F: \ p_t^* \neq p_t$.

(iii) $[p_t^C, p^F]$:

Define $t \equiv T - m$, and $\Gamma_{T-m} \equiv \sum_{k=0}^{m} \delta^k \Pi_{T-m+k}$. As the present pricing decision in t may also affect profits from ticket sales in all future periods, the objective function in t is restated as $p_{T-m}^* = \arg\max[\Gamma_{T-m}]$, where $p_{T-m}^* \in [p_{T-m}^C, p^F]$.

As Γ_{T-m} is continuous on $[p_{T-m}^C, p^F]$, we get $\partial \Gamma_{T-m} / \partial p_{T-m} = \left(\sum_{k=0}^{m} \delta^k \partial \Pi_{T-m+k} \right) / \partial p_{T-m}$.

Because $\partial \Pi_{T-m} / \partial p_{T-m} > 0$ and $\partial^2 \Pi_{T-m} / \partial p_{T-m}^2 = 0$, and in addition $\partial \Pi_{T-m+k} / \partial p_{T-m} < 0$ and $\partial^2 \Pi_{T-m+k} / \partial p_{T-m}^2 > 0$ for $k = 1, \dots, m$, it must hold true that either:

- $\Gamma_{T-m}(p_{T-m}^C) < \Gamma_{T-m}(p_{T-m}) < \Gamma_{T-m}(p^F)$, or

- $\Gamma_{T-m}(p^F) < \Gamma_{T-m}(p_{T-m}) < \Gamma_{T-m}(p_{T-m}^C)$, or

- $\Gamma_{T-m}(p_{T-m}^C) = \Gamma_{T-m}(p^F) > \Gamma_{T-m}(p_{T-m})$,

for any p_{T-m} in the open interval (p_{T-m}^C, p^F). It follows that $p_{T-m}^* \in \{p_{T-m}^C, p^F\}$. $\qquad \square$

Appendix B (Proof of Proposition 2)

Proof of Proposition 2 is given by proving that the implications **(I)** and **(II)** are true:

(I): $p^*_{T-m+1} = p^C_{T-m+1} \rightarrow p^*_{T-m} = p^C_{T-m}$,

(II): $\Omega_{m-1} \le \dfrac{1-z}{z} < \Omega_m \rightarrow p^*_{T-m} = p^C_{T-m}$,

with $\Omega_m \equiv \sum_{n=1}^m \left[\sum_{k=n}^m \dfrac{(k-1)!}{(n-1)!(k-n)!} \delta^k (b\hat{\tau})^n \right]$ for $m \ge 1$, and $\Omega_0 \equiv 0$.

From **(I)** and **(II)** is deduced that $\dfrac{1-z}{z} < \Omega_m \rightarrow p^*_{T-m} = p^C_{T-m}$.

(I): Having defined $t \equiv T - m$ and $\Gamma_{T-m} \equiv \sum_{k=0}^m \delta^k \Pi_{T-m+k}$, we use the Proposition 1 result $p^*_{T-m} \in \{ p^C_{T-m}, p^F \}$ and examine the conditions under which $\Gamma_{T-m}\left(p^C_{T-m}\right) > \Gamma_{T-m}\left(p^F_{T-m}\right)$.

Considering (A.2) on the price interval $\left[p^C_{T-m}, p^F \right]$, $\Pi_{T-m} = z(a + bn_{T-m-1}) + (1-z)p_{T-m}\hat{\tau}$ are the profits for $m = 1,...T-1$. For $m = 0$, $p^*_T = p^F$ holds, hence, $\Pi_T = z(a + bn_{T-1}) + (1-z)$.

Inserting Π_{T-m+k} for $k = 0,...,m$ into Γ_{T-m} yields:

$$\Gamma_{T-m} = \sum_{k=0}^m \left[\delta^k z(a + bn_{T-m-1}) + \delta^k p_{T-m+k}(1-z)\hat{\tau} \right] + zb \sum_{k=0}^{m-1}\left[\sum_{n=1+k}^m \delta^n \tau_{T-m+k} \right]. \qquad \text{(B.1)}$$

Since $p^*_{T-m} = p^C_{T-m}$ if $\Gamma_{T-m}\left(p^C_{T-m}\right) > \Gamma_{T-m}\left(p^F\right)$, and $p^*_{T-m} = p^F$ otherwise, we can use (B.1) to rewrite $\Gamma_{T-m}\left(p^C_{T-m}\right) > \Gamma_{T-m}\left(p^F\right)$ as:

$$b \cdot \dfrac{\sum_{k=0}^{m-1}\left[\sum_{n=1+k}^m \delta^n \left(\tau_{T-m+k}(p^C_{T-m}) - \tau_{T-m+k}(p^F_{T-m}) \right) \right]}{1 - (a + bn_{T-m-1})} > \dfrac{1-z}{z}, \qquad \text{(B.2)}$$

where $p^*_{T-m} = p^C_{T-m}$ iff (B.2) holds true and $p^*_{T-m} = p^F$ otherwise.

Now let $\Delta\tau_{m,k} \equiv \sum_{n=1+k}^m \delta^n \left(\tau_{T-m+k}(p^C_{T-m}) - \tau_{T-m+k}(p^F_{T-m}) \right)$, so that we can write:

$$b \cdot \dfrac{\sum_{k=0}^{m-1} \Delta\tau_{m,k}}{1 - (a + bn_{T-m-1})} > \dfrac{1-z}{z}, \qquad \text{(B.3)}$$

and define $\hat{m} \equiv m + 1$. As $\Delta\tau_{m,k}$ allows factoring out $1 - (a + bn_{T-m-1})$ for $k = 0,...,m-1$, it follows that if (B.3) holds, (B.4) must always hold:

$$\frac{\sum_{k=0}^{\hat{m}-1}\Delta\tau_{\hat{m},k}}{1-\left(a+bn_{T-\hat{m}-1}\right)} > \frac{\sum_{k=0}^{m-1}\Delta\tau_{m,k}}{1-\left(a+bn_{T-m-1}\right)}. \tag{B.4}$$

From (B.3) and (B.4) it follows that, if $p_{T-m}^{*}=p_{T-m}^{C}$, it must also hold that $p_{T-\hat{m}}^{*}=p_{T-\hat{m}}^{C}$, or, equivalently:

$$p_{T-m+1}^{*}=p_{T-m+1}^{C} \;\rightarrow\; p_{T-m}^{*}=p_{T-m}^{C}. \qquad\qquad \square$$

(II): Proof is given by applying backward induction to (B.2). With $p_T^{*}=p^{F}$, we solve (B.2) for $m=1$, and derive $\delta b\hat{\tau} > (1-z)/z$, hence:

$$p_{T-1}^{*}=p_{T-1}^{C} \quad\text{if}\quad \delta b\hat{\tau} > \frac{1-z}{z}, \tag{B.5}$$

$$p_{T-1}^{*}=p^{F} \quad\text{if}\quad \delta b\hat{\tau} \le \frac{1-z}{z}. \tag{β.5}$$

We now look at the case where (β.5) holds true. Hence, we assume $p_{T-1}=p^{F}=1/\hat{\tau}$. Using $p_T=p_{T-1}=p^{F}$ to solve (B.2) for $m=2$, we get $\delta^2(b\hat{\tau})^2+\left(\delta+\delta^2\right)b\hat{\tau} > (1-z)/z$ and write:

$$p_{T-2}^{*}=p_{T-2}^{C} \quad\text{if}\quad \delta b\hat{\tau} \le \frac{1-z}{z} < \delta^2(b\hat{\tau})^2+\left(\delta+\delta^2\right)b\hat{\tau}, \tag{B.6}$$

$$p_{T-2}^{*}=p^{F} \quad\text{if}\quad \delta^2(b\hat{\tau})^2+\left(\delta+\delta^2\right)b\hat{\tau} \le \frac{1-z}{z}. \tag{β.6}$$

Continuing the process of backward induction and following the beta-branches, we find the generalized condition (B.2) for $m\ge1$, which is given by:

$$\sum_{n=1}^{m}\left[\sum_{k=n}^{m}\frac{(k-1)!}{(n-1)!(k-n)!}\delta^{k}(b\hat{\tau})^{n}\right] > \frac{1-z}{z}.$$

Defining $\Omega_{m}\equiv\sum_{n=1}^{m}\left[\sum_{k=n}^{m}\frac{(k-1)!}{(n-1)!(k-n)!}\delta^{k}(b\hat{\tau})^{n}\right]$ for $m\ge1$, and $\Omega_0\equiv0$, the ticket pricing conditions in generalized form read:

$$p_{T-m}^{*}=p_{T-m}^{C} \quad\text{if}\quad \Omega_{m-1}\le\frac{1-z}{z}<\Omega_{m},$$

$$p_{T-m}^{*}=p^{F} \quad\text{if}\quad \Omega_{m}\le\frac{1-z}{z}. \qquad\qquad \square$$