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**FAIRNESS, ENVY, GUILT AND GREED – BUILDING EQUITY
CONSIDERATIONS INTO AGENCY THEORY**

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ABSTRACT

In this paper we examine the extent to which fairness considerations are salient to senior executives and consider the implications for agency theory, tournament theory, and the design of top-management incentives. We look for patterns in a unique data set of senior executive preferences and seek explanations for these patterns using a model of fairness first advanced by Fehr & Schmidt (1999). We propose a number of amendments to Fehr & Schmidt's model. We challenge some of the standard tenets of agency theory and tournament theory, demonstrating why equity considerations should be taken into account. We add to the growing literature on behavioural agency theory.

KEYWORDS: fairness; agency theory; tournament theory; executive pay

Introduction

For over thirty years management scholars have been heavily influenced in the way that they conceptualise executive compensation by two economic frameworks. Agency theory (Alchian & Demsetz, 1972; Eisenhardt, 1989; Jensen & Meckling, 1976; Ross, 1973; Spence & Zeckhauser, 1971) postulates, inter alia, that in order to motivate executives (agents) to carry-out actions and select effort levels that are in the best interests of shareholders (principals), boards of directors, acting on behalf of shareholders, must design incentive contracts which make an agent's compensation contingent on measurable performance outcomes. Tournament theory (Connelly, Tihanyi, Crook, & Gangloff, 2014; Lambert, Larkin, & Weigelt, 1993; Lazear & Rosen, 1981; Rosen, 1982) extends the agency model by proposing that principals structure a company's management hierarchy as a rank-order tournament, thus ensuring that the highest-performing agents are selected for the most-senior management positions. Tournament theory postulates that executives compete for places in a company's upper echelons via a sequential elimination tournament. It predicts that compensation is an increasing convex function of an agent's position in the management hierarchy, with increases in remuneration between levels in the hierarchy varying inversely in proportion to the probability of being promoted to the next level. By implication, the compensation of the CEO, ranked highest in the tournament, will typically be substantially more than the compensation of executives at the next highest level.

Both agency and tournament theories make standard economic assumptions about human behavior: agents are rational, self-interested and rent-seeking; their utility is positively contingent on pecuniary incentives and negatively contingent on effort; there is no non-pecuniary agent motivation (Besley & Ghatak, 2005). Neither theory takes into account equity considerations (Bowie & Freeman, 1992; O'Reilly, Main, & Crystal, 1988). However, in recent years a number of management scholars have advanced a new version of agency

theory based on more realistic assumptions about behavior (Pepper & Gore, 2012, 2014; Pepper, Gore, & Crossman, 2013; Rebitzer & Taylor, 2011; Sanders & Carpenter, 2003; Wiseman & Gomez-Mejia, 1998). The intention has been to construct a better theoretical account of executive compensation and agent motivation. To date, this approach, known as behavioural agency theory, has focused on attitudes to risk, time preferences and intrinsic motivation. Scholars have known for some time that fairness is also a key factor in determining whether employees are motivated by their pay, especially when comparisons are made with the compensation of other team members (Akerlof & Yellen, 1990; Clark & Oswald, 1999), (Card, Mas, Moretti, & Saez, 2012; Larkin, Pierce, & Gino, 2012; Nickerson & Zenger, 2008). Some management scholars (e.g., Gomez-Mejia & Wiseman, 1997; Schlicht, 2008; Wade, O'Reilly, & Pollock, 2006) argue that fairness is equally germane to senior executives as it is to other workers. However, empirical evidence about top managers' attitudes to fairness has historically been limited.

In this article we ask to what extent are fairness considerations salient to senior executives? We examine the implications for agency theory and tournament theory and consider how the design of top-management incentives might be affected. In the first section we review the literature on fairness from multiple perspectives, before constructing a theoretical framework in which we define 'fairness', and 'envy', after Varian (1974, 1975) and Baumol (1986). We combine these definitions with a utility function which reflects fairness and incorporates factors for 'envy' and 'guilt', after Fehr & Schmidt (1999). The second and third sections describe the research methodology and the results of the empirical study. We look for patterns in a unique data set of senior executives' preferences collected from around the world and seek explanations for these patterns using a model of fairness proposed by Fehr & Schmidt (1999). The fourth section discusses the results and tests these against the general proposition that 'fairness matters' (Isaac, Matthieu, & Zajac, 1991). The

discussion section proposes a number of amendments to Fehr & Schmidt's model of fairness, speculates on the role of greed, and examines the significance of the model for agency theory, tournament theory, and the design of top-management team incentives. The concluding section incorporates comments on the paper's limitations and contribution.

Theoretical antecedents: Fairness, social comparisons and organisational justice

Fairness has a normative dimension (i.e., 'what should be done?') and an ethical component (i.e., 'what is just?'). There is an extensive literature on the relationship between fairness and incentives in various scholarly traditions, including moral and political philosophy (Bowie & Freeman, 1992; Cohen, 2008; Grant, 2002; Nozick, 1973, 1974; Rawls, 1971|1999, 2001), legal studies (Adler, 2012; Kaplow & Shavell, 2002), social psychology (Adams, 1965; Blau, 1964; Deutsch, 1975b; Festinger, 1954; Homans, 1961; Leventhal, 1976), economics (Baumol, 1986; Isaac et al., 1991; Rabin, 1993; Varian, 1974, 1975; Zajac, 1995) and management (Folger, 1998; Folger & Cropanzano, 1998, 2001; Greenberg, 1982; Greenberg & Colquitt, 2005a; Greenberg & Cropanzano, 2001; Meindl, 1989). Rawls and Nozick debate the possible trade-off between equal distributions of wealth among persons, and distributions which incentivise activities that enhance the total wealth of society. Rawls asserts the 'difference principle', postulating that making a greater index of primary goods available to more advantaged groups is justified in so far as it adds to the index of less advantaged groups (Rawls, 2001: 61-63). Nozick challenges Rawls from a libertarian perspective with entitlement theory (sometimes known as the 'Wilt Chamberlain' argument, after the iconic American basketball player), contending that a person who acquires a holding of goods in a just manner, by means of a legitimate transfer, and from someone who was previously properly entitled to the goods comprised in that holding, is therefore justly entitled to those goods, even if he or she becomes inordinately wealthy as a consequence (Nozick, 1973: 57).

The difference principle provides the ethical justification for low-powered, muted, or as Roberts (2010) calls them, ‘weak’ incentives. Entitlement theory provides ethical support for high-powered, wealth-creating (‘strong’) incentives. Cohen (2008: 87-91) contests both the difference principle and entitlement theory, proposing instead an egalitarian ethos which argues that economic efficiency in a fair society should not require some members to be provided with inequality-generating rewards. Grant (2002) views incentives as potentially coercive, so that the fairness, or otherwise, of incentives is an inherently problematic issue. Bowie & Freeman (1992: 50-51) call for the development of a specific theory of fairness that is appropriate to principal-agent relationships.

Festinger (1954) takes a different approach, without the ethical overtones, with social comparison theory. He argues that we each have a drive to measure our abilities and opinions; that, in the absence of objective mechanisms, we evaluate ourselves in comparison with other people; and that, given a range of possible referents, someone close to our own abilities or opinions will be selected for comparison. Adams (1965) incorporates an assessment of differential inputs into the social comparison process, building on the work of Homans (1961) and Blau (1964). Deutsch (1975b) points out that distribution logics are values-dependent and proposes that equity, as opposed to equality or need, will be the dominant principle of distributive justice only where economic productivity is the primary goal. Alternatively, where maintaining harmonious social relations is a common goal, equality will be the dominant logic, and where welfare is the primary goal, need will be the guiding principle. Meindl (1989) develops this line of thought in a managerial context, arguing that differential equity-based allocations are more desirable when workers are not operating in tightly-coupled teams, but less differentiation will be appropriate when the focus is on team-production. In other parts of the management literature ‘fairness’ is often used interchangeably with ‘justice’ (Greenberg & Colquitt, 2005b). After an early focus by

management scholars on distributive justice (Deutsch, 1975a), an extensive organisational justice literature has developed, incorporating concepts of procedural justice, interactional justice, and, increasingly, attempts to integrate multiple justice dimensions (Colquitt, Greenberg, & Zapata-Phelan, 2005). Aspects of organisational justice other than distributive justice are beyond the scope of this paper.

Varian (1974, 1975), and later Baumol (1986) make social comparison the basis of an economic theory of fairness. Fehr & Schmidt (1999) propose a model which, while making no reference to Varian or Baumol, nevertheless largely follows the structure of their definitions. Isaac *et al* (1991) advance what they call a ‘positive theory of economic fairness’, which they use to derive political and legal principles. Other economists (e.g., Andreoni & Miller, 2002; Bolton & Ockenfels, 2000; Charness & Rabin, 2002; summarised in Fudenberg & Levine, 2012) propose economic theories of fairness which are essentially variations on Fehr & Schmidt, but which allow for, *inter alia*, differential wealth effects and concave utility functions.

In order to provide the analytical framework for the article we make a number of observations at this point. First, in this paper we have adopted Lindenberg’s ‘method of decreasing abstraction’, commencing with a simple framework and, in successive stages, incorporating additional assumptions as necessary on the basis that: ‘a model should be as simple as possible and as complex as necessary’ (Lindenberg, 1991: 117). Secondly, as stated above, one of the main objectives of this paper is to challenge parts of agency theory and tournament theory. Although widely adopted by management scholars (Connelly *et al.*, 2014; Eisenhardt, 1989) and highly influential in the design of corporate governance frameworks (Daily, Dalton, & Cannella, 2003), these are both essentially economic models. Therefore, we have deliberately adopted an economic model of fairness as our starting point with a view to ‘challenging the economic paradigm from within’. Thirdly, we recognise that,

in the context of a values-laden concept like fairness, normative and positive distinctions become intertwined. Hume's law (an 'ought' cannot be derived from an 'is') does not proscribe the converse (i.e., there is no reason why an 'is' cannot be derived from an 'ought'). Fairness cognitions influence fairness beliefs, which in turn affect fairness perceptions, thus motivating fairness behaviours. 'Should' judgements (Folger & Cropanzano, 2001) involve a degree of what Mackenzie (2007) calls 'performativity'. Thus, there is a de facto connection between normative and positive dimensions, justifying the multi-perspective approach that we have adopted in this paper.

Analytical framework

Varian (1974, 1975) and Baumol (1986) both propose similar definitions of fairness and envy, which we summarize as follows. For two individuals X (he) and Y (she):

A distribution of goods is called fair if X prefers his own bundle of goods x to the bundle of goods y obtained by Y, that is, if X does not envy y , AND if Y prefers her own bundle of goods y to the bundle of goods x obtained by X, that is, if Y does not envy x .

A distribution of goods is said to involve envy by X of the bundle of goods y obtained by Y if X would rather have y than the bundle of goods x obtained by X AND to involve envy by Y of the bundle of goods x obtained by X if Y would rather have x than the bundle of goods y obtained by Y

These definitions are essentially mirror images. They are typically sparse definitions of the kind favoured by economists (Hausman, 1992). It is important to note that, as defined, X's envy focuses on the bundle of goods y , not the economic agent Y, and that, in the same way, Y's envy focuses on x not X; X and Y consult only their own preferences and decide whether they would rather have the other person's bundle of goods rather than their own. X is not required to know about Y's preferences, and Y is not required to know about X's

preferences; nor is the other person's identity relevant (Baumol, 1986). Rawls (1971|1999 : 466-7) calls this 'benign envy' rather than 'envy proper'.

Fehr & Schmidt (1999) propose a model of fairness which follows the structure of these definitions and which has become a standard in the economic literature. Assume that two players dislike inequitable outcomes. They experience feelings of inequity if they end up worse-off than other players in the game; let us call this 'envy'. They also experience feelings of inequity if they end up better-off than other players in the game; let us call this 'guilt'. If the two players are identified as X and Y, then X's utility function in respect of a monetary payment, x , can be stated as follows:

$$U_X(v) = v_x - \underbrace{\alpha_x \max [(v_y - v_x), 0]}_{\text{Factor for envy}} - \underbrace{\beta_x \max [(v_x - v_y), 0]}_{\text{Factor for guilt}} \quad (1)$$

where v_x is the value of the monetary payment made to X and v_y is the value of the monetary payment made to Y. The second term in the utility function, i.e., $\alpha_x \max [v_y - v_x, 0]$, which applies if Y is paid more than X, represents envy. The third term, $\beta_x \max [v_x - v_y, 0]$, which applies if X is paid more than Y, represents guilt. The relative weighting of envy and guilt is provided by the factors α_x and β_x , so that α_x is the coefficient for envy and β_x is the coefficient for guilt. Fehr & Schmidt assume that $\alpha_x \geq 0$ and that $0 \leq \beta_x \leq 1$. No upper constraint is placed on α_x , but they acknowledge that there may be a small number of subjects for whom $\beta_x < 0$. We return to this point later. They also make the assumption that $\alpha_x \geq \beta_x$, i.e., that envy weighs heavier than guilt so that X's experience of inequity will be greater if they are worse-off than Y, and less if they are better-off (Brown, 2001; Ezzamel & Watson, 1998)

From Equation 1 we derive the general principle that 'fairness matters' (Isaac et al., 1991), in the sense that preferences are perceived to be unfair by some agents, who therefore make alternative choices which are not consistent with the standard economic calculus. This

general proposition is tested empirically, along with a number of specific predictions which are identified below.

Research methods

We now turn to the empirical study. The data were gathered by an international research firm from its global panel of independent senior executives in 2011 using a questionnaire designed by the authors. A sample-frame was selected from the panel by identifying potential survey respondents, based on a list of pre-selection criteria (earnings, job title, company size etc.), to ensure that only ‘senior executives’ as defined for the purposes of the study were included within the sample. We define ‘top-management team’ and ‘senior-executive team’ (hence ‘senior executives’) as the group of very senior managers who are responsible for specifying and executing a firm’s strategy, who through their actions are capable of affecting the company’s profits, share price, reputation and market positioning (Carpenter, Geletkanycz, & Sanders, 2004; Hambrick & Mason, 1984). Individual invitations were issued by email to everyone in the sample-frame. Of 12869 relevant executives on the database, 756 agreed to take part in the survey, a response rate of 6%. The main demographics are set out in Table 1.

 TABLE 1 ABOUT HERE

A low response rate is not unusual in international surveys (Harzing, 2000) and is common in attitudinal studies of managerial elites (Pettigrew, 1992); it is to be expected that these two factors will compound. In the present case, careful examination of the sample demographics showed that a wide range of ages, senior roles, company types, company sizes, industries and countries were represented in the sample. A series of χ^2 tests for goodness of fit were used to test for differences between the demographic profile of the sample-frame and the sample; (t-test were not possible in this case because sample-frame means were not available).

The overall result was χ^2 (df =62, n =756) =2.57, $p < 0.005$, indicating a significant degree of fit. At individual factor level the results were: job title χ^2 (df =9, n =756) = 1.85, $p < .001$; age χ^2 (df =6, n =756) =.011, $p < .005$; gender χ^2 (df =1, n =756) =.017, $p < .25$; country χ^2 (df =25, n =756) =.055; $p < .005$; industry χ^2 (17 df =17, n =756) =.637, $p < .005$. The results indicate, with a high degree of probability, that the sample was representative of the sample-frame. Therefore, we were able to conclude that self-selection bias (Cascio, 2012) was unlikely to be a problem in this case.

The sample was segmented into three earnings bands: \$350,000 and under (n = 506); \$350,000 - \$724,999 (n = 178); \$725,000 or more (n = 72). Separate questionnaires were issued to participants in the three earnings brackets, with monetary amounts in each of the three questionnaires proportionate to each participant's income level. For convenience, we report the findings in the main body of the paper by reference to the amounts set out in questions covering the bracket for executives earning \$350,000 and under, which we refer to as 'the base case'.

Problem 1

The first part of the study involved two pairs of questions which examined the impact of equity comparisons using an ultimatum game scenario (Guth, Schmittberger, & Schwarze, 1982). An unusual feature was that participants were invited to assume the roles of both proposer and responder in turn, although the question did not take the form of a repeated game. The first pair of questions involved a relatively small amount at stake (referred to hereafter as the 'endowment') of \$5,250 in the base case.

In an experiment two people are brought together. Person X (he) is given \$5,250 and is told that he can split this in any way he likes with Person Y (she). Person Y can accept or reject the offer. If Y accepts the offer then X and Y both get their money. If she

rejects the offer then neither X nor Y get to keep the money. Both parties are aware of the amount involved and the terms of the arrangement, but are anonymous to each other and cannot negotiate over the outcome.

Participants were asked: (1) if you were person X, how much would you offer person Y? (2)

If you were person Y, what is the minimum offer you would accept from person X?

Questions (3) and (4) were identical to questions (1) and (2), except that the amounts available to share between the proposer and responder were increased in proportion to the three earnings bands to \$45,000, \$165,000 and \$277,500 respectively.

According to the standard economic model (Henrich et al., 2001) the proposer should offer a nominal sum, which the responder should be prepared to accept, on the principle that something is better than nothing. However, Fehr & Schmidt (1999) postulate that, assuming that the total amount at stake (which we refer to as the ‘endowment’ and signify by E) equals 1, then the majority of offers will be approximately equal to 0.5; that there will be no offers greater than 0.5; that very low offers are likely to be rejected (and hence are rarely made); that the probability of rejection decreases in inverse proportion to the size of the offer; and that offers of 0.5 will always be accepted. Fehr & Schmidt go on to note that these patterns are observable in a number of previous empirical studies and that the regularities hold good regardless of the amount of the endowment (Fehr & Schmidt, 1999: 826-827).

Problem 2

The second part of the study was based on a problem originally designed by Shafir, Diamond & Tversky (1997) which examined the importance of absolute rewards compared with rewards relative to salient others. The amounts reported here again refer to the base case.

Jean is invited to join the senior management team of Company J with a total reward package worth \$187,500. Jacques, a contemporary of Jean’s with comparable expertise

and experience, is invited to join the senior management team of Company Q with a total reward package of \$195,000. Subsequently Jean discovers that the average total reward package of her peers in Company J's management team is \$180,000. Jacques discovers that the average total reward package of his peers in Company Q's management team is \$202,500. All other things being equal, who do you think is likely to be more highly motivated? Possible answers: (A) Jean; (B) Jacques; (C) They are likely to be equally motivated.

In this case, the standard economic model predicts that an agent would choose the higher absolute amount over the lower absolute amount, i.e., (B). Exceptions to this general rule are possible if the agent views the situation as a repeated game, with the lower relative reward in round 1 signalling the possibility of both higher absolute and higher relative rewards in later rounds; see Nowak, Page & Sigmund (2000). However, in the present case the question was framed in such a way that it gave no indication that the game would be repeated. What predictions follow from Fehr & Schmidt's model depends upon who, Jean or Jacques, or their peers in Company J and Q, is treated as the principal referent, and the relationship in each case between the respective coefficients for envy, α , and guilt, β . A decision matrix is set out in Table 2.

TABLE 2 ABOUT HERE

In the top left-hand quadrant we are comparing Jean's utility function: $U(v) = \$187,500 - \alpha_j \$7,500$ with Jacques's utility function: $U(v) = \$195,000 - \beta_q \$7,500$. It can be seen that if $\beta_q \leq 1 + \alpha_j$, then Jacques is more motivated, and if $\beta_q = 1 + \alpha_j$, then they are equally motivated. Only if $\beta_q > 1 + \alpha_j$, is Jean more motivated. In the top right-hand quadrant we are comparing $U(v) = \$187,500 - \alpha_j \$7,500$ for Jean, with $U(v) = \$195,000 - \alpha_q \$7,500$ for Jacques. Jacques will be more motivated unless his coefficient for envy is significantly more

than that of Jean i.e., $\alpha_q > 1 + \alpha_j$. Similarly, in the bottom left-hand quadrant, Jacques will be more motivated unless his coefficient for guilt is significantly more than Jean's i.e., $\beta_q > 1 + \beta_j$. In the bottom right-hand quadrant we are comparing $U_j(v) = \$187,500 - \beta_j \$7,500$ for Jean with $U_q(v) = \$195,000 - \alpha_q \$7,500$ for Jacques. In this case Jean will be more motivated if Jacques's envy is significantly greater than Jean's guilt i.e., $\alpha_q > \beta_j + 1$; otherwise Jacques will be more motivated. The way the question is constructed makes the top left-hand and bottom-right hand quadrants the most logical frames of reference for respondents.

Results

Problem 1

The results of the first part of the study are set out in a scatter diagram. Figure 1 shows the distribution of maximum offers and minimum acceptances. The smaller endowment in questions (1) and (2) is identified as E_1 and the larger endowment in questions (3) and (4) is identified as E_2 . For the purposes of comparison, the monetary amounts offered by X and accepted by Y were normalised by converting them into fractions of E_1 and E_2 , such that $0 \leq x \leq 1$ and $0 \leq y \leq 1$, where x is the maximum amount offered by X and y is the amount accepted by Y. There was a strong correlation (.571, $p < .01$) between the two distributions. The mean amount offered was .43 in the case of the smaller endowment and .41 in the case of the larger endowment. The mean amounts accepted were .41 in the first case and .38 in the second case. Standard deviations for both offers and acceptances were .21 in the case of the smaller endowment and .22 in the case of the larger endowment.

FIGURE 1 ABOUT HERE

A number of distinct patterns of responses can be observed in Figure 1. A cluster of points (9.66% in the case of the smaller endowment, E_1 , and 14.68% in the case of the larger

endowment, E_2) can be seen just above the origin representing relatively small maximum offers ($x \leq 0.1$), matched by similarly small minimum acceptances ($y \leq 0.1$). This is the standard economic rational choice: the proposer offers a nominal sum, which the responder is in turn prepared to accept. A much larger cluster (representing 42.33% of the sample for E_1 and for 41.53% E_2) occurs around the point where the maximum amount offered and minimum amount accepted is between 0.4 and 0.5, implying an absolute standard of fairness on the part of participants who expected the stake to be shared equally between X and Y. This cluster cannot be explained by rational choice theory. A significant number of responses are on the line which proceeds at an angle of 45° , starting at the origin and ending at the centre point [0.5, 0.5], indicating that equal amounts are being offered and accepted. Excluding amounts already counted in the previous two categories, these represented an additional 6.48% of the sample for E_1 and 4.10% for E_2 . It implies that relative fairness was important to participants: their expectation was evidently that X and Y should expect to receive the same amount, whether acting as proposer or responder, although not necessarily as much as half of the endowment. As well as being fair in an intuitive sense, this is also a logical response in circumstances where the proposer assumes that the responder has the same utility function.

Other points on the two charts are more widely dispersed. A number of participants (15.34% for E_1 , and 14.29% for E_2) were prepared to offer up to 40% of the endowment, but would accept less. This constitutes a risk averse or strategic choice. Evidently the proposers wanted to be reasonably certain that the responders would accept their offers, by allowing for the possibility that the responders' minimum acceptance levels were higher than their own. Conversely, some participants (6.48% for E_1 , and 6.75% for E_2) wanted up to 50% of the endowment, but offered less than the minimum amount they were prepared to accept, indicative of risk-seeking - attempting to retain a higher proportion of the endowment by betting that the responder would be prepared to accept a smaller amount. These results are

also consistent with Fehr & Schmidt's model. However, a number of participants (a total of 19.71% for E_1 , and 18.65% for E_2) confounded Fehr & Schmidt's prediction that no one would offer more, nor accept less than one-half of the endowment. For the purposes of subsequent analysis we consider this conflicting data in two parts. First, data for which the minimum acceptance is greater than 0.5 fundamentally contradicts Fehr & Schmidt's theory: because $U_Y(0.5) = 0.5 > U_Y(y)$ where $y > 0.5$, regardless of the levels of envy and guilt, an offer of half the endowment should always be accepted. Secondly, data for which the maximum offer is greater than 0.5 but the minimum acceptance is less than 0.5 is not predicted by the Fehr & Schmidt model, because Fehr & Schmidt anticipate that an offer of 0.5 will always be accepted, so there is no logic to offering more. However, the result is not inconsistent with the model provided $y \leq 0.5$: a possible explanation is that proposers who are very risk averse, imagining that responders might have high minimum acceptance levels, choose to make apparently excessive offers. We therefore distinguish between data points where $y > 0.5$ regardless of the value of x , which contradicts Fehr & Schmidt's model, and data points where $x > 0.5, y < 0.5$, which are not necessarily incompatible with Fehr & Schmidt. These data are summarised in Table 3.

TABLE 3 ABOUT HERE

Problem 2

In the second part of the study, Jean, the executive receiving the lower absolute but higher relative amount was chosen by 345 participants (45.6%). Jacques, the executive receiving the higher absolute sum was chosen by 234 participants (31.0% of the total sample), with 177 participants (23.4%) expressing the view that Jean and Jacques would be equally motivated. Comparable, but more pronounced, discrepancies between relative and absolute amounts were reported by Shafir *et al.*, (1997). The standard economic model is unable to explain these results: according to the rational choice calculus an economic agent should always

choose a higher absolute amount over a lower absolute amount. Fehr & Schmidt's model, on the other hand, is capable of providing an explanation.

To see this, we can use the results of Problem 1 to estimate envy coefficients (which we refer to as α coefficients) for participants in the survey in order to make predictions about their preferences for Jean or Jacques in Problem 2. In the ultimatum game, if the offer by X is declined by the responder Y, then the resulting utility of both players is zero, i.e., $U_X(0) = U_Y(0) = 0$. If the offer is accepted, then $U_Y(y) \geq 0$. Therefore, an individual's minimum acceptance will be the point at which $U_Y(y) = 0$. Given that $U_Y(0.5) = 0.5$ in all cases, the minimum acceptance will be in the range $0 \leq y \leq 0.5$. From Fehr & Schmidt, we know that in this range $U_Y(y) = y - \alpha(1-2y)$, so that if $U_Y(y) = 0$, then $\alpha = y / (1-2y)$. We assume, based on the way that Problem 2 is framed (with each participant individually considering the cases of both executives) that participants will attribute to Jean and Jacques the same coefficients for envy and guilt. We know from Table 2 that, if $\alpha < 1 + \beta$, then Fehr & Schmidt's model predicts that Jacques will be regarded as being more motivated, regardless of his frame of reference. Jean will only be selected if $\alpha > 1 + \beta$ although, even in this case, Jacques will still be chosen if Jean and Jacques view each other as referents, rather than their company peers. Therefore, we would expect individuals selecting Jean to have higher α coefficients than participants choosing Jacques. We would also expect a rank order correlation between α scores and participants selecting, respectively: first, Jacques; secondly, indifference; and, thirdly, Jean.

The mean minimum acceptances and implied α coefficients are set out in Table 4. These are derived from the responses to the ultimatum game for E₁ and E₂ for respondents selecting Jean or Jacques. Because we are using Fehr & Schmidt's model to estimate α coefficients for each respondent, we include only data for survey participants whose responses to the ultimatum game are consistent with Fehr & Schmidt.

 TABLE 4 ABOUT HERE

Table 4 shows that participants choosing Jean over Jacques do on average have higher α coefficients. In the case of the smaller endowment, the mean implied α score for those selecting Jean is 1.51, compared with 1.17 for those choosing Jacques. In the case of the larger endowment, α coefficients are 1.16 and 0.89 respectively. As predicted there was a significant rank-order correlation ($r_s = .081$, $p < .05$, $n = 664$ for the smaller endowment and $r_s = .088$, $p < .05$, $n = 665$ for the larger endowment). The number of participants selecting Jean with α coefficients greater than 2.0, as predicted by Fehr & Schmidt, is 182 out of a total of 306 (59.48%) in the case of the smaller endowment, and 178 out of 300 (59.33%) in the case of the larger endowment. Conversely, the number of participants choosing Jacques with α coefficients ≤ 0.1 is only 39 (12.75%) in the case of the smaller endowment and 52 (17.33%) in the case of the larger endowment. Although not a proof, these findings are consistent with Fehr & Schmidt's fairness model. We comments further on these results below in the discussion section.

Discussion

The results show the inadequacies of the standard economic model in providing explanations for these phenomena, and that Fehr & Schmidt's model is much better able to explain the data. In the first problem, fairness theory accounts for around 88% of the data (87.83% for E_1 and 87.96% for E_2), compared with the much small proportion which is explained by the rational choice model (9.66% for E_1 and 14.68% for E_2). In the second problem, over 45% of survey participants (306 out of 664 participants in the case of the smaller endowment and 300 out of 665 in the case of the larger endowment) make choices which indicate a very strong

preference for fairness. The results demonstrate that senior executives are concerned about fairness to a significant extent, thus answering the first part of the research question.

However, Fehr & Schmidt's model is not able to explain why, in the first of the two research problems, around 12% of participants claim more than 50% of the endowment. Nor is it able to explain why, in the second problem, more than 100 participants with α coefficients > 2.0 choose Jacques and not Jean; or why 39 (E_1) and 52 (E_2) participants with $\alpha \leq 0.1$ choose Jean and not Jacques. We address these matters below under the sub-heading of 'greed'. Three further issues are raised by the second problem. The first concerns context: it is a relevant factor that Jean and Jacques are both members of senior management teams; Company J and Company Q will presumably be more interested in maximizing the total utilities of their management teams than the single utilities of individual team members. The second is the question of identity. The example makes it clear that the identities of the parties are relevant to their preferences: Jean may envy Jacques as well as Jacques's total reward; Jacques may be jealous of his peers in Company Q as well as their level of earnings. The third is the issue of their respective contributions, i.e., the ability and effort which Jean and Jacques supply to their employers in return for their rewards. Jean may be less envious of Jacques if she senses that he receives a larger reward in return for greater ability or greater effort. Jacques may be less jealous of his peers if he recognises that their contributions to Company Q are greater than his. We address these issues below under the sub-heading 'refining the fairness model', before commenting on the implications of our findings for agency theory, tournament theory, and the design of top-management team incentives.

Greed

Table 5 shows how in problem 2 the proportion selecting Jean and Jacques differs between low envy ($\alpha \leq 0.1$) and high envy ($\alpha \geq 2.0$) groups. Setting aside the proportion of indifferent responses, which is fairly consistent across the categories, there is a significantly higher

propensity to select Jean in the high envy group. As we have already noted, this is consistent with Fehr & Schmidt's theory, as the requirement $\alpha_q > \beta_j + 1$ is almost certainly satisfied: $\beta = 1.0$ implies an agent would be as happy having nothing as everything, which seems highly implausible and is why Fehr & Schmidt impose the condition $\beta \leq 1.0$; indeed any result where $\beta > 0.5$ would appear to be unlikely, as it would imply that increasing guilt outweighs the marginal utility of wealth.

TABLE 5 ABOUT HERE

However, it will be observed that 27-28% of executives in the high-envy group still select Jacques, which is not predicted by Fehr & Schmidt. This might be because some participants take the view that Jean and Jacques always regard each other as their primary reference points, in which case Jacques will always be selected. At the other end of the spectrum, while preferences for Jacques are more prevalent than for the high envy group, as predicted, there are still a large number of respondents in the low envy group (39 for E_1 and 52 for E_2) who select Jean. Under Fehr & Schmidt's model, this can only be explained by assuming that there is a sufficient proportion of participants for whom $\beta < 0$, so that the condition $\alpha_q > \beta_j + 1$ is still satisfied even as α tends to zero. Fehr & Schmidt (1999: 824) do recognise the possibility that $\beta < 0$, which they refer to as 'status seeking'. We prefer to describe $\beta < 0$ as 'greed', recognising that for some people the selfish desire for personal reward trumps any desire for fairness. Robertson (2001: 22-23) defines greed in terms of wants, needs and entitlements. In its broadest sense (preferred by Robertson) greed occurs where wants exceed needs. In a narrower sense (preferred by us) greed occurs where wants exceed both needs and entitlements. There is also a visceral quality to greed (Robertson, 2001: 14-19), so that including greed in the model is consistent with views expressed by Elster (1996) about the importance of recognising emotion as a factor in economic

calculations. Therefore, we propose that greed should be incorporated into the fairness framework by allowing $\beta < 0$, in which circumstances the coefficient for guilt ($\beta \geq 0$) becomes a coefficient for greed ($\beta < 0$). While, *prima facie*, this is not a major feature of the data, the number of senior executives participating in the study for whom $\beta < 0$ is not insignificant, so that $\beta \geq 0$ cannot be assumed in the way it is by Fehr & Schmidt (1999: 824). We do not pursue this phenomenon further in the current paper, but note the impact of greed on executive pay as an item for further research.

Refining the fairness model

The analysis to this point provides empirical evidence in support of the proposition that fairness matters to senior executives as it does for other workers, albeit that the presence of negative β means that in some circumstances the effects may be more muted. Fehr & Schmidt's model, despite its relative simplicity and high level of abstraction, has proved to be an effective framework for explaining the data. However, Fehr & Schmidt focus on the impact of differential reward outcomes, and the questions in our study imply no difference in the extent to which rewards are deserved. In order to draw inferences from the theory for senior executive incentive design, the model needs to be refined to allow for the possibility of differential inputs and hence for the possibility that differential levels of reward might be perceived to be fair.

Akerlof and Kranton (2000) argue that the identity of an economic agent (e.g., X in terms of the initial definitions of fairness and envy in this paper) affects his utility function and should therefore be taken into account in the economic calculus. The identity of a referent (e.g., Y) may also affect the utility function of X: i.e., X may envy Y rather than just y. The choice by both Varian and Baumol of the word 'envy', a characteristically emotive term, is potentially significant. In the present context, this means that envy is a phenomenon which involves both a comparison of two bundles of goods (x and y) and an emotional

reaction (of X to Y); X envies Y (the person) and y (the bundle of goods); to ignore the emotional component runs the risk of misunderstanding the phenomenon. In Rawlsian terms this is ‘envy proper’ rather than ‘benign envy’ (Rawls, 1971|1999: 467).

Allowing for the fact that the identity of the two economic agents is a relevant factor, we must also recognise the possibility that X and Y may make differential contributions (e.g., in terms of their ability and effort) prior to receiving x and y, and that his perception of these differential contributions might be taken into account by X as he weighs the extent to which he envies or does not envy the bundle of goods y obtained by Y. To allow for this we incorporate equity theory (Adams, 1965). Adams explains equity in the context of social exchange in terms of X’s perception of the costs of his inputs (i.e., what X must do to obtain x) and the value of his outputs (i.e., the bundle of goods x obtained by X as a reward) versus the perceived cost of Y’s inputs (i.e., what she must do to obtain y) and Y’s perceived outputs (i.e., her bundle of goods y); formally:

$$\left(\frac{O_x}{I_x}\right) : \left(\frac{O_y}{I_y}\right) \quad (2)$$

where O_x are the outputs of the first agent, X, e.g., his compensation, I_x is the first agent’s inputs e.g., his ability and effort, O_y are the outputs of the second agent, Y, and I_y is her inputs. Inequity is perceived by X to exist if $\left(\frac{O_x}{I_x}\right) \neq \left(\frac{O_y}{I_y}\right)$. If $\left(\frac{O_x}{I_x}\right) \leq \left(\frac{O_y}{I_y}\right)$ he feels envy and if $\left(\frac{O_x}{I_x}\right) \geq \left(\frac{O_y}{I_y}\right)$ he feels guilt (Adams, 1965).

Incorporating the concept of identity and the Adams’ ratio into Fehr & Schmidt’s utility function enables us to generate a new version of the fairness model. It assumes that X will assess both the identity of, and the contribution provided by, X, to earn v_x , and by Y to earn v_y . We represent this as follows:

$$U_x(v) = v_x - \underbrace{\alpha_x \max \left[\left(\frac{v_y}{c_y} - \frac{v_x}{c_x} \right), 0 \right]}_{\text{Factor for envy}} - \underbrace{\beta_x \max \left[\left(\frac{v_x}{c_x} - \frac{v_y}{c_y} \right), 0 \right]}_{\text{Factor for guilt / greed}} \quad (3)$$

where $U_x(v)$ is the utility of the payment to X, v_x is the value of the payment as perceived by X, v_y is X's perception of the value of the payment to Y, c_x is the contribution made by X in return for v_x , c_y is X's perception of the contribution made by Y in return for v_y , α_x is the coefficient for envy, such that $\alpha_x \geq 0$, and β_x is the coefficient for guilt, such that $0 \leq \beta_x \leq 1$, or greed in case that $\beta_x < 0$.

We recognise that the Equation (3) may not be strictly solvable because perceptions are involved: X's perceptions of v_x , c_x , v_y and c_y may be different from Y's perceptions of v_x , c_x , v_y and c_y ; the equation is therefore not as mathematically tractable as Fehr & Schmidt's original model. Festinger recognised this type of problem with social comparisons in the way that he talked about evaluations being 'unstable' (Festinger, 1954; Corollary IIA). However, we contend that the framework is analytically sound, that it helps to explain the importance of equitable payment, and that this is more important than mathematical tractability.

Top-management team perspective

The fairness model provides important insights into the optimal design of incentives in teams. Two seminal works on teams by economists are Marschak & Radner (1972) and Alchian & Demsetz (1972), although in both cases the focus is on information sharing. Holmstrom (1982) studies moral hazard in teams, with a particular focus on free-riding and internal competition, again primarily from an information economics perspective. Lindenberg & Foss (2011) and Foss & Lindenberg (2012) examine the relationship between group agency, motivation, and joint production, but not specifically the part played by fairness. Henderson & Fredrickson (2001), Siegel & Hambrick (2005) and Fredrickson, Davis-Blake & Sanders (2010) comment on the implications of pay disparities in top-management teams, citing evidence that collaboration diminishes when large pay disparities exist.

It is evident from our study that perceived fairness will affect team motivation. If we make the not unreasonable assumption that individual team members treat other members as

key referents (Trevor & Wazeter, 2006), then it is relatively easy to demonstrate by mathematical deduction that the combined total utility of team members is maximised when the Adams' ratio is in equilibrium. To illustrate this, consider a team with two members. Their individual utilities are calculated by substituting them, in turn, for X and Y in the fairness function given by Equation (3). Assuming that the two team members feel envy and guilt in equal measure, if $\frac{V_x}{C_x} = \frac{V_y}{C_y}$, then envy and guilt cancel each other out. If, however, $\frac{V_x}{C_x} > \frac{V_y}{C_y}$ or $\frac{V_x}{C_x} < \frac{V_y}{C_y}$, then total team utility will be reduced by some combination of envy and guilt. A formal proof is provided in the Appendix. The proof assumes $\alpha + \beta \geq 0$, which is consistent with Fehr & Schmidt's original assumption. Alternatively, if $\beta < 0$ (see above under the sub-heading of greed) then the constraint still holds if $|\alpha| > |\beta|$, i.e., envy weighs heavier than greed. Tournament theory would still be consistent with scenarios where $|\beta| > |\alpha|$, but firms may not wish to encourage a culture of greed. This argument supports the proposition that fairness matters in top-management teams. It is consistent with the findings of Henderson & Fredrickson (2001) (better firm performance is observed where equity considerations within top-management teams are weighed against tournament-like incentives), Siegel & Hambrick (2005) (in technologically-intensive companies greater pay dispersion within top-management teams is harmful to firm performance) and Fredrickson, Davis-Blake & Sanders (2010) (social comparisons among top-management team members mean that greater pay dispersion is negatively related to firm performance).

Conclusions

This study has demonstrated that fairness considerations are salient to senior executives. It provides evidence that the prevalent currently-held view of senior executive pay practices, which emphasises the importance of high-powered incentives and pay-for-individual-performance, underestimates the role and significance of fairness. It can be inferred from this

that, in order to maximise the total motivation of top-management teams (which, according to behavioural agency theory, is causally connected with superior business performance; see Finkelstein, Hambrick, & Cannella, 2009; and Pepper & Gore, 2012), companies should design incentives which take account of equity considerations.

We contribute to the literature on fairness, agency, tournaments and executive pay in various ways. First, we propose various modifications to the model of fairness proposed by Fehr & Schmidt (1999), allowing for differential contributions by agents, and recognising that, in some circumstances, ‘greed’ may have to be substituted for ‘guilt’ (i.e., by admitting the possibility of $\beta < 0$). We contend that this revised fairness model is particularly relevant to (behavioural) agency theory, thus responding to the call for the development of a specific theory of fairness that is appropriate to principal-agent relationships (Bowie & Freeman, 1992: 50-51). Secondly, by demonstrating the extent to which fairness considerations are salient to senior executives, we provide support for criticisms of agency theory (e.g., those advanced by Bowie & Freeman, 1992) and tournament theory (e.g., O’Reilly et al., 1988) who argue that standard versions of these theories do not take equity into account. This is especially pertinent in multi-agency situations, for example where shareholders wish to optimise the performance of top-management teams. In this way, we add to the growing literature on behavioural-agency theory (Pepper & Gore, 2012, 2014; Rebitzer & Taylor, 2011; Sanders & Carpenter, 2003; Wiseman & Gomez-Mejia, 1998), which is endeavouring to enhance the explanatory and predictive power of agency theory by combining ideas from the economics and management literatures and by incorporating a more realistic set of behavioural assumptions.

The approach which we have taken in this paper has been exploratory, looking for patterns in the data and seeking explanations for those patterns in existing theory, before integrating the theory and findings to construct new theory (Bewley, 1999). In this sense it does not

offer a formal proof of the main propositions, and more empirical research is in order. Furthermore, although Fehr & Schmidt's model explains more of the data in the empirical study than standard economic theory, it does not explain everything; an account of why some participants in the ultimatum game will only accept more than 0.5 of the endowment is still required. We also need to clarify why in Problem 2 some participants with low α coefficients choose Jean. We have speculated that a possible explanation lies in relaxing one the constraints imposed by Fehr & Schmidt, allowing $\beta < 0$, thus converting guilt into greed. In extremis, this proposition might have implications for some of our other conclusions; however, we do not pursue this possibility further in the current paper.

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Table 1 Demographics

| Variable | | | All participants n = 756 | |
|----------------------------------|-----|-------|------------------------------------|-----------|
| | f | % | f | % |
| <i>Indicative total earnings</i> | | | <i>Industry sector (continued)</i> | |
| ≤ \$350,000 | 505 | 66.9% | Energy, Utilities & Mining | 23 3.0% |
| \$350,000 > w > \$725,000 | 178 | 23.6% | Engineering & Construction | 53 7.0% |
| ≥ \$725,000 | 72 | 9.5% | Entertainment & Media | 22 2.9% |
| <i>Job title</i> | | | Financial Services | 37 4.9% |
| Chairman | 61 | 8.0% | Forestry, Paper & Packaging | 12 1.6% |
| CEO/President/MD | 293 | 38.8% | Government & Public Sector | 10 1.3% |
| CFO/Treasurer | 64 | 8.5% | Healthcare | 34 4.5% |
| CIO/Technology Director | 90 | 11.9% | Hospitality & Leisure | 22 2.9% |
| Other C-level Executive | 72 | 9.5% | Industrial Manufacturing | 54 7.2% |
| Vice-President/Director | 144 | 19.0% | Insurance | 23 3.0% |
| Head of Business Unit | 5 | 0.7% | Metals | 14 1.9% |
| Head of Department | 11 | 1.5% | Oil and Gas | 17 2.2% |
| Senior Manager | 3 | 0.4% | Pharmaceuticals | 15 2.0% |
| Other Senior Executive | 13 | 1.7% | Retail & Consumer | 60 7.9% |
| <i>Age:</i> | | | Technology | 69 9.1% |
| Under 39 | 194 | 25.7% | Transport & Logistics | 26 3.4% |
| 40-44 | 142 | 18.8% | Other | 76 10.1% |
| 45-49 | 143 | 18.9% | <i>Country</i> | |
| 50-54 | 115 | 15.2% | United States | 123 16.3% |
| 55-59 | 80 | 10.6% | United Kingdom | 34 4.5% |
| 60-64 | 51 | 6.7% | France | 35 4.6% |
| 65 + | 31 | 4.1% | Netherlands | 55 7.3% |
| <i>Gender</i> | | | Switzerland | 40 5.3% |
| Male | 619 | 81.9% | Germany | 31 4.1% |
| Female | 137 | 18.1% | Spain | 30 4.0% |
| <i>Industry sector</i> | | | Russia | 45 6.0% |
| Aerospace | 12 | 1.6% | Poland | 30 4.0% |
| Defense | 6 | 0.8% | Brazil | 52 6.9% |
| Asset Management | 9 | 1.2% | Mexico | 28 3.7% |
| Automotive | 14 | 1.9% | China | 51 6.7% |
| Banking & Capital Markets | 38 | 5.0% | India | 31 4.1% |
| Business services | 55 | 7.4% | Australia | 31 4.1% |
| Capital & Infrastructure | 17 | 2.2% | Middle East | 75 9.9% |
| Chemicals | 20 | 2.6% | South Africa | 31 4.1% |
| Communications | 18 | 2.4% | Other | 34 4.4% |

Table 2 Predicted results in the second problem according to Fehr & Schmidt, 1999

| | Jacques treats Jean as his principal referent | Jacques treats his peers in Company Q as his principal referents |
|---|---|--|
| Jean treats Jacques as her principal referent | Jacques will be more motivated, unless $\beta_q > 1 + \alpha_j$ | Jacques will be more motivated unless $\alpha_q > 1 + \alpha_j$ |
| Jean treats her peers in Company J as her principal referents | Jacques will be more motivated unless $\beta_q > 1 + \beta_j$. | Jean will be more motivated if $\alpha_q > \beta_j + 1$; otherwise Jacques will be more motivated |

Table 3 Results of the two-part ultimatum gain

| Results categories | | Small Endowment | | Large Endowment | |
|---|--------------------------|-----------------|---------|-----------------|---------|
| | | n | % | n | % |
| <i>Rational choice option</i> | | | | | |
| Small x and y | $x, y \leq 0.1$ | 73 | 9.66% | 111 | 14.68% |
| <i>Fair options</i> | | | | | |
| Absolute fairness | $0.4 \leq x, y \leq 0.5$ | 320 | 42.33% | 314 | 41.53% |
| Relative fairness | Other cases of $x = y$ | 49 | 6.48% | 31 | 4.10% |
| <i>Risk adjusted options</i> | | | | | |
| Risk averse, $y \leq 0.5$ | $x > y, x, y \leq 0.5$ | 116 | 15.34% | 108 | 14.29% |
| Risk seeking, $y \leq 0.5$ | $x < y, x, y \leq 0.5$ | 49 | 6.48% | 51 | 6.75% |
| Risk averse, $y > 0.5$ | $x > y, y > 0.5$ | 57 | 7.54% | 50 | 6.61% |
| <i>Total consistent with Fehr & Schmidt</i> | | 664 | 87.83% | 665 | 87.96% |
| Greed | $x < y, y > 0.5$ | 92 | 12.17% | 91 | 12.04% |
| Total | | 756 | 100.00% | 756 | 100.00% |

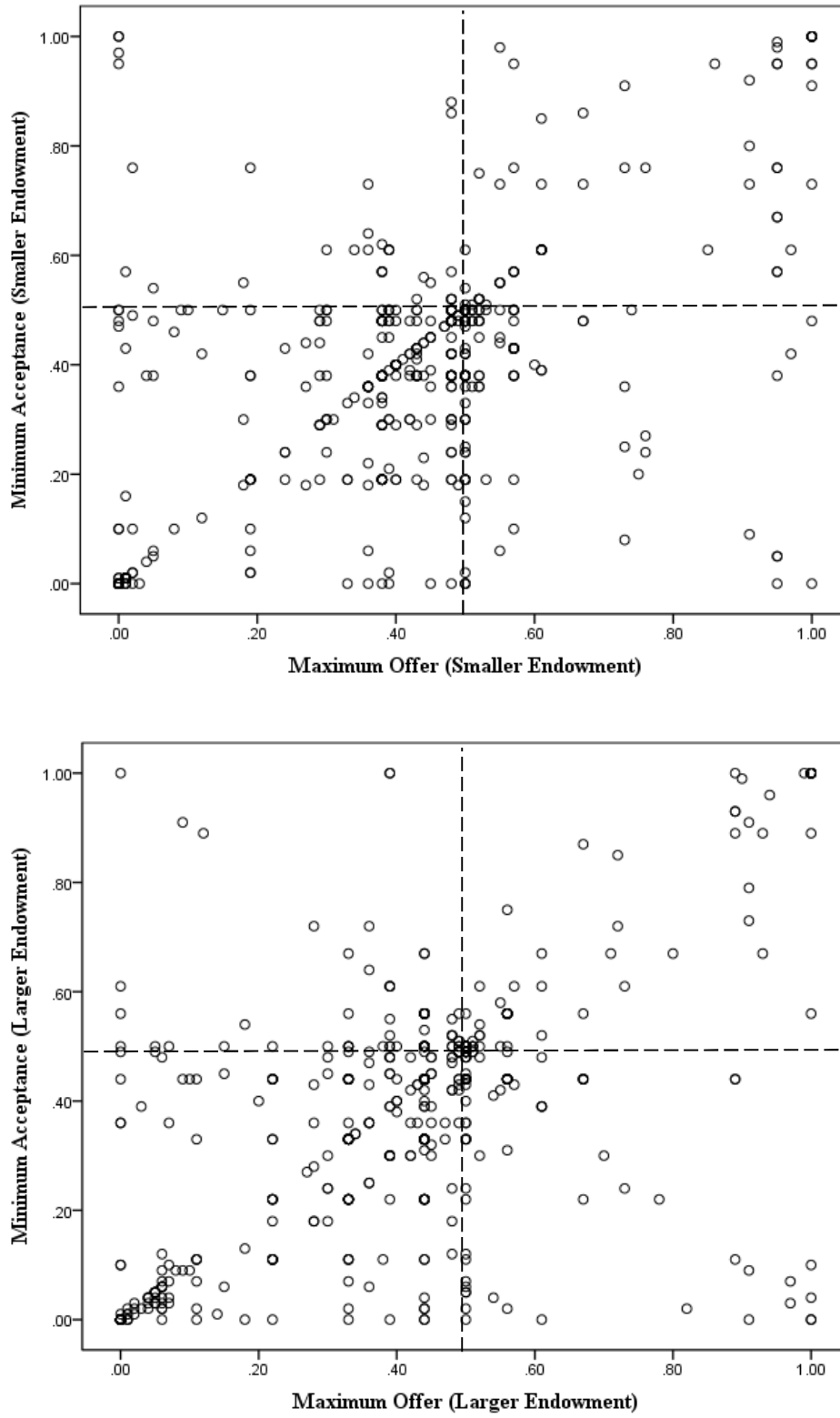
Table 4 Estimating Jean and Jacques's coefficients for envy

| Problem 2: participants choosing... | Problem 1: minimum amount accepted | | | | | | | |
|---|------------------------------------|-------------------|-------------------|---------------------|------------------|------|-------------------|---------------------|
| | n | Smaller endowment | | | Larger endowment | | | |
| | | Mean | Std. deviation | Implied α | n | Mean | Std. deviation | Implied α |
| Jacques | 196 | 0.35 | 0.18 | 1.17 | 206 | 0.32 | 0.20 | 0.89 |
| Indifferent | 162 | 0.38 | 0.17 | 1.51 | 159 | 0.34 | 0.20 | 1.08 |
| Jean | 306 | 0.38 | 0.16 | 1.51 | 300 | 0.35 | 0.19 | 1.16 |
| Total | 664 | 0.37 | 0.17 | 1.40 | 665 | 0.34 | 0.19 | 1.05 |

Table 5 Distribution of results in Problem 2

| α coefficient | Minimum amount accepted in Problem 1 | | | | | | | |
|-------------------------|--------------------------------------|---------|-------------|-------|------------------|---------|-------------|-------|
| | Smaller endowment | | | | Larger endowment | | | |
| | Jean | Jacques | Indifferent | Total | Jean | Jacques | Indifferent | Total |
| $\alpha \leq 0.1$ | 39 | 31 | 20 | 90 | 52 | 50 | 35 | 137 |
| $0.1 < \alpha \leq 2.0$ | 85 | 59 | 41 | 185 | 70 | 48 | 29 | 147 |
| $\alpha > 2.0$ | 182 | 106 | 101 | 389 | 178 | 108 | 95 | 381 |
| Total | 306 | 196 | 162 | 664 | 300 | 206 | 159 | 665 |

Figure 1 Distribution of the Results of the Ultimatum Game



Appendix Proof of the importance of fairness in a team context

I. Assume that $\alpha + \beta \geq 0$, i.e., either that $\alpha, \beta \geq 0$ or, if $\beta < 0$, that $|\alpha| > |\beta|$

II. Given that:

(i) X and Y are members of a two person team T, i.e., T: (X, Y)

(ii) X's utility function is: $U_x(v) = v_x - \alpha_x \max[(\frac{v_y}{c_y} - \frac{v_x}{c_x}), 0] - \beta_x \max[(\frac{v_x}{c_x} - \frac{v_y}{c_y}), 0]$

(iii) Y's utility function is: $U_y(v) = v_y - \alpha_y \max[(\frac{v_x}{c_x} - \frac{v_y}{c_y}), 0] - \beta_y \max[(\frac{v_y}{c_y} - \frac{v_x}{c_x}), 0]$

(iv) We want to maximise team utility, i.e., $U_t(v) = U_x(v) + U_y(v)$

III. Let $(\frac{v_x}{c_x}) = \delta$ and $(\frac{v_y}{c_y}) = \varepsilon$

IV. We know (from I.) that:

$$U_t(v) = v_x - \alpha_x \max[(\varepsilon - \delta), 0] - \beta_x \max[(\delta - \varepsilon), 0] + v_y - \alpha_y \max[(\delta - \varepsilon), 0] - \beta_y \max[(\varepsilon - \delta), 0]$$

V. If we assume that $\varepsilon > \delta$, then:

(i) $U_t(v) = v_x - \alpha_x (\varepsilon - \delta) + v_y - \beta_y (\varepsilon - \delta)$

(ii) $U_t(v) = v_x + v_y - \alpha_x (\varepsilon - \delta) - \beta_y (\varepsilon - \delta)$

(iii) $U_t(v) = (v_x + v_y) - (\alpha_x + \beta_y) (\varepsilon - \delta)$

Therefore, because $(\alpha_x + \beta_y) > 0$ and $(\varepsilon - \delta) > 0$, then:

(iv) $(v_x + v_y) > (v_x + v_y) - (\alpha_x + \beta_y) (\varepsilon - \delta)$

VI. If, alternatively, we assume that $\delta > \varepsilon$, then:

(i) $U_t(v) = v_x - \beta_x (\delta - \varepsilon) + v_y - \alpha_y (\delta - \varepsilon)$

(ii) $U_t(v) = v_x + v_y - \beta_x (\delta - \varepsilon) - \alpha_y (\delta - \varepsilon)$

(iii) $U_t(v) = (v_x + v_y) - (\alpha_y + \beta_x) (\delta - \varepsilon)$

Because $(\alpha_y + \beta_x) > 0$ and $(\delta - \varepsilon) > 0$, then:

(iv) $(v_x + v_y) > (v_x + v_y) - (\alpha_y + \beta_x) (\delta - \varepsilon)$

VII. If, as a further alternative, we assume that $\delta = \varepsilon$, therefore:

(i) Because $(\varepsilon - \delta) = (\delta - \varepsilon) = 0$

(ii) Then $U_t(v) = v_x + v_y$

VIII. Thus $U_t(v)$ is maximised when $\delta = \varepsilon$, i.e., when $(\frac{v_x}{c_x}) = (\frac{v_y}{c_y})$. QED.