

Relative Performance Compensation and Dynamic Incentives

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Abstract¹

In this paper we examine a new dataset from a commodities company that organizes several contests among its retailers to increase their sales. The results shed light on the incentive effect of different aspects of tournament design. First, we show that those who participate in the tournament appear to provide higher effort than non-participants. We also document the impact of the size of the tournament on participant's motivation, the effects of the dynamic considerations that arise as the tournament progresses, and the implications for multitasking as retailers decide on their allocation of effort into the sale of different products.

JEL Classification: ???

Keywords: tournaments, relative performance compensation, dynamic incentives, multitasking

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1. Introduction

When budgets and quotas are rendered ineffective for evaluating personnel or firm performance because of volatile and uncertain economic conditions, relative performance evaluation systems have been suggested as a possible solution. These compensation schemes help to identify better performers while eliminating the effect of common shocks. Sales contests and other kinds of tournaments are popular with many corporations. Moreover, the hierarchical structure inherent in all organizations induces incentives from promotions which essentially resemble a tournament by which those workers who perform best are rewarded with a job higher up the corporate ladder.

While there is an extensive body of theoretical work on tournaments and relative performance evaluation beginning with the pioneering work of Lazear and Rosen (1981), there is still very limited empirical evidence on the performance effects of these incentive systems, and most that do exist focus on sports tournaments.²

In this paper we analyze a tournament organized by a manufacturer of commodity products in a less developed country among its retailers.³ This setting allows us to better understand the dynamic incentive effects of a relative performance-based rewards system. The compensation scheme consisted of eight regional tournaments that assigned a certain number of equal cash prizes to the highest ranked retailers in each region at the end of the tournament. The firm introduced this reward system in May of 2002, providing us with a natural experiment to test tournament theories in a business environment. By comparing sales pre and post tournament periods we can better

² See McLaughlin (1988) for a review of the literature.

³ For confidentiality reasons, we were not allowed to provide more detailed information about this company.

understand how contest design influences incentives. Moreover, monthly performance updates for the year-long contest (eight months in its first occurrence) allows us to analyze the dynamic effects created by relative success at different stages of the tournament (which essentially creates ex-post heterogeneity among participants). We also exploit the fact that the firm organizes the tournament as a set of independent regional contests, which provides a small cross-section to analyze the impact of certain design choices.

Our evidence indicates that: (i) participation in the tournament increases retailers' effort; (ii) the effort exerted by each participant seems to be inversely related to the size of the contest (even keeping constant the fraction of prizes); (iii) extreme success in the tournament, measured by relative rankings, attenuates the incentive effect of this compensation scheme; (iv) retailers in losing rankings who do not drop from the contest initially increase their effort, but the further they fall away from winning positions the lower their effort becomes; (v) there is an important multitasking component in the allocation of effort across the different products that are being sold, which can explain part of the improvement in performance.

Previous empirical literature on relative performance compensation has focused mostly on showing the consistency of observed compensation/promotion schemes with theoretical predictions (e.g. Antle and Smith (1986), Gibbons and Murphy(1990)). Analyses of contest design elements, notably number and size of the prizes, have mainly used experimental settings (e.g. Bull et al. (1987), Schotter and Weigelt (2004)) or evidence drawn from sports competitions (e.g. Ehrenberg and Bognanno (1990)). Very

few papers have used actual business settings (e.g. Knoeber and Thurman (1994), Matsumura and Shin (2004)).

Our paper makes three contributions. First, we contribute to the literature on incentives by showing the consistency of relative performance compensation with certain strategic objectives (namely, the increase of total effort and the improvement in the allocation of effort across different tasks). Second, we contribute to the literature on tournament design by examining the incentive effects of the number of participants. Finally, we extend the literature on relative performance compensation by analyzing the dynamic impact on participants' incentives of a multiple period tournament with periodic updates.

The results shed light on important organizational issues, such as the use of promotions as an incentive device. They suggest that increasing the size of the organization (while keeping the fraction of promotions constant) is likely to reduce incentives. In such case, larger organizations ought to provide stronger rewards (in the form of larger wage differentials among the different levels in the hierarchy) in order to keep workers motivated. Furthermore, the dynamic effects are also very important for determining the optimal level of promotion frequency. To the extent that longer periods between promotions exacerbate the heterogeneity among contestants, incentives might suffer.

The structure of the paper is as follows. Section 2 provides an institutional background for the paper. Section 3 includes a brief summary of tournament theory. The motivation for the empirical analysis and the results of the analyses are described in Section 4. Section 5 concludes.

2. Institutional Details

In this section we briefly describe the tournament design and the market in which Firm A operates.

2.1. The Market

Firm A operates in a commodity market in a less developed country. The national economy has systematically grown in the last decade but volatility has been high. The country's inflation, underemployment and political uncertainty are on par with most other under-developed countries, making forecasting difficult.

As occurs in most commodity markets, input cost fluctuations determine price evolution. Competitors closely track and mirror each other's prices. Firm A, considered a best-in-class, commands a small premium over its peers. Firm A sets its prices weekly unless major changes in market conditions dictate a shorter revision period. Surprisingly, the industry has managed to avoid a price war and all major players are financially healthy.

Firm A's main product is almost identical to its competitors'. Company A also sells two "enhanced" products that bundle the base product with other components. This differentiated offering commands a price premium over the main product.

The products are bulky and expensive to store. All three product offerings have a relatively short shelf life due to both physical degradation and customers' desire for fresh merchandise, which Firm A promotes. Expensive storage, limited shelf life, and volatile

prices limit the ability of salespeople and retailers to window-dress their performance by discretionally choosing the timing of their sales.

Manufacturers either sell directly to big consumers and wholesalers or use a network of retailers that also provides product advisory and financial services to small and financially weak end consumers. Retailers typically carry a full line of products that complement Firm A's offerings and may carry more than one brand of each product. In this market sales are final and product returns are not allowed.

2.2 The Tournaments

Company A was acquired by a foreign multinational in 2000. After restructuring the manufacturing division, the new managers shifted their focus to its commercial strategy. The new commercial strategy focused on decommo-ditization of its products. Product differentiation and alliances with small and medium retailers were the main initiatives to achieve this goal.

The product differentiation strategy involved quality improvements in manufacturing and a customer education campaign. The restructured manufacturing facilities easily implemented more stringent quality standards and facilitated the introduction of new product offerings. The communication strategy stressed freshness and physical attributes of the product that could be easily tested by the end consumer. Retailers were also instrumental in the education campaign. Firm A created the title of Certified Prescrip-tor. To obtain this certification the retailer had to go through a basic training program that gave her the knowledge to advise end-consumers on the best way to optimize the use of Firm A's products.

The company decided to focus on small and medium retailers with the objective of avoiding the prize pressure of big traders. It limited the bargaining power of any single retailer and its attractiveness to other manufacturers. To secure retailers' loyalty, firm A instituted a volume discount program. This program was similar to a bonus bank, which required the retailer to continue selling the firm's products for one year after she earned the bonus.

The managers believed that the retailers' margins and loyalty discounts weren't a strong enough incentive to achieve the target growth rates. They decided to try a sales tournament because the market uncertainty created an ideal setting for this incentive mechanism. Moreover, the use of prizes instead of additional commissions would reduce the probability of retailers passing their incentives to end consumers with the risk of triggering a price war.

In May 2002, firm A designed a set of tournaments among retailers called the Reward Program. Their goal was to motivate retailers to sell more, increase the proportion of premium products in retailers' orders, and minimize the demand variability. The latter would ease scheduling for the manufacturing department by making demand more predictable. Almost 70% of firm A's retailers signed up for the contest for a total of 500 participants. All the retailers were enrolled in the contest for the second edition of the Reward Program in 2003.

There are eight tournaments corresponding to the eight regions which the firm's sales force is organized. The total number of winners is 50 (51 in 2003) and the prizes

for all winners are identical, \$3,000 cash, regardless of their final ranking. The prize money is substantial compared to most retailers' profits.⁴

At the beginning of each month, individual sales targets are set for each retailer. These targets promote two objectives. First, they try to level the playing field by setting higher goals for larger retailers and requiring them to sell more to move up in the rankings, similar to the handicap system of amateur golf championships. Second, retailers must increase their sales.

Although the tournament horizon is the fiscal year, to qualify for the contest, each month a retailer must buy at least 150 units of product from Company A and 70% of his/her target quantity for the month. Performance is evaluated by a scoring system that assigns points per each ton of product sold above an individualized objective. The points per ton vary depending on the type of product; basic, premium and specialty products command points at a rate of 1, 5 and 9 points per ton respectively. Rankings are calculated within each region based on the percentage of realization over target (see Appendix).

In 2002, the monthly tournament targets were calculated as the moving average of the six preceding months. For the 2003 tournament, the target sales for each retailer were established at the beginning of the year based on her size and purchasing history from firm A. Monthly objectives were calculated by applying seasonality factors estimated by the firm's strategic planning department.

⁴ The prize represented about 50% of the annual profit of the median retailer.

The tournaments run throughout the fiscal year, except the first edition, which ran from May to December 2002. Retailers' performances are assessed and communicated monthly. If the retailer fails to achieve the 150 units or 70% of their target requirement, it is eliminated from the tournament.⁵ Otherwise its score is calculated using the cumulative target and actual sales data and the new relative ranking is noted. Each retailer is informed whether it is in a winning or losing ranking, but it does not receive monthly information on the scores of the other retailers in her area. Retailers also receive periodic information on competitors' market share and end user prices.

2.3 Descriptive Statistics

To maximize the effectiveness of the retailer campaign, firm A divided it into eight different contests. Each contest corresponds to one of the eight regional markets in which the company sells its products.

Table I shows that the tournaments are heterogeneous in size, both by number of contestants (ranging from less than 10 more than 100) and by sales volume (ranging from 33,000 units to 324,000 units). The region boundaries loosely follow the political departments of the country, but also consider firm A's competitive position and the geographical span that the firm's salesforce and logistics organization could be expected to cover. Regions C and H, which correspond to the largest and most competitive local

⁵ During the month of May (the first month in which the tournament was implemented), Company A decided not to drop any participant if they failed to comply with the participation requirements (purchasing more than 150 units, and more than 70% of the target level). After that, however, the tournament proceeded by the rules specified in the text.

markets, have been identified by the company as target areas for expansion. Each region is allocated approximately one prize every ten retailers participating in the contest.⁶

Firm A's basic product accounts for the overwhelming majority of its sales by weight (93%). Their premium product represents one percent of sales and their enhanced product accounts for six percent of sales. Sales of the enhanced product are concentrated in geographically close regions C and H, which seem to be better suited for this product given their more sophisticated customer base.

Qualifying constraints (150 units and 70% of target) aren't equally binding in each of the tournaments, probably because target sales is set more aggressively in the larger and more consolidated regions that have more historical information about customers. Therefore, the average excess performance for contestants who reach the final round (which ranges from 57% to 197%) is largest for the expansion regions, as is the rate of survival from start to finish.

Panel B of Table I shows the evolution of drops (contestants not satisfying the qualification requirements) during the tournament. All regions follow a similar pattern, with most of the attrition occurring in the first three months of the campaign. The zero drops of May 2002 reflects the firm's policy of not enforcing the qualification requirements the first month of the Reward Program.

In summary, the heterogeneous starting characteristics of the eight tournaments and their evolution over time of composition and performance generate a diverse set of observations with which to test the hypotheses.

⁶ The allocation of prizes also seem to reflect each region's percent in total Company A's sales except, for the two largest regions.

3. Hypotheses Development

In essence, relative performance compensation is a reward structure in which an individual's compensation depends on the performance of her peers as well as her own. These schemes have been shown to be useful for dealing with agency problems to induce effort among several agents.⁷ Under certain circumstances (in particular, when there is a common shock to each individual output) compensation mechanisms based on relative performance can outperform traditional individually-based compensation schemes. They also arise naturally in certain settings, such as promotions in an organization.

Giving a prize (or a promotion) to the highest performing agents will increase incentives. The additional effort exerted will be rewarded with an increase in the probability of winning the tournament (and hence the prize). However, there are two cases in which relative performance compensation will be completely ineffective. First, if the impact of idiosyncratic shocks on output is so high that it dominates the effort's impact on output. In this case, the individual's equilibrium strategy is not to exert any effort because she cannot change the probability of winning – it is basically determined by luck. The second more relevant case is when the varying abilities of contestants are not dealt with the handicap system. At the extreme, the ability of each contestant will perfectly predict the outcome of the tournament, eliminating all incentives of the relative performance mechanism. These considerations lead to the first testable hypothesis:

⁷ In our context, we use the term effort quite broadly to represent any change in behavior that leads a better performance in the contest. This could be achieved by working harder, longer hours, on a different customer segment, or, in general, paying more attention to the objectives of the company.

H1. If retailers believe they can influence the probability of winning the reward by exerting effort, the introduction of relative performance compensation will increase their sale effort.

We also examine the effect of the number of players on incentives. It is initially unclear whether the effect on incentives is positive or negative. While increasing the number of players (for a given number of prizes) intensifies competition and may result in higher effort, it also reduces the chances of winning for any given effort level, and the productivity of effort (and with it, motivation) could decline. Furthermore, these effects are affected by the shape of the density function of the shocks. Thus, the net effect is ambiguous. Orrison et al. (2004) show that under the assumption of uniformly distributed shocks these effects cancel out, and the resulting marginal return to effort is constant (independent of the number of players). More generally, Gibbs (1996) shows that for symmetric unimodal distributions, incentives decrease as the number of participants increase if the fraction of prizes is small, and kept constant (proposition 6). Incentives also decrease when the number of participants increases if the number of prizes is kept constant at a level below one half the number of participants (proposition 4).

Our evidence can help clarify the net results of these effects and check their empirical validity (at least within the range of parameters the tournaments were taking place). We can summarize these considerations with the following hypotheses:

H2a. The larger the number of contestants in the tournament, keeping constant the *fraction* of prizes, the lower the retailers' effort.

H2b. The larger the number of contestants in the tournament, keeping constant the *number* of prizes, the lower the retailers' effort.

A very important dimension for the purposes of this paper is to gauge the effect of the dynamic nature of the tournament described above on incentives. As the Reward Program evolves, the distance to the winning positions may affect the amount of effort put forth by the contestants. When a tournament takes place over time, the participants will find themselves in an asymmetric position ex-post (even if they are identical from an ex-ante perspective). A player that falls behind is likely to find it very difficult to climb in the rankings and qualify for a prize. Consequently, she may slow or stop trying. Moreover, retailers in losing positions may blame the contest design rather than their own performance, causing a negative reaction towards the organizing firm and an abnormal drop in their sales. Similarly, a player that is well positioned at the top might see little threat of losing and decrease her effort. Motivation should be at its highest for those players that are in an intermediate ranking, and for whom winning or losing a position could change the outcome of the tournament.⁸ These ideas translate in the following hypothesis:⁹

H3. The effort exerted by the retailer is inversely related to the distance between her ranking and the ranking representing the last winning position. This hypothesis can be broken down into two sub-hypotheses:

⁸ The intuition behind this argument is very similar to that for stock options. When options are under water, the manager finds himself in the flat part of the incentive scheme, and hence loses motivation.

⁹ Most of the literature on tournaments considers static environments in which all players are symmetric. As argued above, this will not be the case in a dynamic tournament ex-post. As a result, we do not have a very explicit theory that would generate a prediction.

H3a. For retailers in winning positions, the higher the ranking the lower the effort exerted.

H3b. For retailers in losing positions, the lower the ranking the smaller the effort exerted.

The final hypothesis concerns the multitasking problem retailers face. They are responsible for selling different types of products. And the point system introduced in the tournament disproportionately rewards the high-end products. As a result, we would expect to see a shift in effort from sales of low-end towards high-end products for those who are participating in the contest. This can be stated as follows:

H4. The tournament induces retailers to shift effort towards selling high-end products.

Next we discuss the approach we follow to test these predictions.

4. Empirical Approach

We will consider the following theoretical model for the output of the retailers:

$$output_{i,m} = effort_{i,m} + a_i + u_{i,m}$$

Output will be a function of the effort retailer i makes during month m . But we also allow for the existence of a retailer fixed effect, a_i , which could be interpreted as either the size, ability, or any other intrinsic (time invariant) characteristic of the retailer which affects sales. And finally, there is an idiosyncratic component, $u_{i,m}$, which could be decomposed into a common and an individual specific shock.

We will be interested in the determinants of effort. As mentioned above, $effort_{i,m}$ should depend, first of all, on whether the retailer is participating in the tournament during month m (this is the effect of the introduction of the incentive scheme). Furthermore, once in the tournament, the effort level will depend on the specific characteristics of the tournament the retailer finds herself in, namely the number of prizes and players, and the relative position at the start of the period (all of which affect the probability of winning the prize, and hence incentives).

We use two different measures of output, denoted by $output_{i,m}^{M\bullet}$. First, we measure output as the absolute level of monthly sales measured in points¹⁰, $output_{i,m}^{M1} = monthly\ sales_{i,m}$. For this measure proper controls for the individual heterogeneity would be required in order to obtain a meaningful interpretation of the coefficient.

The second measure of performance considers the total sales (measured in points) over the target (also in points) set by the company for that particular individual:

$$output_{i,m}^{M2} = \frac{monthly\ sales_{i,m}}{target_{i,m}} - 1$$

where $target_{i,m}$ is the sales objective set by the company for retailer i during month m . To the extent that the company is able to observe the individual effects, and correct for them when setting the targets, this measure would eliminate them. Similarly, time effects would also be controlled for, as the targets are adjusted for seasonality. However, there would be some individual heterogeneity in this measure so long as the company does not

¹⁰ See section 2.2 for a description of the computation of this weighted measure.

perfectly correct for it (for instance, if the tournament is biased towards some particular type of retailer).

We use these measures to estimate equations of the following sort:

$$output_{i,m}^{M\bullet} = X'_{i,m}\beta + Z'_{i,m}\gamma + a_i + u_{i,m}$$

in which we pool each individual month observation. We will be interested in the effect of the variables $X_{i,m}$, given by β , which are meant to capture the effect of certain variables on effort. $Z_{i,m}$ denotes the controls used and $u_{i,m}$ is the noise term.

In order to test the presence of incentive effects from the tournament, we will use the full sample to compare the sales of participants to non-participants using a difference in differences estimation. This amounts to the set of variables $X_{i,m}$ containing a dummy for those who participate in the tournament, a dummy for the months of the tournament, and the interaction of both (the coefficient on which gives us the effect of introducing the tournament). This interaction term essentially compares the change in output levels before and after the introduction of the tournament for participants and non-participants. A positive coefficient indicates that participants increase output during the months of the tournament by more than non-participants do. This will be taken as a measure of the effect of the Reward Program. We will also include additional controls ($Z_{i,m}$) in some specifications, such as the level of aggregate sales for the industry and individual fixed effects.

When analyzing the different determinants of incentives in the tournament, we will limit the sample to those observations in which the player is currently participating in

the competition. In this case, $X_{i,m}$ will contain the measures of distance and number of participants.

In order to understand the effects of the player's ranking on a player and her willingness to exert effort we generate the variables $distance\ for\ winners_{i,m} = \max\{0, prizes - ranking_{it}\}$ and $distance\ for\ losers_{i,m} = \max\{0, ranking_{it} - prizes\}$. $distance\ for\ winners_{i,m}$ equals the absolute value of i 's provisional ranking at the beginning of month m when she is winning, minus the lowest ranking she could get and still qualify for a prize. When a player is at the top of the ranking, $distance\ for\ winners_{i,m}$ is the minimum number of places she would have to fall to exclude her from the winners' circle. When a player is badly ranked, $distance\ for\ losers_{i,m}$ is the number of positions the player would have to climb to join the group of winners.

We will also include the lagged output as an explanatory variable to control for the possibility of autocorrelation in the shocks to performance. It is well known that the inclusion of the lagged dependent variable in a regression yields biased estimates when using fixed effects to account for individual heterogeneity (see Nickell (1981)). It is, however, possible to obtain consistent estimates for this case. Let's difference the previous model:

$$\Delta output_{i,m}^{M\bullet} = \Delta output_{i,m-1}^{M\bullet} \delta + \Delta X'_{i,m} \beta + \Delta Z'_{i,m} \gamma + \Delta u_{i,m}$$

where $\Delta vbl_{i,m} = vbl_{i,m} - vbl_{i,m-1}$. The individual effect drops out of the equation, and hence there is no need to estimate it with fixed effects. But the differenced model has errors which are correlated with the lagged dependent variable: $Cov(\Delta output_{i,m-1}^{M\bullet}, \Delta u_{i,m}) \neq 0$, since $output_{i,m-1}^{M\bullet}$ and $u_{i,m-1}$ are correlated. But the lagged values of $output_{i,m-1}^{M\bullet}$ are valid

instruments for $\Delta output_{i,m-1}^{M\bullet}$, since $Cov(output_{i,m-2}^{M\bullet}, \Delta u_{i,m}) = 0$ (they are also correlated with $\Delta output_{i,m-1}^{M\bullet}$ for obvious reasons). This suggests an estimation method, first proposed by Anderson and Hsiao (1982) and then improved by Arellano and Bond (1991), in which the differenced equation is estimated using $output_{i,m-k}^{M\bullet}$ as instruments for $\Delta output_{i,m-1}^{M\bullet}$.

Implicit in this discussion is the assumption that the errors, $u_{i,m}$, are iid. With autocorrelated disturbances it is no longer true that $Cov(output_{i,m-2}^{M\bullet}, \Delta u_{i,m}) = 0$, and hence the lags are no longer valid instruments. Arellano and Bond (1991) propose a test for the validity of this assumption. It is based on the observation that when the errors are not autocorrelated, then $\Delta u_{i,m}$ must have first order negative autocorrelation, but no second order autocorrelation.¹¹ When reporting results based on this estimation method, we also include these tests.

The results obtained are presented next.

5. Empirical Results

5.1. Relative Performance Compensation Incentive Effects

In this section we use evidence from difference-in-differences estimation to test whether retailers increase their effort after the introduction of the Reward Program (hypothesis H1). Ideally, we would prefer to test Hypothesis 1 using a sample of retailers

¹¹ Autocorrelated errors would display second order autocorrelation.

that were randomly assigned to the program. Unfortunately, the firm offered every retailer the option to join. Lack of adequate retailer information to run a selection model limits our ability to correct for potential biases. Nevertheless, we include fixed effects in some of our specifications. This should control for any self-selection into the tournament based on individual characteristics, and hence will be our most preferred specification. Furthermore, interviews with retailers revealed that the most common reason for refusing contest participation was fear of committing to written targets. It seemed that the self-selection was not influenced by the retailers' expected performance. This gives more power to the use of non-participants as a control population.

First, we compare the performance of retailers that did not enter the contests against that of those that entered and remained in the contest for the first five months of 2002 (including only the first month of the tournament). Results are summarized in Table II, models 1 and 3. We find a strong and positive impact of the survivor dummy (the difference-in-differences estimator) on retailer performance, both in the OLS and fixed effects specifications. This evidence suggests the presence of tournament incentive effects and is consistent with the findings of Matsumura and Shin (2004). Additionally, larger retailers are more likely to participate in the contest, as shown by the positive and significant coefficient on the participant dummy.

Table II Models 2 and 4 also present the comparison of performance for the entire year of 2002. Here we distinguish between retailers that remain versus those that drop out of the tournament. The results confirm the above incentive effects for the entire year through a very significant and positive effect of remaining in the tournament. They also indicate a negative and significant effect of dropping out of the tournament. This

evidence suggest that retailers become demotivated and stop exerting effort as suggested by Moldovanu and Sela (2001) and consistent with the experimental evidence of Müller and Schotter (2003). Furthermore, since the results still hold when we include fixed effects, they cannot be explained by a selection effect, by which retailers with high productivity remain in the tournament and those with low productivity drop.

In summary, empirical evidence suggests that the tournament increases the effort of participating retailers and seems to generate demotivation in those that drop out of the contest. However, the limitations of our sample do not allow us to assess the tournament's relative impact versus alternative compensation mechanisms or even whether the combined effort of all retailers will be larger due to the introduction of the mechanism.

5.2. Incentive Effects and the Size of the Contest

In table III we expand the previous difference-in-differences analysis to consider the impact of tournament size on incentives. To do this, we add the interaction between the survivor variable and the size of the tournament, as measured by the number of prizes.¹² The coefficient on this variable reveals how the incentives of the tournament change when we increase the size of the contest while keeping (approximately) constant the fraction of winners at 10%.

The results in table III reveal a very significant negative effect. In those regions in which there is a larger number of participants, the introduction of the Reward Program was not as successful in inducing higher effort. As mentioned above, this is consistent

¹² The results are unchanged if we use the number of players remaining in the tournament, instead.

with the results obtained by Gibbs (1996). Models (1) and (3) consider only the effect on the first month of the tournament. This best corresponds with the statement in hypothesis H2a, as all participants are included (and, as we saw in the description of the tournaments, the number of prizes is 10% the number of participants). In models (2) and (4), the fraction of prizes does not remain constant as the tournament progresses (because of the contestants who drop). But even there, we still see a negative impact of the size of the tournament.

5.3. Incentive Effects of the Rank Distance

In this section we analyze how the retailers' tournament rankings affect the level of effort they exert. If in the previous section we pooled all the observations of participating and non-participating retailers, in this and the next section we will limit our analysis to those retailers who participate and still remain in the contest.

Economic theory predicts that retailers' effort will fall when they believe their chances to win (or lose) are very slim (Gibbs (1996)). This will happen when their rankings are relatively far of the winning (losing) rankings. Thus we should expect that the farther retailers in losing positions fall, the less effort they exert, and the higher retailers in winning positions climb, the less effort they exert.

Table IV contains the evidence that tests Hypothesis 3. A winning retailer's distance from losing positions at the end of the prior period has a generally negative impact on this period's effort, suggesting that participants lose their motivation as their chances of winning increase.

Conversely, end-of-last-period distance to winning positions for losing retailers has a generally positive and significant effect on participant effort. Thus, we do not observe the expected loss of motivation effect on the set of losing retailers. Instead, they seem to increase effort when they fall behind.

A look at the models in columns 2 and 4 can help us better understand these results. There, we include quadratic terms on the distance measures. It is clear that the distance for winners is fairly linear. However, the distance for losers has a quadratic term which is negative. Those who fall in the rankings would initially become more motivated to work hard and get back up. But if the retailer falls too much, demotivation begins to appear, and effort eventually decreases.

In summary, it seems that when a retailer climbs in the tournament rankings, winning the prize becomes increasingly likely and the retailer loses motivation and reduces her effort. Conversely, if the retailer is in losing positions her motivation remains high while it remains in the tournament and not too far from the top. However, as the participant falls further, demotivation begins to appear. These results highlight one of the biggest problems inherent in a relative performance compensation system: the demotivation that can be caused because of the non-linear structure of its rewards.

5.4. Incentive Effects of the Number of Players

In this section we analyze how retailers' effort varies as the number of players changes. The results also appear in Table IV. Notice that in the dynamic panel data estimation any variable that is constant over time is differenced out and drops from the model. Therefore, we are controlling not only for individual effects, but also for the

number of prizes in the tournament. Hence, the coefficients on the number of players speak at the validity of hypothesis H2b.

The coefficient on the number of contestants is consistently negative and significant. These results generally support the hypothesis that retailers' become increasingly motivated when they perceive their chances to impact the contest results increase as the number of participants falls, as Gibbs (1996) stresses. This result is not consistent with Orrison et al (2004), who find that in tournaments with a relatively large proportion of prizes, the contestants shirk and exert less effort in small tournaments. Whereas the ratio of prizes per contestant in our sample is well below one half in most of our observations, in the Orrison et al (2004) experiment the shirking effect occurs when the proportion of prizes grows from $1/2$ to $2/3$. The cause of our different results may be that we are considering different segments of the size of the contest vs. incentive relationship.

In summary, the empirical evidence in this section indicates that the increase in the number of contest participants reduces retailer's motivation to exert effort. It seems as if the ex-ante added difficulty in winning the prize demotivates retailers due to a perceived reduction in the likelihood of winning with extra effort rather than spurring the competitive nature of retailers to exert more effort.

5.5. Relative Performance Compensation and Multitasking

As discussed in section 2.2, retailers were responsible for selling three different types of products. One of the reasons for introducing the tournament (as stated to us by the management of the company) was to induce retailers to devote more attention to the

high end products. This was implemented through the point system described in section 2.2, in which high end products received a disproportionately high weight in the calculation of performance.

In this section we aim to understand to what extent the results presented above come from a shift in sales from basic to high-end products,¹³ due to the multitasking problem retailers face, or whether they were due to an increase in overall effort, translated into higher total sales. To measure the first effect, we look at the fraction of sales in high end products over total sales for each retailer in each month. We measure overall effort as the total monthly sales measured in units, rather than points.

In table Va we reproduce the difference-in-differences estimates for these two measures. The first two columns correspond to the change in the composition of sales. The positive coefficient for Survivor indicates that the introduction of the tournament made participants shift their effort towards the high-end products. In column (2) we see that these typically represent 3.8% of total sales for non-participants, but they increase to 5.5% when the retailer is still in the tournament. Notice also that once a retailer drops from the tournament, the fraction of high-end products returns to the normal level prior to entering the tournament (as the insignificant coefficient on Drop shows).

The rest of the table shows the effect on total sales. Here, the effect is still positive for those who participate, but negative for those who drop. This suggests that the results in section 5.1. are the consequence of both an increase in total effort and a shift in effort across the different products lines. However, the loss of motivation for those who drop

¹³ Notice this shift in sales need not be detrimental to the company's profits. Indeed, it actively wanted to induce this stronger emphasis on high-end products.

out is not explained by a reduction in the sales of high-end products beyond their level prior to May, but rather by an absolute reduction in sales.

By comparing the estimates for monthly sales in table II and Va, we can conclude that most of the increased performance as measured in points (table II) is due to the multitasking effect. While the tournament increases total output by 35.5 units, it increases the number of points by 111. Hence, the difference must come from the shift of sales towards high-end products.

We also test whether multitasking and total effort respond in the same way to the dynamic effects and the size of the tournament. For this analysis we implement the dynamic panel data estimation to these two new variables. The results are in table Vb. They are essentially the same we obtained in section 5.3. Both the fraction of high-end products and total monthly sales decrease as the retailer increases in the winner positions, increase when he falls down the loser positions, and decrease as the number of participants increase (although this later effect is less strong in the multitasking case).

5.6. Robustness of the results

In this section we test the robustness of the results presented in table IV. We consider two extensions. First, we reproduce the same results for the interim periods, dropping the first three months of the tournament (in which most of the attrition takes place) and the last one (in which the incentives to bring sales forward from the following month are the strongest). The results are in the first two columns of table VI. They are essentially unchanged from those in table IV.

Secondly, the dynamic panel data estimates presented in table IV are obtained from the observation of those retailers who remain in the tournament. But since those whose performance does not satisfy the requirement of the company drop from the tournament, there might be some self-selection taking place. In order to correct for it, we implement the Heckman selection procedure for dynamic panel data models described in Wooldridge (2002). It essentially amounts to estimating each month a selection model to predict those who remain in the tournament, and then compute an inverse mills ratio. This variable is then introduced in the estimation of the dynamic panel. This is done in the second part of table VI. Again we see that the results are mostly unchanged and survive this robustness check.

6. Conclusion

This paper analyzes the incentive effects of several tournaments organized by a commodities company among its retailers. The variation among them allows us to gain some insight on the effects of different aspects of the design. The tournaments appeared to induce higher levels of effort. These incentives were stronger for the tournaments with a smaller number of players. This suggests that it is not possible to replicate incentives in larger organizations by simply maintaining a constant fraction of winners. They might require larger prizes if incentives are to be kept high.

These results have important implications for organizational design. The theory of tournaments is thought to be a good modelling device to study promotions. The results we present suggest that as the size of the organization increases it will be harder to

maintain incentives, even keeping constant the fraction of promotions. In such a case, rewards would have to increase. This would amount to larger organizations having a wider wage differential among the different levels in the hierarchy.

We also offer some new insight into the costs of tournaments (or incentives through promotions), particularly when they take place over several periods, and dynamic considerations come into play. These tournaments make contestants heterogeneous as the tournament progresses (even if they are homogeneous *ex-ante*) since past performance matters for the final outcome. Those who performed well in the past will take a lead, while those unlucky will fall behind. In such a case, a design that tries to preserve the linearity of incentives (as in Holmstrom and Milgrom (1989)) might be more appropriate to keep a constant pressure on incentives.

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Appendix Computation of Retailers Scores

Scores are calculated as the weighted sum of each retailer's sales. The weights or points depend on the type of product. Both the target and actual sales of each retailer are translated into points and the percentage excess performance is calculated. Rankings are calculated within each region monthly using the cumulative sales. To remain in the tournament, each retailer must achieve at least 70% of its monthly point-target and sell at least 150 units of product per month.

Example of a score calculation:

Customer 1

	First month			Second month			Third month		
<i>Dispatches</i>	Target	Real	Excess	Target	Real	Excess	Target	Real	Excess
Basic	250	280		280	300		280	310	
Premium	50	60		50	60		50	60	
 <i>Points</i>									
Basic	250	280		280	300		280	310	
Premium	250	300		250	300		250	300	
	500	580	80	530	600	70	530	610	80

Requirements

More than	150 ok	150 ok	150 ok
More than 70 %	350 ok	371 ok	371 ok

Final calculation

Sum of excesses	230	
Sum of targets	1560	
 Increase	14.7%	Performance over target

Table I
Summary Statistics

Panel 1. Descriptive Statistics. This table describes the characteristics of the eight tournaments organized by firm A among its retailers. The tournament ran from May to December 2002 and January to December 2003. Each winner receives \$3,000 cash, regardless of the region or the final rank achieved in the tournament. The target for each retailer is set monthly. Rankings are calculated within each region based on the percentage of realization over target, provided certain requisites are met.

Region	Initial Number of Contestants		Contestants in Final Round		Number of Winners	Mean Excess Performance**	Total Sales ('000s Units)	Breakdown of Sales (by weight)***		
	2002	2003	2002	2003				Basic	Premium	Enlarged
A	100	165	13	47	10	68%	324	94%	3%	3%
B	21	56	5	6	2	115%	52	96%	0%	4%
C	65	73	6	7	4*	143%	186	78%	0%	22%
D	64	78	6	12	6	69%	110	96%	0%	3%
E	6	7	5	4	1	122%	33	92%	0%	8%
F	105	148	38	23	14	57%	268	97%	1%	2%
G	87	119	10	43	8	91%	302	94%	2%	3%
H	52	105	8	9	5	197%	221	93%	0%	7%
TOTAL	500	751	91	151	46	108%	1497	93%	1%	6%

* In 2003 the number of winners increased to 5 for region C

** For Contestants in Final Round

*** Sales to all Retailers participating in the tournament. Percentages are similar for the whole region

**Table I (cont.)
Summary Statistics**

Panel 2. Retailers Dropping from the Tournament by Month. This table displays the number of retailers dropping out of the tournament by month. Individual targets are set monthly for each retailer. To stay in the tournament a retailer must buy at least 70% of their target and a minimum of 150 units of product. Retailers not satisfying both requirements are dropped from the tournament. Retailers in the table below may have violated one or both conditions.

Month	2002		2003	
	Drops (#)	Drops (%)	Drops (#)	Drops (%)
January			282	47%
February			96	16%
March			40	7%
April			81	13%
May	0	0%	45	7%
June	136	32%	5	1%
July	205	49%	13	2%
August	29	7%	6	1%
September	13	3%	3	0%
October	11	3%	26	4%
November	15	4%	3	0%
December	10	2%	3	0%
Total Drops	419	100%	603	100%

Table II
The Incentive Effect of Tournaments

This table shows the effect of the introduction in 2002 of the tournament on the effort level of the retailers. It reports OLS and fixed effects regressions of output on a participation dummy (Participant), a dummy for the months of the tournament, a dummy to indicate the retailer is still in the tournament at the beginning of the period (Survivor), a dummy to indicate the retailer was in the tournament but then dropped (Drop), and some controls (National Consumption and Individual Fixed Effects). The coefficient for Survivor shows the differences-in-differences estimate of the effect of the tournament. Each observation corresponds to an individual during a particular month. Output is measured as the level of monthly sales in points. The participation dummy takes a value of 1 whenever the individual participated in the tournament in 2002. Tournament Month equals 1 if the tournament was in place at that particular month (May to December 2002). The Survivor dummy takes a value of 1 whenever the individual is in the tournament as of the beginning of that month. The Drop dummy takes a value of 1 if the retailer participated in the tournament but did not satisfy the qualification requirements in one month prior to the current period. Columns 1 and 3 use the first five months of 2002 (which include the first tournament month), while columns 2 and 4 use the full sample for that year.

Dependent variable: Monthly Sales

	Model 1	Model 2	Model 3	Model 4
Participant	565.845 (20.24) ^{***}	565.845 (20.25) ^{***}		
Tournament month	-46.917 (1.28)	-4.552 (0.25)	-46.917 (3.08) ^{***}	-9.457 (1.06)
Survivor	175.371 (2.59) ^{***}	263.031 (6.45) ^{***}	175.371 (5.16) ^{***}	111.221 (4.74) ^{***}
Drop		-208.610 (6.05) ^{***}		-61.728 (2.74) ^{***}
National Consumption	0.000 (2.76) ^{***}	0.000 (3.60) ^{***}	0.000 (5.61) ^{***}	0.000 (9.26) ^{***}
Constant	-141.706 (1.51)	-99.395 (1.61)	87.011 (1.81) [*]	18.976 (0.53)
Individual Fixed Effects	No	No	Yes	Yes
Observations	6185	14844	6185	14844
R-squared	0.09	0.11	0.84	0.73

Robust t-statistics in parentheses

^{*}, ^{**}, ^{***} Significant at the 10%, 5%, and 1% level respectively

Table III**The Incentive Effect of Tournaments and Contest Size**

This table shows the effect of the introduction in 2002 of the tournament on the effort level of the retailers. It reports OLS and fixed effects regressions of output on a participation dummy (Participant), a dummy for the months of the tournament, a dummy to indicate the retailer is still in the tournament at the beginning of the period (Survivor), a dummy to indicate the retailer was in the tournament but then dropped (Drop), and the interactions between Survivor and Drop with the number of prizes (Size of the Contest) together with some controls (National Consumption and Individual Fixed Effects). The coefficient for Survivor shows the differences-in-differences estimate of the effect of the tournament. The interaction terms show how this effect depends on the size of the tournament. Each observation corresponds to an individual during a particular month. Output is measured as the level of monthly sales in points. The participation dummy takes a value of 1 whenever the individual participated in the tournament in 2002. Tournament Month equals 1 if the tournament was in place at that particular month (May to December 2002). The Survivor dummy takes a value of 1 whenever the individual is in the tournament as of the beginning of that month. The Drop dummy takes a value of 1 if the retailer participated in the tournament but did not satisfy the qualification requirements in one month prior to the current period. Columns 1 and 3 use the first five months of 2002 (which include the first tournament month), while columns 2 and 4 use the full sample for that year.

Dependent variable: Monthly Sales

	Model 1	Model 2	Model 3	Model 4
Participant	586.015 (20.06) ^{***}	580.963 (20.42) ^{***}		
Tournament month	-46.917 (1.28)	-3.808 (0.21)	-46.917 (3.09) ^{***}	-9.354 (1.05)
Survivor	639.541 (3.72) ^{***}	693.553 (8.03) ^{***}	406.660 (4.14) ^{***}	231.921 (3.67) ^{***}
Size of the Contest	-18.676 (5.85) ^{***}	-13.998 (7.14) ^{***}		
Survivor*Contest Size	-56.359 (3.77) ^{***}	-49.808 (7.04) ^{***}	-28.083 (3.31) ^{***}	-14.365 (2.69) ^{***}
Drop		-213.411 (6.22) ^{***}		-59.763 (2.65) ^{***}
Natn'l Consumption	0.000 (2.77) ^{***}	0.000 (3.36) ^{***}	0.000 (5.63) ^{***}	0.000 (9.18) ^{***}
Constant	-8.060 (0.09)	17.507 (0.29)	87.011 (1.82) [*]	21.285 (0.59)
Fixed Effects	No	No	Yes	Yes
Observations	6185	14844	6185	14844
R-squared	0.10	0.13	0.84	0.73

Robust t-statistics in parentheses

^{*}, ^{**}, ^{***} Significant at the 10%, 5%, and 1% level respectively

Table IV
Tournament Design and Incentives

This table shows the dynamic effects of the tournament, together with the effect of the number of players and prizes, on incentives. It reports the Arellano-Bond (1991) estimates for the dynamic panel data model. Dependent variables are absolute monthly sales and monthly sales relative to target (both in points). An observation corresponds to an individual during a particular month. Distance for Winner is the difference (positive) between the ranking of a player that is among the set of winners in a particular month and the lowest ranking that receives a prize, and zero for retailers in losing rankings. Distance for Loser is the same difference (positive) for a player that has a rank lower than the number of prizes, and zero for retailers in winning rankings. Number of Players is the number of retailers that remain in the tournament in a specific region in a given month. All explanatory variables except the Lagged Output are treated as exogenous. The first difference in Lagged Output is instrumented with the lagged levels.

Dependent Variable	Monthly sales	Monthly sales	Sales over target	Sales over target
Lagged Output	0.216 (1.21)	0.207 (1.18)	-0.020 (0.21)	-0.024 (0.25)
Distance for Winners	-84.567 (4.27)***	-80.849 (2.37)**	-0.161 (3.88)***	-0.160 (2.55)**
Distance for Winners Squared		0.814 (0.25)		0.002 (0.40)
Distance for Losers	9.476 (2.83)***	23.554 (3.62)***	0.017 (4.07)***	0.040 (4.89)***
Distance for Losers Squared		-0.190 (4.03)***		-0.000 (4.99)***
Number of Players	-8.419 (2.14)**	-8.980 (2.25)**	-0.013 (4.14)***	-0.015 (4.42)***
Constant	89.182 (1.09)	93.606 (1.14)	0.019 (0.19)	-0.232 (2.90)***
Month Effects	Yes	Yes	Yes	Yes
Observations	3183	3183	3165	3165
Number of Individuals	496	496	491	491
AR(1)	-2.13**	-2.05**	-4.21***	-4.17***
AR(2)	-1.15	-1.15	-0.20	-0.20

Robust p-values in parentheses

*, **, *** Significant at the 10%, 5%, and 1% level respectively

Table V**The Incentive Effect of Tournaments and Multitasking**

Panel 1. Differences-in-Differences Evidence. This table shows the effect of the introduction in 2002 of the tournament on the allocation of effort of the retailers. It reports fixed effects regressions of output on a participation dummy (Participant), a dummy for the months of the tournament, a dummy to indicate the retailer is still in the tournament at the beginning of the period (Survivor), a dummy to indicate the retailer was in the tournament but then dropped (Drop), and some controls (National Consumption and Individual Fixed Effects). The coefficient for Survivor shows the differences-in-differences estimate of the effect of the tournament. Each observation corresponds to an individual during a particular month. There are two measures of output. The first, High End Products, is the fraction of sales corresponding to the premium and specialty products over the total. The second measure is Monthly Sales, which is measured in units, rather than points. The participation dummy takes a value of 1 whenever the individual participated in the tournament in 2002. Tournament Month equals 1 if the tournament was in place at that particular month (May to December 2002). The Survivor dummy takes a value of 1 whenever the individual is in the tournament as of the beginning of that month. The Drop dummy takes a value of 1 if the retailer participated in the tournament but did not satisfy the qualification requirements in one month prior to the current period. Columns 1 and 3 use the first five months of 2002 (which include the first tournament month), while columns 2 and 4 use the full sample for that year.

Dependent variable: Monthly Sales

	<u>High End Products (%)</u>		<u>Monthly Sales</u>	
	<u>(1)</u>	<u>(2)</u>	<u>(1)</u>	<u>(2)</u>
Tournament month	0.003 (0.25)	-0.010 (1.33)	-23.107 (2.38)**	6.621 (0.93)
Survivor	0.008 (0.54)	0.017 (2.07)**	90.055 (5.34)***	35.493 (2.70)***
Drop		0.001 (0.18)		-48.071 (3.63)***
National Consumption	-0.000 (0.84)	0.000 (0.41)	0.000 (5.84)***	0.000 (8.24)***
Constant	0.062 (3.26)***	0.038 (3.38)***	100.428 (3.48)***	60.234 (2.45)**
Individual Fixed Effects	Yes	Yes	Yes	Yes
Observations	3069	8009	6185	14844
R-squared	0.73	0.59	0.90	0.77

Robust t-statistics in parentheses

*, **, *** Significant at the 10%, 5%, and 1% level respectively

Table V (cont.)

Tournament Design and Multitasking

Panel 2. Dynamic Panel Evidence. This table shows the dynamic effects of the tournament, together with the effect of the number of players and prizes, on multitasking. It reports the Arellano-Bond (1991) estimates for the dynamic panel data model. Dependent variables are High End Products (the fraction of sales corresponding to the premium and specialty products over the total) and Monthly Sales (which is measured in units, rather than points). An observation corresponds to an individual during a particular month. Distance for Winner is the difference (positive) between the ranking of a player that is among the set of winners in a particular month and the lowest ranking that receives a prize, and zero for retailers in losing rankings. Distance for Loser is the same difference (positive) for a player that has a rank lower than the number of prizes, and zero for retailers in winning rankings. Number of Players is the number of retailers that remain in the tournament in a specific region in a given month. All explanatory variables except the Lagged Output are treated as exogenous. The first difference in Lagged Output is instrumented with the lagged levels.

	<u>High End Products (%)</u>		<u>Monthly Sales</u>	
	<u>(1)</u>	<u>(2)</u>	<u>(1)</u>	<u>(2)</u>
Lagged Output	0.230 (2.34)**	0.224 (2.28)**	0.165 (1.77)*	0.158 (1.70)*
Distance for Winners	-0.012 (4.55)***	-0.013 (2.60)***	-18.847 (3.74)***	-25.335 (2.36)**
Distance for Winners Squared		0.000 (0.59)		1.280 (1.11)
Distance for Losers	0.001 (2.38)**	0.003 (4.54)***	3.519 (4.36)***	8.227 (5.25)***
Distance for Losers Squared		-0.000 (3.15)***		-0.064 (4.32)***
Number of Players	-0.001 (1.49)	-0.001 (1.75)*	-2.976 (1.73)*	-3.179 (1.85)*
Constant	0.002 (1.02)	0.002 (0.67)	-7.021 (0.78)	-8.906 (0.98)
Month Effects	Yes	Yes	Yes	Yes
Observations	3169	3169	3183	3183
Number of Individuals	493	493	496	496
AR(1)	-6.69***	-6.73***	-4.23***	-4.21***
AR(2)	1.60	1.65*	0.28	0.26

Robust p-values in parentheses

*, **, *** Significant at the 10%, 5%, and 1% level respectively

Table VI
Robustness Checks

This table shows the robustness of the dynamic effects of the tournament, together with the effect of the number of players and prizes, on incentives. It reports the Arellano-Bond (1991) estimates for the dynamic panel data model. In the first two columns we restrict the sample excluding the first three and the last months of the tournament. In the last two, we implement a Heckman selection procedure to predict who remains in the tournament. The Inverse Mills Ratio obtained is then used to correct for any self-selection that might arise due to the dropping of some retailers. Dependent variables are absolute monthly sales and monthly sales relative to target (both in points). An observation corresponds to an individual during a particular month. Distance for Winner is the difference (positive) between the ranking of a player that is among the set of winners in a particular month and the lowest ranking that receives a prize, and zero for retailers in losing rankings. Distance for Loser is the same difference (positive) for a player that has a rank lower than the number of prizes, and zero for retailers in winning rankings. Number of Players is the number of retailers that remain in the tournament in a specific region in a given month. All explanatory variables except the Lagged Output are treated as exogenous. The first difference in Lagged Output is instrumented with the lagged levels.

	Interim Periods		Heckman Selection	
	Monthly Sales	Sales over Target	Monthly Sales	Sales over Target
Lagged Output	-0.050 (0.29)	0.117 (1.81)*	0.127 (0.89)	-0.078 (0.54)
Inverse Mills Ratio			372.789 (1.84)*	-0.439 (0.91)
Distance for Winners	-55.112 (3.46)***	-0.211 (7.86)***	-59.789 (3.73)***	-0.139 (3.20)***
Distance for Losers	9.573 (2.31)**	0.035 (6.83)***	13.329 (3.72)***	0.023 (0.91)
Number of Players	-10.165 (2.06)**	-0.024 (5.66)***	-9.616 (1.98)**	-0.017 (3.65)***
Constant	-464.643 (3.90)***	-0.229 (2.57)**	108.305 (1.08)	-0.120 (0.83)
Month Effects	Yes	Yes	Yes	Yes
Observations	2210	2203	2449	2443
Number of Individuals	405	404	405	404
AR(1)	-3.46***	-2.94***	-3.69***	-1.34
AR(2)	-0.32	1.46	-0.19	-1.11

Robust p-values in parentheses

*, **, *** Significant at the 10%, 5%, and 1% level respectively