

# When is Bargaining Successful? Negotiated Division of Tournament Prizes

David Goldreich and Łukasz Pomorski\*

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## Abstract

We study bargaining at the end of high-stakes online poker tournaments, in which participants often negotiate a division of the prize money rather than risk playing until the end. This setting is ideal for studying bargaining: the stakes are substantial, outside options are clearly defined, there are no restrictions on the negotiations, no agency conflicts, and little private information. As expected, negotiations occur when gains to trade are large. Surprisingly, although the likelihood of a successful deal is increasing in the stakes, this relation is driven only by the tournaments with the very largest prizes. Puzzlingly, the success of a proposal to make a deal depends on who makes it, but making a proposal does not affect the proposing player's payoff in a completed deal. Divisions of prizes are closely related to players' outside options, while at the same time one of two focal points is often chosen. We also find intriguing differences between two-player deals and deals among three or more players.

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\*Both authors are at the Rotman School of Management, University of Toronto; Goldreich is also at CEPR. They can be contacted at [david.goldreich@rotman.utoronto.ca](mailto:david.goldreich@rotman.utoronto.ca) and [lukasz.pomorski@rotman.utoronto.ca](mailto:lukasz.pomorski@rotman.utoronto.ca), respectively. We gratefully acknowledge the many useful comments of Tony Bernardo, Sabrina Buti, Rachel Croson, Sergei Davydenko, Craig Doidge, Esther Eiling, Hulya Eraslan, Raymond Kan, Lisa Kramer, Evgeny Lyandres, Jan Mahrt-Smith, Tom McCurdy, Nikolai Roussanov, Holger Sieg, Glen Whyte, and participants of the 2007 Financial Research Association conference, 2008 Economic Science Association meeting, Third World Congress of the Game Theory Society, and seminar participants at Hebrew University. We thank Yiyi Yang for excellent research assistance. All errors are our own.

Bargaining and negotiations pervade many aspects of economic life and social interactions, including goods exchange, labor disputes, and even wars. Consequently, this topic has received a great deal of attention in the economics literature. However, we have scarce empirical or experimental evidence on some of its most important facets. For example, we know little about what determines when negotiations are initiated, which agents are more likely to propose to start bargaining, whether the identity of the party proposing a deal influences the likelihood of an agreement being reached, or whether the proposer's payoff is systematically affected. Experimental studies rarely deal with these issues as experiments usually commence with a given bargaining situation and are not designed to investigate the initiation of bargaining. Similarly, studying these topics is difficult in empirical contexts that often involve unequal parties, agency conflicts, private information, or payoffs or other features that are difficult to quantify and analyze. In contrast, we approach bargaining in an empirical setting in which bargaining arises endogenously, the potential negotiators are principals, there is relatively little private information, stakes are substantial, and the outside option and the payoffs under a successful deal are clearly and unambiguously defined. In this setting, we study what determines the initiation and success of bargaining and also touch upon a variety of other aspects, such as the impact of stakes, determinants of bargaining power, and the differences between two- and more-than-two person negotiations.

The context of our study is the negotiations that often occur near the end of high-stakes online poker tournaments (in which total prize money averages more than \$80,000 per tournament). Each tournament has a schedule of monetary prizes awarded on the basis of the final rankings of players. However, at any time before the end of the tournament, the remaining players can agree to stop the game and share the remaining prize money in any mutually agreeable way. The gains to trade stem from the elimination of risk inherent in playing the game out. The terms of the division are the subject of negotiation, and the only constraint that players face is that the sum of their payoffs must equal the sum of the remaining prizes. In particular, the terms of the deal may depend on the number of chips each player has, as well as anything else that affects their bargaining power. Any player can veto a proposed division, in which case the tournament continues.<sup>1</sup> In the absence of a deal, each player faces an uncertain outcome, although players who are currently leading in the tournament (i.e., have more chips) have a greater likelihood of obtaining larger prizes.

This setting combines real-world bargaining with clarity usually found only in a laboratory. The

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<sup>1</sup>Bargaining here has similarities to the  $n$ -player, one-cake model of Binmore (1985), and the “unanimous game” of Krishna and Serrano (1996), Chatterjee and Sabourian (2000) and Ali (2006).

payoffs and outside options (i.e., that the game continues) are well defined and players in our sample are likely experienced enough to evaluate it meaningfully. Since players are anonymous, we observe essentially all information they have about one another. Moreover, the stakes are substantial. In a typical deal, two of three players divide, on average, more than \$37,000, which suggests that players take the discussion seriously.

In our sample of 1246 online tournaments, 31% had a negotiated division of the prize money prior to the end of the tournament. A further 34% had proposals or discussions to make a deal that ultimately were not completed. Of course, the fact that the agents in our sample often strike deals to reduce risk indicates that they are risk averse, but their decision to participate in poker tournaments in the first place implies that they also derive enjoyment from playing (or are risk seeking over smaller gambles). Their preference for games of chance may make it less likely that they will make a deal, but when examining the cross section of proposals and the results of bargaining, there is no reason to expect them to systematically behave differently from lawyers, managers, or workers. Moreover, in the empirical analysis we control for preferences (using variables such as the amount players pay to participate), which may alleviate any selection bias.

Some of the detailed results in this paper are consistent with our a priori intuition and some are not. The intuitive results are that deals are more likely when the stakes are high, that it is easier to reach agreement with fewer players remaining, and that the terms of deals are closely related to players' outside options. However, even these results are not so simple. Although stakes have a strong positive influence on the probability of striking a deal, the effect is driven only by the very largest amounts. Reaching agreement is more likely in tournaments with total prize pools above \$100,000 (about 14% of our sample). However, in the subsample of tournaments with prize pools below \$100,000, the size of the tournament has no effect on the probability of making a deal. (In our analysis, we control not only for the prize pool, but also for the amount at risk. Deals usually involve only a small number of remaining players, so the amount divided is only part of the total prize pool.)

The likelihood of achieving agreement and the likelihood of even discussing a proposal are both strongly negatively related to the number of players remaining in the tournament. In fact, 85% of deals in our sample involve only two or three players. Moreover, the majority of proposals are made right after a player has been eliminated from contention. This may be because players recognize that when all parties have veto power, it is more difficult to reach an agreement in larger groups.

Additionally, we find that the distribution of wealth is important.<sup>2</sup> Proposals tend to be made when chip stacks are relatively equal, and given a proposal, a deal is more likely to be accepted when there is less inequality. As we argue below, this effect arises because players prefer equal divisions, but also because the risk of continuing the game is the highest when chip stacks are equal.

Some results are puzzlingly in conflict with our *ex ante* expectations. For example, one might predict that the identity of the player who initiates negotiations would have no effect on whether or not a deal is successfully completed. Any information conveyed by a player proposing a deal should be reflected in the terms of the deal and not in the likelihood of its success. (Recall that the terms are entirely up to the players.) However, we find that proposals by players with many chips and by highly-ranked players are more likely to be accepted. Compounding this puzzle, when considering the terms of accepted deals, being the proposer does not affect a player's payoff. Once we control for player characteristics (e.g., the number of chips he holds or his recent success), we find no evidence that players who start negotiations signal their willingness to accept a smaller payoff.

Another intriguing finding is the behavior of the player with the most chips. In deals that are agreed to when more than two people remain, the player with the most chips receives a relatively larger slice of the pie, even after controlling for the number of chips he has and his expected payoff. But when deals are agreed to between two players only, this effect reverses; the richer player actually subsidizes his poorer opponent. Thus, there appears to be a fundamental difference between two-person bargaining and bargaining among three or more people. As an implication for the experimental literature, this suggests that the results of two-person games may not generalize directly to games with more than two players.

Our results also illustrate the importance of focal points in bargaining (as in Roth, 1985). In our sample, the terms of agreed upon deals fall into three categories, each accounting for about one-third of completed deals: splits in which the prize money is divided equally among all remaining players, splits proportional to the number of chips each player has,<sup>3</sup> and other splits. Thus, in about two-thirds of all tournaments with a deal, players rely on one of two well-known and simple-to-understand division methods. These focal points often deviate substantially from expected payoffs, yet players frequently agree to them unanimously.

The setting of this empirical study is poker tournaments, but this paper is emphatically not

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<sup>2</sup>We use the terms “wealth,” “rich,” and “poor” to refer to the number of chips (i.e., the “stack”) each player has.

<sup>3</sup>More specifically, in proportional splits among  $n$  players, each player receives  $n^{th}$  prize plus an amount equal to the remaining prize pool times his proportion of outstanding chips.

about poker but rather about bargaining. One contribution relative to existing empirical papers is that they are often most relevant to a specific setting or application. For example, in works on labor negotiations (see Card, 1990), political bargaining (e.g., Diermeier and Merlo, 2004), or household bargaining (e.g., Del Boca and Flinn, 2006), the main focus is often the behavior and impact of labor unions, political parties, or households, respectively, rather than bargaining per se. Moreover, in some studies, the negotiating parties are unequal, their payoffs and outside options are private information or simply unclear, and there are agency conflicts that may influence the bargaining process. Such complications are either absent in our data or can be controlled using the variables we observe (e.g., the number of chips each player has), which makes it easier to identify the forces driving negotiations. Finally, the bargaining setting considered in some papers involves constraints or structure imposed on the process. For instance, Farmer, Pecorino, and Stango (2004) analyze the impact of final offer arbitration on bargaining success. In contrast, there are no such constraints in our study, which allows us to focus on bargaining in general rather than on a particular process.

Also related to our work are papers that estimate structural models of bargaining in a variety of contexts.<sup>4</sup> However, the nature of the structural estimation is to test particular predictions of bargaining theory. Moreover, some of these studies focus on a particular setting. In contrast, we intentionally abstract from specific models to provide an open-ended description of bargaining.

The extensive experimental literature on bargaining (reviewed in Roth, 1995) avoids many of the limitations of empirical studies. Experiments are structured so that the bargaining process, the payoffs, and the incentives are well defined. The clarity of laboratory bargaining enables the experimenter to test specific hypotheses. Our contribution relative to this literature is that in our setting the initiation of bargaining is endogenous, which allows us to characterize when it is likely to occur and to identify the person who initiates it. Second, compared to most experiments, the stakes in our sample are substantial, and the large variation in the stakes allows us to study their impact. Moreover, experimental studies often (intentionally) simplify the bargaining problem. For example, the responding player might only be allowed to accept or reject the offer; even if he can make a counteroffer, he may need to wait to the next round, by which time the total prize pool will have shrunk.<sup>5</sup> In our setting, bargaining is closer to real-world negotiations. Lastly, there is little experimental literature comparing bilateral and multilateral bargaining.<sup>6</sup> In contrast, approximately

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<sup>4</sup>See, e.g., Sieg, (2000); Epple, Romano, Sarpca, and Sieg (2006); Eraslan (2006); Watanabe (2006); Green, Hollifield, and Schurhoff (2007).

<sup>5</sup>Some of the early experimental literature had few constraints on the bargaining process, as described in Roth (1995). Experiments now typically have tight structures designed to compare subtle differences in the process.

<sup>6</sup>Exceptions include Knez and Camerer (1995) and Okada and Riedl (2002) who study three-person variations of

half of our sample involves bargaining between more than two players; in fact, some of our most exciting results pertain to the differences between two-player and more-than-two-player bargaining.

Thus, our study combines many of the advantages of both the empirical and the experimental literature. In this sense, we share some of the benefits of game-show studies,<sup>7</sup> which feature a simple setting with substantial monetary prizes. In contrast to game show studies, we can largely ignore nonmonetary incentives and “limelight effects,” such as fear of embarrassment, being a “good sport,” and so forth. Additionally, players in our sample arguably have a better grasp of the game structure, probability theory, etc., than a typical game-show contestant. Most importantly, to the best of our knowledge, none of the existing game-show papers focuses on bargaining.

This paper proceeds as follows. After introducing the data in the next section, we study when deals are proposed and when proposals are successful. In Section 2.1 we use tournament-wide variables (such as the prize pool) to predict whether a deal will be completed or at least discussed in a given tournament. In Section 2.2, we condition on a proposal being made to characterize the states of the tournament that are conducive to negotiations and to investigate when proposals successfully lead to deals. In Section 3 we analyze what determines the terms of completed deals. Given all the results, we organize and discuss them in Section 4 and conclude the paper in Section 5.

## 1 Setting and data

The data in our study are a sample of 1,246 poker tournaments from one of the largest online poker sites. The prize pool averages more than \$80,000 per tournament, and the largest tournaments have prize pools of well over \$1 million. We first discuss the key features of the tournament structure and then we describe the data. A detailed description of the data acquisition is in Appendix A.

### 1.1 Online poker tournaments

The data come from large, multi-table tournaments of a popular variety of poker called no-limit hold'em. The mechanics and the strategies of hold'em poker are unimportant for this study. However, the tournament structure is crucial. To participate in a tournament, players must pay a “buy-in,”

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the ultimatum game. Guth and van Damme (1998) and Kagel and Wolfe (2001) study a three-person ultimatum game in which one player is completely passive. Some other recent experiments have more than two players bargaining, but with a majority voting rule (e.g., Frechette, 2006 and Battaglini and Palfrey, 2007).

<sup>7</sup>See, for example, Gertner (1993), Metrick (1995), Berk, Hughson, and Vandezande (1996), or Post, van den Assem, Baltussen, and Thaler (2007).

which is set aside entirely for the prize pool. The total prize pool of a tournament is, in general, the buy-in multiplied by the number of players participating.<sup>8</sup>

In the multi-table tournaments we consider, players are assigned to tables of nine players each. Players start the tournament with the same number of chips and bet with others at their table. When a player loses all of his chips, he is eliminated from the tournament. As players drop out, the number of tables is reduced and remaining players are reseated so that each table has nine or close to nine players. When a player is reseated, he takes his chips to the new table. Eventually, there are only nine players remaining, who together possess all the original chips. They form the “final table.” Our analysis starts at that stage of the tournament.

At the final table, players continue to bet until all but one are eliminated. The remaining player wins first prize, and all others are ranked in the reverse order in which they were eliminated. The prize structure varies, but in a typical tournament with 900 starting players, 81 players would be awarded prizes, with first prize receiving about 25% of the total prize pool, second prize 14%, and then the prizes get progressively smaller with the lowest winners receiving about 0.2%.

The most important feature for the purposes of our study is that at the final table, before the end of the tournament, players may make a deal in which they split the remaining prizes in a mutually agreeable way.<sup>9</sup> For example, if there are three players remaining and the top three prizes are \$20,000, \$10,000, and \$6,000, respectively, the players might agree to take \$12,000 each, regardless of the final outcome of the tournament. The terms of the deal are entirely up to the players, so if player A has more chips than players B and C, and thus is likely to win the tournament, the split may be \$18,000 for player A and \$9,000 each for players B and C. The key restriction is that all remaining players must agree to the terms of any deal (i.e., each has veto power).

After a deal is made, play must continue until one player has all the chips. Even though the prizes have already been distributed, players can still compete for nonmonetary benefits of winning the tournament (if any). Thus, for the purposes of our analysis of bargaining, such nonmonetary benefits can be ignored.

The software used by the online casino presents all player communication in a “chat window” that is also visible to tournament observers. We record all communication among players at the

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<sup>8</sup>In addition, each player pays a fee of up to 10% of the buy-in, which is kept by the “house.” In some tournaments, players who are eliminated early are allowed to pay the buy-in again and reenter the tournament. Such re-buys increase the total prize pool.

<sup>9</sup>Players are not allowed to divide prizes before they reach the final table of nine players.

final table and, in particular, all negotiations regarding a split of the prizes.<sup>10</sup> Deal negotiations are conducted via the chat window and are finalized by the tournament support personnel. Tournament support personnel do not suggest, encourage or discourage any particular deal but merely ensure that all players agree and then execute the deal. No structure is imposed on the negotiation process in the sense that there are no a priori defined proposal “rounds,” no order in which players propose offers and respond to them, or any other regulations. Although the negotiation occurs online, as Croson (1999) shows, online negotiations are efficient. Thus, the only major differences between the bargaining process and real-world negotiations in other contexts are that the players cannot see one another and that their information about one another is largely limited to what they can infer from the game played thus far.

## 1.2 Data

We collected data over a period from April 2007 to July 2007. Because of the technological limitations of collecting data in real time over the Internet (each computer can only record one tournament at a time), we capture only a subset of available tournaments. We chose those with large prize pools but with a variety of buy-ins. Because of sporadic Internet connection breakdowns, the recordings of a few tournaments were interrupted; these tournaments do not enter our data set. The data consist of all activity at the final table of each tournament, including hand-by-hand data on the number of chips each player has and the outcome of each hand, from the start of the final table until the completion of the tournament. The data also include all “chat”, including negotiations about potential deals. We manually process the chat transcript to identify when proposals to negotiate are made, the bargaining process, and the terms of the deal.<sup>11</sup>

In Table 1 we display the summary statistics of the tournaments in our data set. The average tournament has a total prize pool of \$82,034 (the median is \$47,855). The largest 5% of tournaments in our sample boast prize pools of \$200,000 and up, and the very largest prize pools exceed \$1 million. On average, almost 950 players start in each tournament, and each tournament lasts an average of more than 6 hours. The price to play in a tournament (buy-in plus fee) averages \$77.50.

In all tournaments in our sample all nine players at the final table get monetary prizes, but the

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<sup>10</sup>Communication among players via other channels is unlikely. Such communication during play is considered cheating and expressly forbidden by the online casino. Moreover, other than their on-line nicknames, players are anonymous and their contact information is unavailable.

<sup>11</sup>The initial proposal usually does not spell out exact terms of the division. Moreover, proposals are frequently rejected before precise deal terms are put forward. Of course, for all completed deals, we have the exact terms.

prize structures are heavily skewed toward top finishers. First prize averages \$17,628, and second averages \$10,273. Therefore, on average, when there are only two players left in the game, they can negotiate over the \$7,000 difference, which we refer to as the “surplus.” More generally, when there are  $n$  players remaining in the game, surplus is defined as the sum of the top  $n$  prizes minus  $n$  times the  $n$ th highest prize. In other words, it is the total amount players divide less the minimum amount they are guaranteed to receive regardless of how they perform over the remainder of the tournament.

In all tournaments in our sample, the surplus is very sizable compared with the stakes in typical bargaining experiments. However, unlike most experiments, in the absence of an agreement, our participants have an outside option of continuing to play and a chance to win any of the remaining prizes.

The point of dividing the remaining prizes before the end of a tournament is to reduce the risk inherent in playing the game out until the end. For example, suppose there are two players remaining in a tournament, each with an equal probability of winning and each with log utility, who agree to divide first and second prizes equally. The gain to each player from this agreement is the difference between the agreed upon payoff and the certainty equivalent of continuing to play. The sample averages of \$17,628 and \$10,273 for first and second prizes, respectively, imply the per player value created of:

$$CE(\text{equal split}) - CE(\text{keep playing}) = \frac{17,628 + 10,273}{2} - e^{0.5(\ln(17,628) + \ln(10,273))} = \$493.44. \quad (1)$$

Of course, the value created varies depending on the actual prize structure, the number of players involved, their utility functions, and so forth, reduced by the value that each player puts on his enjoyment of the game.

We argue that the value created by successful negotiations in the tournaments in our sample is economically interesting and compares favorably to the stakes in typical bargaining experiments. Moreover, the substantial amount of variation in the prize pools in our sample helps us determine the importance of stakes in starting negotiations and closing deals.

Finally, although players are anonymous and can only be recognized via their on-screen pseudonyms, there exist rankings of these pseudonyms based on each player’s track record. The existence of such rankings suggest that players (or, more accurately, their nicknames) have a reputation. To control for it, we obtain a ranking of online poker player nicknames from a third-party website. Of the

50,000 nicknames recorded as having positive profits, we classify the top 200 as “highly ranked” (or “famous”) players.<sup>12</sup> We also experiment with the top 100, 500, and 1000 players with very similar results. We repeat our analysis with a second proxy for reputation. We identify players (player nicknames) who reach the final table multiple times in our sample. We conjecture that such “repeat offenders” are famous or perhaps skilled players. The results we obtain with this alternative measure are qualitatively similar to those obtained for players ranked in the top 200.

## 2 When do negotiations start, and when are they successful?

This section investigates when negotiations are initiated and what determines their success. We begin in Section 2.1 with the “macroscopic” view: Given the characteristics of a tournament, what variables help predict whether a deal will be made? In Section 2.2, we condition on a proposal to negotiate being made and focus on the state of the game at the time of the proposal.

### 2.1 Tournament-level variables

In Table 2 we summarize the negotiations and deal making. The purpose of this table is to present a variety of summary statistics; we proceed with a more careful statistical analysis subsequently. In 386 tournaments (30.98%), players agreed to split the prize money before the end of the tournament. Of the other 860 tournaments, in 429 (34.43% of all tournaments) there was at least one proposal to make a deal, but agreement was not reached. Of these, in 243 (19.50% of all tournaments) there was at least some discussion following the proposal (that is, the proposal was not ignored by the other players). Finally, in 431 tournaments (34.59%), there was no proposal to divide the prizes. It is thus apparent that even though the prize pools are often substantial, deals are not the norm. In the majority of the tournaments in our sample, no division of prizes occurs; in about one-third of cases, no one even tries to open a negotiation, in spite of relatively high stakes in these tournaments.

The average amount of money at stake (whether measured as the total prize pool, or as the remaining prize pool for the nine players at the final table) is considerably higher for the tournaments with a deal than for tournaments without one. Moreover, the average decreases from tournaments with a deal to tournaments with some negotiations (albeit not successful) to tournaments with at

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<sup>12</sup>This ranking was recorded before our main tournament data and is not influenced by whether a player may have reached a final table in our sample. The rankings are roughly based on the dollar winnings and the number of tournaments played. Unfortunately, we could not obtain the exact algorithm used for computing the rankings.

least a proposal to tournaments in which no deal is even mentioned. Medians of the top nine prizes are quite similar, regardless of whether negotiations take place and regardless of the outcome of negotiations. This suggests that the size of the tournament is important only when the amount at stake is substantial. However, the top nine prizes may not be the best measure of the gains associated with making a deal. As we discuss below, deals typically occur when two or three players remain at the final table (the median number of players participating in a deal is two). Thus, a better measure may be the difference between the first and the second prize (i.e., the surplus available to the last two players). We obtain the same results with this measure: The average surplus is highest for tournaments with a successful deal and lowest for those without any proposals, and the difference between the two is \$3,300.

Skewness of the prize structure is another variable that is correlated with whether a deal occurs. We compute the skewness of the top nine prizes using the usual skewness estimator. Our goal is to capture how much more the top winners of the tournament get relative to players who are eliminated earlier. Thus, the higher the skewness in prizes, the riskier it is to keep playing. We find that skewness of the top nine prizes is highest for tournaments with a deal and lowest for tournaments without any proposals. This suggests that in our setting risk aversion plays a larger role than any preference for skewness (as in, e.g., Alderfer and Bierman, 1970) that players may have.

By construction, the prize pool of a tournament equals the product of the buy-in and the number of players. Thus, the pattern in the size of the prizes should be reflected in these two variables. The number of players per tournament is higher for tournaments with a deal, both in terms of the average and the median. Although the average ticket price (i.e., buy-in) is very similar for all subsets of tournaments, the median is substantially lower for tournaments with a deal, higher for those with an unsuccessful proposal and highest for those without even a proposal to negotiate. The buy-in may be related to players' utility derived from playing in high-stakes tournaments, or to players' risk aversion. Whether players in high buy-in tournaments experience high utility from playing or have low risk aversion, their perceived gains to trade are lower, and thus, they are less likely to agree to end the tournament prematurely. At the same time, buy-in is mechanically related to the prize pool and the number of players, so the patterns discussed previously may be partly induced by these other variables.

The next two variables in Table 2 are the number of highly ranked players at the final table and the number of "repeat offenders" – players who appear multiple times in our data. Both of

these variables, which capture reputation, indicate that, on average, fewer such players appear in tournaments that involve a deal.

Finally, the last part of Table 2 summarizes the number of proposals in different subsets of our sample. Note that it usually takes two proposals to reach an agreement; the average is 1.84 proposals per tournament, and, in more than 50% of the tournaments with a deal, the first proposal is unsuccessful.

Table 3 refines our analysis in a multivariate setup. We use a logit specification to model the probability that a deal occurs (top panel) or that a negotiation takes place regardless of its result (bottom panel). The independent variables are those suggested by Table 2 that are observable at the start of the final table. We compute standard errors using White's (1980) method to control for potential heteroscedasticity.<sup>13</sup> We report the estimation results in the form of marginal effects as they are easier to interpret; the signs and the patterns of statistical significance are very similar for the logit coefficients. In Table 3, as well as in other tables that present logit estimation results, we do not report the estimates for the constant term.

Panel A of Table 3 explains the probability of a deal in a given tournament. We begin with perhaps the most obvious variable: the stakes, proxied by the logarithm of the dollar difference between the two top prizes. The estimated coefficient of this variable is positive and statistically significant, which suggests that the larger the stakes, the easier it is to achieve a deal. However, the economic impact is rather limited. If the difference between the first and the second prize doubles, the probability of reaching an agreement increases by approximately  $0.049 \times \ln(2) = 3.4\%$ . This effect, while noticeable, is perhaps not as strong as expected. When we use a different proxy for the tournament stakes, the log of the sum of the top nine prizes, the estimated coefficient is still positive but no longer statistically significant. As explained above, deals typically are negotiated with relatively few players left in the game, so the difference between the top two prizes may be a better measure of gains to trade than the sum of the top nine prizes.

Next, we investigate the impact of the shape of the prize schedule, that is, how far away the top prizes are from the bottom ones. The first variable we consider is the ratio of the two top prizes. Unlike the difference between the two prizes, this variable captures the shape of the payoff, but not the dollar magnitude. As regression (3) demonstrates, the prize ratio has a positive and statistically significant estimate; moreover, it lowers the impact of the tournament size. Regression (4) leads to

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<sup>13</sup>We also compute standard errors using bootstrap and jackknife procedures. The results are very similar to those presented here.

a similar conclusion using another proxy for the shape of the prize schedule, the skewness of the top nine prizes. Interestingly, both measures of the shape of the prize structure help explain substantially more variation than the size of the prizes. The pseudo- $R^2$  increases from less than 1% to 3.1% or 3.6% when we add the ratio or skewness, respectively, to the independent variables. As we have explained earlier, this finding illustrates the role of risk aversion in negotiations.

Other variables in Table 3 include the number of highly ranked players at the beginning of the final table and the buy-in. Deals are less likely when many players have a top 200 ranking. We speculate that this is because such players believe they are highly skilled, expect to defeat their opponents, and only agree to a deal if they receive a disproportionately larger portion of the prize pool. Moreover, the amount players pay to participate in the tournament is negatively related to the likelihood of making a deal. When the buy-in doubles, the probability of a deal is reduced by about 3%. As mentioned above, this finding is consistent with players who have lower risk aversion or more utility from playing choosing to participate in the higher buy-in tournaments.

The impact of stakes implied in Table 2 and the first regressions of Table 3 is perhaps surprisingly low. To investigate it in more detail, we estimate regressions (7) and (8) on the subsample of tournaments with total prize pools below \$100,000 (84% of our sample). Even these smaller tournaments involve large sums of money across a wide range. The total prize pool in this subsample varies from just under \$12,000 to almost \$100,000 (average of \$43,433), and the difference between the two top prizes ranges from roughly \$1,000 to \$10,000 (average of \$4,225).

The results are striking. The impact of stakes is noticeable only when we include tournaments with total prize pools greater than \$100,000. In the restricted sample used in regressions (7) and (8), the magnitude of prizes is unimportant. The null hypothesis that the amount of money at stake does not affect the probability of dividing the prizes cannot be rejected at any usual confidence level. Even if point estimates are taken at the face value, the economic impact of stakes is tiny. This result is consistent with the existing literature, which generally finds that stakes have little effect on bargaining behavior in an experimental framework (see Camerer and Hogarth, 1999). However, our earlier results show that the size of the stakes does affect the probability of a successfully agreed upon bargain when we include tournaments with truly large prizes.

Panel B of Table 3 uses similar specifications to explain the probability of a discussion about dividing the prizes. Here, the dependent variable takes the value one if there was at least one proposal and a response to a proposal (regardless of whether that proposal was eventually accepted)

and the value zero if there were no proposals or if all proposals in a given tournament were ignored by other players. The results are quite similar to those obtained for the probability of making a deal. In the full sample, the possibility of a deal is more likely to be discussed when the stakes are larger, the prize structure is skewed, there are fewer highly ranked players, and the buy-in is smaller. As in the case of completed deals, the probability of a discussion is affected by the amount of money at stake – the size of the tournament – only when the prize pool is extremely large.

## 2.2 Proposal-level variables

The previous section describes which characteristics of the tournament influence whether a deal gets made. Now, we change perspective and focus on proposals. We define a proposal as any invitation by a player to discuss a deal. Proposals may or may not include specific terms. Because proposals are endogenous, we first describe which states of the game are particularly conducive to initiating discussion. Then, given a proposal, we investigate the factors that affect its outcome.

### 2.2.1 When are proposals made?

We begin with an investigation into when proposals occur. To our knowledge, little empirical research considers when negotiations are initiated or characterizes the agents who start the discussion.<sup>14</sup> We can shed light on these important issues using our unique data set.

In Table 4 we provide a summary of the state of the game at the onset of bargaining. The first column is a snapshot of the “typical” state of the game and a “typical” player. The values reflect the averages computed over all hands played at all final tables in tournaments which did not have any proposals. The lower part of the first column includes expected characteristics for a player drawn randomly from that sample. The values from this first column serve as a benchmark against which we compare the state of the game at the time of each proposal and the characteristics of the player who initiates discussion (in the second column).<sup>15</sup> We also report the analogous data for a subset of rejected proposals and for the player who rejected the proposal (in the fourth column). We do not further separate proposals into those that led to a deal or were at least discussed; we examine such results in more detail in Tables 5 and 6.

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<sup>14</sup>See Babcock and Laschever (2003) for a discussion of the importance of initiating negotiations in the context of the gender divide.

<sup>15</sup>Reported t-statistics of differences are based on standard errors robust to heteroscedasticity and clustered at the tournament level, which allow for dependence between hands played in the same tournament.

Proposals occur relatively late in the game. The number of players remaining is lower, and the time since the start of the final table is higher for hands when proposals occur than for those we draw randomly from no-proposal tournaments. This difference may reflect that it is easier to negotiate when fewer players remain. This conjecture is supported by the finding that proposals typically occur soon after a player is eliminated. On average, just over one player gets eliminated in the 10 hands preceding a proposal. In comparison, only 0.6 players are eliminated in each set of 10 consecutive hands randomly drawn from no-proposal tournaments. In fact, 33% of all proposals are made within one hand of when a player goes bankrupt, and in 67% of proposals at least one player has been eliminated in the previous 10 hands.<sup>16</sup> Moreover, proposals are more likely when there are few highly ranked players left at the table. At a random time at the final table, just over 10% of players are highly ranked.<sup>17</sup> However, at the time of a proposal, only 6.3% of players are highly ranked.

Another important determinant of proposals is the distribution of chips among players. We measure the inequality of the distribution using the Gini coefficient, which is often employed in other contexts to capture income or wealth inequality. If  $s_i$  denotes player  $i$ 's chip stack size,  $\bar{s}$  is the average stack size, and  $n$  players remain, the Gini coefficient is<sup>18</sup>

$$\frac{n}{n-1} \frac{\sum_{i=1}^n \sum_{j=1}^n |s_i - s_j|}{2n^2 \bar{s}}.$$

The virtue of this variable is its appealing interpretation. It measures the expected difference in wealth between two randomly selected players, normalized by the average wealth of all players. Gini coefficients are always between zero and one and are increasing in inequality.<sup>19</sup>

Proposals occur when the distribution of chips is relatively equal; the average Gini coefficient at the time of the proposal is significantly below the benchmark. Moreover, the inequality tends to decrease before a proposal, although this tendency may be related to the recent elimination of players with very few chips. The change in the Gini coefficient over the 10 hands prior to a proposal is significantly negative, but it is positive for non-proposal hands.<sup>20</sup> This effect is quite pronounced

<sup>16</sup>Late in the game, forced bets (i.e. "blinds") are higher, but we find no evidence that this is related to the propensity of players to propose or complete deals.

<sup>17</sup>The percentage of ranked players may be high because of their higher skill, but also because they participate in many more tournaments than do typical players.

<sup>18</sup>We multiply the usual formula for the Gini coefficient by  $n/(n-1)$  to correct for bias. This correction is important in our context as  $n$  is small.

<sup>19</sup>We experimented with other measures of inequality, including the Herfindahl index and generalized entropy measures, with qualitatively similar results.

<sup>20</sup>The positive change in Gini for non-proposal hands indicates that inequality tends to increase as the game pro-

in that only 31% of all proposals in our sample take place after an increase in inequality.

In the bottom half of Table 4, the player characteristics we consider include a dummy that takes the value one when a particular player has the most chips at the table. If players were to propose at random, the expected value of this variable would depend on the number of players. Therefore, we normalize the “chip leader dummy” by subtracting the inverse of the number of remaining players so that its expected value is equal to zero regardless of the number of players.<sup>21</sup> As a measure of relative wealth, we use the number of chips a player has, divided by the average number of chips per player at the table. Thus, relative wealth equals one for the average player. We capture past (short-term) success using the change in relative wealth in the past 10 hands. Another measure of past success is the number of hands a player has won out of the past 10 hands, standardized by the average number of hands that remaining players have won during the same stretch. The benchmark value of this variable is one. The last variable is the fraction of highly-ranked players remaining in the game. In the benchmark, this variable is averaged over all hands at final tables without proposals.

We find that the player who initiates bargaining (i.e., the proposer) is less likely to be the player with the highest chip stack, and controls about 7% fewer chips than the average player remaining in the game. The recent track record is partly responsible for this trend. The proposer’s wealth in chips relative to other remaining players decreases by 11.3% on average over the previous 10 hands. He also tends to have won slightly fewer recent hands compared with other players remaining in the game. In contrast, the player who vetoes a deal (i.e., the rejector) tends to be richer than the average remaining player. Interestingly, proposers are substantially less likely to be highly ranked, whereas rejectors are as likely to be highly ranked as a random player in our sample.

### 2.2.2 When are proposals successful?

We now examine when a proposal successfully prompts a deal or at least induces players to negotiate. In Table 5 we divide proposals into accepted (i.e., those that culminate in a deal) and not accepted. Of the latter, we separately consider proposals that induce discussion and those ignored by the remaining players.<sup>22</sup> As in Table 4, we present two sets of variables in Table 5: Those that characterize the state of the game, such as the number of players remaining, in the top panel, and those that characterize the

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gresses.

<sup>21</sup>We disregard situations when more than one player holds the highest number of chips. These situations are rare; in our entire sample of 177,663 hands played, in only 3 cases (0.002%) did two players have equal chip stacks.

<sup>22</sup>Unlike Table 4, which requires the identity of the rejector, in Table 5 “discussed and rejected” proposals include those that failed to reach agreement without any one player explicitly rejecting the deal.

player who made the proposal, e.g., his recent success, in the bottom panel. We compare the averages of these variables, conditional on the outcome of the proposal. The differences in averages and the corresponding t-statistics appear in the last three columns of the table. In unreported analysis, we also compute the medians and test for their equality. The results are very similar and any major differences between the averages and the medians are mentioned below. We keep the summary of Table 5 results to a minimum since they will be discussed further as part of the multivariate analysis in Table 6.

The outcome of a proposal critically depends on the number of players remaining in the tournament. On average, 2.7 players remain when a deal is achieved (median = 2). Only the final two players are involved 55% percent of the time and 30% of deals are among three players. The number of players is larger in proposal discussions that do not reach a deal (average of 3.5, median of 3), and in ignored proposals (average of 4.4, median of 4). The differences across the averages and medians are all highly statistically significant.

Deals are typically sealed when chips are relatively evenly distributed among the remaining players. When inequality increases, a proposal is less likely to be accepted, but may still be discussed. As inequality grows further, discussions become less likely and proposals tend to be ignored. This monotonic pattern is highly statistically significant. Differences in medians (unreported) are similarly significant according to the Wilcoxon rank-sum test.

As Table 3 suggests, the number of ranked players active at the beginning of the final table is negatively related to the likelihood of a deal. That finding is strongly supported in Table 5: The percentage of remaining players who are highly ranked increases from 3.9% for accepted proposals to 7.1% for discussed and to 7.3% for ignored ones.

The bottom panel of Table 5 describes the player who makes the proposal and the relation between his characteristics and the success of the negotiations. Although in all cases the proposer is less likely to be the chip leader, we find no statistical difference in the chip leader dummy between accepted and rejected proposals. However, the relative wealth of the proposer is significantly lower than the average in not accepted proposals. Among failed proposals, discussed ones tend to come from wealthier proposers than do ignored ones, but the statistical significance of this difference is weak.

We refine this analysis in a multivariate framework in Table 6 by estimating the probability of reaching a deal given a proposal (top panel) or at least discussing a proposal (bottom panel) using

a logit specification. As in Table 3, we report marginal effects rather than logit coefficients. Robust standard errors are clustered at the tournament level to control for the dependence between multiple proposals made in the same tournament.<sup>23</sup>

After a proposal is made, the probability of coming to an agreement strongly depends on the number of players remaining in the game. The economic significance of this variable is substantial. When the number of players decreases from three to two, the probability of reaching agreement increases by about 16%.<sup>24</sup> In the second panel of Table 6 we find a similarly strong effect on the probability of discussing a proposal: Proposals with more players remaining are more likely to be ignored.

The impact of the number of players suggests two possible explanations. First, reaching agreement is likely easier with fewer players (recall that each player has veto power). Second, the prizes and the distance between prizes increase as more players are eliminated: The fewer players remain in the game, the larger is the per player surplus to be divided among them. However, as we show below, the number of players remains significant also when we control for the per-player surplus directly.

The presence of highly ranked players discourages deals. The economic impact of this variable is almost as high as that of the number of players. For example, if there are two (four) players left and one of them is highly ranked, the probability of reaching agreement drops by approximately 16% (8%). In the previous tables we observe that ranked players are less likely to propose a deal; here we go further to find that the presence of ranked players strongly discourages acceptance of proposals. Interestingly, the presence of ranked players has a smaller effect on discussions. The marginal effect of ranked players is still negative in the second panel of Table 6, but lower than that in the first panel. Moreover, in some specifications that variable is no longer significant.

When we control for other variables, equality of chip stacks is still very important for reaching agreement. When the Gini coefficient drops from its average value by one standard deviation (0.164 measured across all proposals), the probability of reaching agreement increases by 8% to 9%, depending on the specification. The second panel of Table 6 indicates that the effect on the probability of taking a proposal seriously is similar in terms of both economic and statistical significance.

It is not clear why proposals are more likely to be discussed and accepted when wealth is more

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<sup>23</sup>In unreported analysis, we experiment with other specifications designed to capture this dependence. For example, we introduce dummy variables for the second, third, and more-than-third proposal in a given tournament without qualitatively changing the results.

<sup>24</sup>Further illustrating the economic significance of the number of players, about 58% of two-person proposals in our sample culminate in a deal, whereas only 16% of four-player proposals are accepted.

equally distributed. Recall that players are free to choose any division of the surplus and could easily compensate players with the most chips when dividing the prize money. There are a few possible explanations for why chip distribution matters. First, the risk of continuing the game, measured as the sum of the standard deviations of future payoffs, is highest when stacks are equal (assuming equal skill of all players). Because the benefit of agreeing to a deal is a reduction in risk, the total gains to trade (assuming equal weight on each player's risk reduction) are highest when all chip stacks are the same. Second, when players have a similar number of chips, the terms of the deal may gravitate toward the equal division, which is a natural focal point.<sup>25</sup> Third, if players have a natural preference for equal divisions out of a sense of fairness (as discussed in Roth, 1995, and modeled by Fehr and Schmidt, 1999 or Bolton and Ockenfels, 2000), unequal chip counts make it more likely that one player will be disadvantaged enough by an equal split to veto the deal.

Given the importance of these variables (the number of players remaining, the fraction of highly ranked players, and stack inequality), we control for all three in the remaining specifications.

The next set of variables that we consider are related to the changes in the state of the tournament before the proposal, namely, the change in the Gini coefficient over the past 10 hands, the number of players eliminated in the past 10 hands, and the number of proposals in the tournament so far. Of these three variables, only the number of players eliminated is significant and then only in the final specification. We find similar effects when considering which proposals are discussed except that we have some mixed evidence that the more persistent players are in proposing a deal (the more proposals they make), the more likely it is that the next proposal will be at least discussed.

In the next specification we return to tournament-level variables that are important in Table 3. The first one is the size of the pie players negotiate over. We can now measure surplus more precisely than in Table 3, as we know the number of players remaining. As defined earlier, surplus is the sum of all remaining prizes minus the prizes that all remaining players are guaranteed (i.e., the sum of remaining prizes minus the lowest remaining prize multiplied by the number of remaining players).

Strikingly, the surplus does not affect the likelihood that a proposal will be accepted. Its estimated coefficient, while positive, is not significant in the top panel of Table 6. However, the size of the surplus is more important for predicting a discussion. The second tournament-level variable in Table 6, prize structure skewness, is marginally positively related to the acceptance of a proposal and significantly related to discussions.

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<sup>25</sup>As we show in the next section, equal split is one of two focal equilibria and occurs in some 30% of deals.

Both the amount at stake and skewness act in the same direction as in Table 3, which predicts deals at the tournament level, but the pattern of statistical significance is generally weaker in Table 6, at the proposal level. A possible explanation is that both variables are correlated with the number of proposals made in a given tournament. High-stakes tournaments and tournaments with a more skewed prize structure both have more proposals. By construction, only one of these proposals can lead to a deal and its corresponding realization of the dependent variable is one. There can be no agreement in earlier proposals, and the dependent variable (the indicator of completed deals) is zero for all prior proposals. Therefore, and because all these proposals have the same prize structure skewness and correlated surplus, our specifications may downplay the effect of tournament-level variables.

We now come to the subset of regressors related to the player who initiates the proposal. The results are generally consistent with those in the univariate comparisons in Table 5. Again, wealth matters. The more chips the proposer has, the more likely it is that the deal closes. When the number of chips of the proposing player is double the average, the deal is about 8% more likely than it would be if the proposer had the average amount. Chip stack size is similarly important in predicting the likelihood of a discussion.

This finding is important. Although the result may seem intuitive, it is difficult to explain it in the traditional modeling framework. Note that the terms of the deal are entirely up to the players and they could – and, as we show in the next section, indeed do – compensate richer players regardless of who starts the negotiations. We are not aware of any theoretical work that would predict that the characteristics of the player who initiates discussion are important for the proposal outcome.

The recent success of the proposing player (measured by the recent change in relative wealth) does not influence the probability of reaching an agreement, nor does it significantly affect the probability that the proposal will be discussed. If the proposer is a highly ranked player, the deal is 14% more likely to be accepted, but not more likely to be discussed. This stands in contrast to the univariate result in Table 5 that proposals made by ranked players are not more likely to be successful. The importance of being a highly ranked proposer is only apparent when we control for other variables.

Lastly, the time passed between the beginning of the final table and the proposal is longer for successful proposals than for unsuccessful ones. Of course, proposals that lead to an agreement are necessarily the last proposals made in a tournament, so this result is at least partially mechanical.

### 3 The division of surplus

In the previous section we investigated when proposals occur and when they are accepted. Here, we start with an accepted proposal and investigate how the surplus is shared. The main research question we address here is what determines bargaining power and the division of prizes.

There are two focal equilibria for the division of surplus. The first is an even division: Each remaining player gets the same amount. The second focal equilibrium is a proportional split: Each player first receives the lowest prize remaining in the tournament, and then the surplus is split proportionally according to the number of chips each player has.<sup>26</sup> Although this second focal point is a traditional way to split prizes in both online tournaments and physical casinos, it is generally not supported by any theoretical construction. Indeed, a proportional split can lead to bizarre outcomes that would never be agreed to by players.<sup>27</sup>

Neither of the above two types of division is a default option or is suggested by the online casino. However, players are comfortable enough with them to choose them in about one-third of the deals in our sample. The remaining one-third of cases are what we call “other” divisions. Players might start by considering one of the first two, and then one player may try to increase his share at the expense of other players. Sporadically, the “other” divisions are ad hoc, as players do not seem to begin their negotiation at either of the two focal equilibria. For example, a player may demand \$10,000 and propose that the other players split the remainder equally.

We begin by examining if the state of the game at the time the deal is struck and the characteristics of the original proposer influence the type of deal reached. We present the results in Table 7. The first columns present summary statistics for all deals and for even, proportional, and other divisions separately, while the last three columns report the differences between the types of division.

Equal splits occur relatively more frequently in smaller tournaments. This may be because, as shown in ultimatum games, players in general prefer equal sharing rules. When stakes are small, equal splits are cheaper to accept for players with more chips; in high-stakes tournaments, deviations from “fairness” due to an equal split are more costly, and players are more likely to negotiate a more complicated division. A similar observation holds for skewness. Skewness is high when the first prize is large compared with the second one. In such circumstances even small differences in the

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<sup>26</sup>Obviously, when all players have exactly the same number of chips, even and proportional divisions coincide.

<sup>27</sup>For example, in one of the tournaments in our sample, a proportional split was discussed and it turned out that such a division would have given more than the first prize money to the chip leader. This proposal was quickly renegotiated.

probability of obtaining the first prize may translate into substantial dollar amounts.

The second part of Table 7 focuses on the state of the game at the time of the successful proposal. Surprisingly, the number of players who participate in the deal is lower for equal splits than for other types of divisions. The average number of players is approximately 2.3 for equal splits and 2.8-2.9 for other types of deals; the medians are 2 for the former and 3 for the latter. The differences between the averages and between the medians are statistically significant. Equal divisions take place somewhat later than other deal types; the average time from the beginning of the final table to a deal is about 6 to 7 minutes (about 12%) longer for the former. This result is consistent with the fact that equal splits occur when fewer players remain in the tournament. Moreover, they occur when there is relatively little inequality in the chip distribution and when inequality has recently decreased. In such situations dividing the surplus equally is closer to a “fair” division.

Finally, we uncover little evidence that the characteristics of the proposing player influence the type of the deal. This is in striking contrast to our earlier finding that the identity of the proposer does affect the probability of agreement to a deal. Across different types of divisions, the wealth, ranking, and recent success of the proposer are very similar. There is perhaps some evidence that the proposer is more likely to be the chip leader when the equal split is agreed to, but the average relative wealth of that player is almost identical to the average wealth of the proposing player in any other kind of deal. Moreover, while the difference in the averages has a t-statistic of 1.97 for the chip leader dummy, the difference in medians is insignificant with a p-value of about 0.5.

We next describe how tournament participants share prizes in a deal, with the goal of empirically determining what influences players’ bargaining power and what factors help them gain a larger share of the surplus.<sup>28</sup> To compare the amounts players obtain in different tournaments, we construct a benchmark for expected value. The model and the probability calculations for this benchmark are described in Appendix B, where we also present some evidence that the model fits the data on tournament outcomes well.

Our model assumes away the strategic elements of the game, such as the ability to vary bets depending on the cards dealt or on other players’ actions. However, it enables us to compute a player’s probability of winning each of the remaining prizes and the expected payoff solely as a function of the number of chips each player has. Below, we discuss the robustness of our results to potential misspecification of the model.

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<sup>28</sup>For recent studies on the effect of individuals’ characteristics on bargaining power see Harding, Rosenthal, and Sirmans (2003) and Scott Morton, Zettelmeyer, and Silva-Risso (2004).

Table 8 relates the amount obtained in a deal to each player’s expected value and to his characteristics. We standardize the amount a player gets by the average amount awarded in the deal. Each observation corresponds to a player who took part in a deal. The total number of observations (1,019) is thus equal to the total number of players who participated in all deals in our sample.<sup>29</sup> Therefore, in each tournament with a division of prizes there is a dependence between observations corresponding to different players. For example, if we know the share of a player in a two-person deal, we can infer the share of the other player as well. Even with more players participating, knowing one of the shares enables us to at least put the bounds on the amount that other players can obtain. Thus, the effective number of observations we have is lower than 1,019. To correct the standard errors accordingly, we cluster them at the tournament level.

To make sure that the fitted values from the regression are logically consistent (i.e., that the predicted shares sum to one in each tournament), we demean both left- and right-hand side variables within each tournament and estimate the regression without the intercept. This way, for each tournament, the fitted values sum up to zero regardless of the estimated parameters, and thus coincide with the sum of the dependent variables (also demeaned tournament by tournament).<sup>30</sup>

We first test whether the terms of the deal are related to the expected value for each player. The univariate regressions show a very strong relation between the normalized expected value and the normalized payoff in the deal. Using this single variable, we explain 89% of the variation in our sample. However, the coefficient of expected value is significantly greater than one, which indicates that having many chips gives the player extra bargaining power to extract more value from the deal than his expected value of continuing to play. Of course, this extra value comes at the expense of players with smaller stacks. While Table 8 presents the estimates of the expected value coefficient, in an unreported analysis we find the same result when we use the fraction of chips a player has. This finding should be expected, because these two variables are highly correlated. Interestingly, when both enter the regression, only expected value is important and the number of chips becomes insignificant.

We find positive coefficients on both the small stack dummy and the chip leader dummy. (Recall that the regression already controls for player stacks via the expected value variable.) Thus, players at both ends of the chip distribution receive more in the deal, at the expense of players with medium

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<sup>29</sup>We lose one deal observation because we could not meaningfully identify the time the proposal was made; thus, we cannot identify the exact chip stacks on which the deal is based.

<sup>30</sup>We also estimate all regressions from Table 8 without demeaning the variables and with a constant term. This specification does not constrain the fitted values. All results are very similar to those from the constrained model.

stacks. One possible explanation for the premium to the small stack player is that he may find it relatively inexpensive to hold up the deal and use his veto power to extract rents.

The economic impact of the variables we consider here is sizable. For example, we find that the player who has the fewest chips earns as much as an additional 4% of the average share awarded. To put this amount into perspective, it corresponds to an additional \$565 in the average deal, and in the largest tournaments in our sample (with prize pools of more than \$100,000) the extra 4% is worth about \$1,700.

We also find evidence that recent increases in chips (over previous 10 hands) have a negative effect on a player's negotiated payoff. Any change in the number of chips is already captured in the expected value variable, but the regression suggests that the parties to the negotiation discount the value of the recently acquired chips of the "nouveau riche." This finding contrasts with the "hot hands" phenomenon (Gilovich, Vallone, and Tversky, 1985, or Croson and Sundali, 2005) which would predict an overweighing of recently acquired chips.

The regression also includes a dummy variable for the player who proposes the deal. The coefficient of this dummy is essentially zero. In other words, once we control for other player characteristics, we find no evidence that a player reveals negative information by proposing a deal.<sup>31</sup> This finding goes against the hypothesis that proposing signals high risk aversion, low skill, or impatience that would be penalized by other players when agreeing to the terms of the deal. It is particularly surprising in light of our previous result that the identity of the proposer affects the likelihood that a deal will be completed.

Ranked players achieve better outcomes in the deal. Controlling for other factors, they get an extra 2.5% of the average award. Combined with the results from previous tables, this finding suggests that highly ranked players may be somewhat less likely to propose a deal,<sup>32</sup> but they are typically ready to discuss terms. They demand a larger fraction of the pie, which is frequently not acceptable to other players (hence the high number of rejections with highly ranked players at the table; recall that the rejecting player is just as likely to be a top player as a random player in our

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<sup>31</sup>In a univariate specification, the proposer dummy is negative. Players who initiate discussion bear a penalty of about 1.5% of the average share. However, this effect seems to arise because proposers tend to be poorer than other players. When we control for wealth using expected values or chip stacks, the impact of the proposer dummy disappears.

<sup>32</sup>Perhaps because they derive more pleasure from playing, which makes ending the tournament less attractive from their point of view. Another possibility is that ranked players are skilled and have a higher probability of winning (which is not known to other players), or that they have a greater risk tolerance. In all these cases perceived gains to trade will be lower in the presence of highly ranked players. Additionally, skilled and unskilled players may differ in their notions of fair compensation for skill, thus hindering deals, as in Babcock and Loewenstein (1997).

sample<sup>33</sup>). In the deals that eventually get made, highly ranked players are able to extract sizable premiums for their (perceived) skill and fame.

In Regressions (4) through (8) we break up the analysis into two subsamples: deals between two players and deals between three or more players. (Of course, we cannot have dummies for both small stack players and chip leaders in the regressions limited to two-player deals.)

The most striking result is that for two-player deals, the coefficient of expected value is significantly lower than one, whereas in deals with three or more players it is significantly greater than one. Furthermore, in the two-player regression, the coefficient of the small-stack dummy suggests that the poorer player extracts an additional 1.4% from his counterparty. Thus, when bargaining occurs between two players, the richer player sacrifices some wealth in favor of the low stack player. This finding is reminiscent of the well-known result in two-person ultimatum games: More powerful players willingly deviate from the Nash equilibrium and cede part of the surplus to their partners. (See Roth, 1995, for a review of experimental results on the ultimatum and other bargaining games.)

The situation changes when more than two players remain in the game. In this case, the richest player extracts about 2% of the pie from the other players. At the same time, the player with the smallest stack also receives a premium, which means that players at both extremes of the wealth distribution are financed by the people in the middle.

Table 9 investigates whether the deviations of the terms of the deal from expected values are related to tournament characteristics. The dependent variable is the sum of the absolute values of the differences between each player's award  $c_i$  and his expected value  $EV_i$ , normalized by the total amount distributed:

$$\frac{\sum_{i=1}^n |c_i - EV_i|}{\sum_{j=1}^n c_j},$$

computed for each deal in our sample. The regressions are run on the cross-section of all tournaments that end with a deal. We compute t-statistics using heteroscedasticity-corrected standard errors.

Several variables highlighted in the previous analysis are again important here. The agreed upon deal differs from the expected values more when more players participate in the deal, when chips are unevenly distributed, and when the prize schedule is more skewed. Therefore, deal complexity increases deviations from the expected value, perhaps because of the difficulty of calculating expectations. Deviations from expected values decrease in the surplus available. When stakes are small,

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<sup>33</sup>In fact, in discussions that have multiple counterproposals (i.e., the most heated ones), the ranked players are less likely to be the rejectors.

players worry less about deviating, but for large stakes, deviations become more costly, and richer players may demand amounts that are closer to a “fair” value. Finally, in contrast with previous results on highly ranked players, the proportion of players that are highly ranked does not significantly affect the deviation from the expected value.

## 4 Discussion of results

Before discussing the results, it is necessary to understand the role of bargaining in our context. Deals are made to reduce the risk inherent in playing tournaments to the end. Gains to trade arise when the amount to be distributed exceeds the value of the outside option (i.e., the certainty equivalent of the possible outcomes faced by the player). The force driving the gains to trade is risk aversion, and our observation that deals occur indicates that at some point risk aversion is stronger than the pleasure of continuing the game.<sup>34</sup> Our analysis begins at that stage. We describe the circumstances in which the gains to trade reach the critical level and a deal is proposed and then accepted, as well as how the gains are distributed among the players.

In general, when multiple parties negotiate the division of an asset, any division of surplus can be an equilibrium (see Edgeworth, 1881). In the Nash (1950) model, the surplus is divided according to the parties’ relative bargaining power. In a multiperiod setting, a discount factor is often modeled to reflect the deadweight cost of delaying the deal (e.g. Rubinstein, 1982). In our case, the cost of a delayed deal, as well as the cost of not completing a deal at all, is the risk to players who face an uncertain outcome. We study the characteristics of the environment (e.g., wealth inequality) and the players (e.g., recent success) to determine when and how players share the surplus. Our findings shed light on what determines bargaining power – an elusive concept that is often taken exogenously in bargaining theory.

Deals are more likely to be proposed and agreed to when the gains to trade are highest. The most obvious factor affecting the gains to trade is the magnitude of the monetary prizes. We find that the likelihood of completing a deal is indeed increasing in the total prize pool, but with a surprising caveat. It turns out that the size of the prizes only matters when the amount at stake is very large. Specifically, when the total prize pool is below \$100,000 (corresponding to a first prize of about \$25,000 and a second prize of roughly half that), we find no relation between the size of the

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<sup>34</sup>Alternatively, players could behave as in Friedman and Savage (1948). They may be risk seeking over small payoffs, but as the per-player surplus increases, they become risk averse and prefer to stop the tournament early.

prize pool and the probability that a deal will be achieved (even if we take point estimates at face value, their economic impact is tiny). Only when we include the highest stakes tournaments does the relation emerge. This finding is robust across all specifications we have tried.

This result has important implications for experimental studies. It turns out that the effect of stakes is quite complicated. Incentives are indeed affected by the amount at stake, but the relationship does not appear to be linear and may emerge only when the stakes become very large.

Other variables related to gains to trade are also important. For example, the likelihood of a deal increases with the skewness of the prize structure. If the distance between the top and lower prizes is substantial, coming in second (or lower) carries a more severe monetary penalty. Players are more likely to agree to split the prizes in such a situation. This finding indicates that in our setting, risk aversion is more important than a preference for skewness.<sup>35</sup> If players like skewness, the gains to trade – and hence their willingness to deal – should be decreasing in the skewness of the prize structure. We observe the opposite effect in our data.

The number of remaining players plays a key role in initiation and success of bargaining. Proposals are more likely to occur and lead to a deal when there are few players remaining in the game. In fact, approximately half of the completed deals in our sample involve two players only. Although we occasionally observe deals between as many as six or seven players, such situations are rare and account for a small percentage of deals in our sample. Moreover, proposals are often made immediately after a player is eliminated, that is, after the number of players that must agree to a deal is reduced. We interpret these findings as evidence that players anticipate difficulties in coming to an agreement in a larger group (recall that a decision to make a deal must be unanimous). Consequently, when many players remain players are reluctant to propose a deal, and even if a proposal is made, it is often unsuccessful.

Moreover, we observe that negotiations and deals are more likely when players' wealth is about equal. This effect may be driven by players' preference for "fair" divisions of surplus: In about 30% of all deals we observe in our sample, an equal split is chosen. As inequality in the number of chips increases, this kind of division becomes less attractive for players with more chips, and such players are more likely to oppose deal-making.

The richness of our data enables us to study how player characteristics affect bargaining power. First, characteristics are more important than standard bargaining theory implies. For instance, the

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<sup>35</sup>Golec and Tamarkin (1998) find the stronger effect for skewness preference in the context of horse race betting.

identity of the person who proposes the discussion matters for the likelihood of reaching success. While most proposals are made by relatively poorer players, the more chips the proposer has, the more likely it is that a deal will take place. This effect, while perhaps in line with common wisdom, is difficult to explain. The terms of the deal are entirely up to the players, who can compensate the rich players regardless of who originally proposed the division.

Second, the fact that a player suggests a deal does not change that player's payoff once we control for his wealth and recent success. This finding conflicts with our a priori expectation that proposers reveal that they are particularly eager to terminate the game and may be willing to sacrifice a part of their monetary payoff to achieve that goal. While this result (from Table 8) is based on our model of expected value, described in Appendix B, it is also supported by "nonparametric" evidence in Table 7. If proposers were systematically hurt, we would observe that the average wealth of the proposing player is lower in proportional deals (which favor richer players) than in equal deals (which hurt richer players). In fact, the average wealth of the proposer is almost the same for these two types of divisions.

Third, player characteristics matter for the terms of the division. We observe an interesting relationship between the wealth (i.e., chip stack) of each player and the amount he receives in a deal. In general, players at the extremes of the wealth distribution (richest and poorest players) are compensated beyond their expected values at the expense of the players in the middle. Interestingly, when there are only two players, the poorer one is able to extract a surplus from the richer one. Again, this result follows from Table 8 and the model for the expected value. However, additional "model-free" evidence can be inferred from Table 7. Equal divisions are more likely when only two players remain in the game and such division will hurt the richer party. On the other hand, proportional divisions are usually made with more than two players remaining; in such situations, proportional divisions favor rich players beyond their expected payoffs.<sup>36</sup> The fact that the richest player loses some of his bargaining power in two-person negotiations suggests that the hold-up problem changes between two- and more-than-two-player bargaining. We think that this finding is particularly interesting and deserving of further study, especially because most of the existing experimental evidence is limited to two-player bargaining games.

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<sup>36</sup>As an extreme example, suppose that with three players remaining one player holds 99% of chips. Under a proportional division, each player would first receive the third prize, but the chip leader would also get 99% of the remaining prize money, likely giving him more than the first prize money in total.

## 5 Conclusion

We use a unique data set to investigate the factors that influence the start and outcome of negotiations and the division of surplus. We consider high-stakes poker tournaments in which players can agree to a negotiated division of the prizes instead of playing until the end. The data set combines significant real-life bargaining with almost laboratory-like conditions and is rich enough that we can control for a variety of both environment- and player-specific characteristics. We investigate all aspects of bargaining, from the initiation of a discussion to the terms of a successfully completed deal.

Although the data in this paper comes from poker tournaments, there are many other contexts in which similar bargaining can arise. For example, in litigation, parties can choose to come to a negotiated settlement rather than risk the ruling of a court. More generally, in any commercial transaction, parties can negotiate a deal or, as an outside option, face the uncertainty of finding another partner with whom to strike a deal.

Economic agents who appear in our sample are obviously not representative of the population at large. Their preference for games of chance (revealed by paying to participate in tournaments) may be behind some of our findings, such as a perhaps surprisingly low frequency of deals. At the same time, players in our sample probably have a better grasp of the game and more experience with it. Moreover, agents in other situations often display a tendency to disregard risks and “keep playing.” Managers of failing companies may take excessive risks rather than negotiate with their creditors, plaintiffs may insist on exaggerated payoffs which make out-of-court settlement less likely, and so forth. All in all, we see no reason why preference for games of chance would drive the main findings of this paper (that the identity of the proposer matters for the success of negotiations, that proposers are not disadvantaged in the terms of the split, the behavior of the “richest” player, and so forth). Our results should not be viewed solely in the narrow context of poker tournaments, but instead as providing insights into when and how economic agents negotiate.

Some of our findings can not be easily explained by the existing literature. For example, we are not aware of theoretical work that can explain our results on when bargaining is initiated or on how the proposing agent’s characteristics impact whether an agreement is reached. Similarly, the importance of the number of parties in bargaining, both in completing a deal and in the division of surplus, has received relatively little attention. We hope that our results motivate further investigations into bargaining and bargaining power.

## Appendix A: Data acquisition

We obtain the data in real time by observing large online poker tournaments. The basic information about tournaments (e.g., prize pool, buy-in fee, number of players) is obtained automatically. We developed a program that records the results of each hand, including the chip stack of each player at every point in time.

All communication among players, casino support personnel, and observers (kibitzers) occurs in the form of “chat,” or real-time exchange of typed messages. We record all chat that takes place at the final table of tournaments in our sample. We inspect all chat transcripts to extract information about proposals, negotiations, and the final deal. Because no formal structure is imposed on the negotiating players, this process is very labor intensive. We begin with scanning the transcript for keywords that appear frequently when players propose a deal. Such keywords include the words “deal,” “chop,” “split,” “talk,” and “numbers.” We use an extensive list of keywords to ensure that we pinpoint the beginning of negotiations, but there could be some tournaments in which we do not capture the exact time of the first proposal, but instead the timing of one of the further rounds of negotiation. This limitation exists because players may signal their willingness to deal with words that are not in our keyword lists (perhaps because they use slang, jargon, or words in a foreign language).

After identifying the beginning of the negotiation, we read through the transcript to record the details about who first proposed the deal, on what terms (if they are already specified at such an early stage), who responded, and what the response was (willing to discuss, rejected, ignored). When all players remaining in a tournament agree to discuss a potential deal, they call support, that is, employees of the online casino, who enforce the terms of the deal. Support staff pause the tournament clock and facilitate the discussion, for example by computing the monetary awards implied by the deal (e.g., by a 50-35-15 split of the prize pool or a proportional split) but are not allowed to interfere with the negotiations or influence the players. When players reach a tentative agreement, support confirms the monetary awards, and each player must type “I agree” to confirm that they agree with the proposal. If all players agree, the deal is final and cannot be renegotiated. If at least one player vetoes the proposal, the deal is rejected, and players either continue negotiating or restart the game to play out the tournament until the end (or possibly discuss a deal again at a later stage).

Chat analysis is a manual process that involves a large volume of data. (The chat transcript from the final table of a tournament typically involves about 500 lines of chat and dealer or administrator

messages, though some tournaments include lively observer chat and their transcripts could have thousands of lines of text.) Although it is possible that we missed some early proposals, it is very unlikely that we missed negotiations that involve longer discussions and virtually impossible that we missed any completed deals. The process of sealing the deal is formalized to ensure that there are no ambiguities about who accepts and who rejects. In completed deals, all players type “I agree” when support prompts them to do so. Such a prompt always contains the word “agree,” so we are confident that we successfully identify all negotiations that are in an advanced stage and, importantly, all deals actually made.

After we gather the data, we carry out multiple checks to verify that different pieces of information are compatible and catch potential mistakes. For example, we verify that the proposed or agreed deal involves exactly as much money as the total prize money still available. We also verify that the players we record as those who proposed, responded to or agreed to a deal are still active (i.e., not eliminated) at the time.

## Appendix B: Expected value of the tournament

We use the Independent Chip Model (ICM) to measure the expected value to each player of continuing the tournament. ICM is used by more sophisticated players to estimate the marginal value of a chip when making strategic decisions. While imperfect, it is considered the best available model that can be applied to general situations.<sup>37</sup> Below we present the model and compare its predictions to the empirically observed outcomes of tournaments that did not end prematurely with a deal.

Suppose that there are  $n$  players remaining and that player  $i$  has  $s_i$  chips. The total number of chips in the game is  $S = \sum_i s_i$ . Each chip is viewed as a lottery ticket to win the tournament. Thus, the probability of player  $i$  winning first place is  $s_i/S$ . (In the two-player game, this is the solution to the well known gambler’s ruin problem.) After first prize is drawn, second prize is drawn from the remaining lottery tickets (excluding those of the first prize winner), so that the probability of winning second prize is the number of chips a player has divided by the total number of remaining chips. Lower ranked prizes are sequentially awarded in the same manner.

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<sup>37</sup>See Nelson, Streib, and Lee (2007) for a more in-depth discussion of ICM and comparisons to simulations of other models.

This leads to the following probabilities:

$$\begin{aligned}
\Pr(i \text{ wins first}) &= \frac{s_i}{S}. \\
\Pr(i \text{ wins second}) &= \sum_{j \neq i} \Pr(j \text{ wins first}) \times \Pr(i \text{ wins second} | j \text{ first}) \\
&= \sum_{j \neq i} \frac{s_j}{S} \times \frac{s_i}{S - s_j}. \\
\Pr(i \text{ wins third}) &= \sum_{j \neq i} \sum_{k \neq i, j} \Pr(j \text{ wins first}) \times \Pr(k \text{ wins second} | j \text{ first}) \\
&\quad \times \Pr(i \text{ wins third} | j \text{ first, } k \text{ second}) \\
&= \sum_{j \neq i} \sum_{k \neq i, j} \frac{s_j}{S} \times \frac{s_k}{S - s_j} \times \frac{s_i}{S - s_j - s_k}.
\end{aligned}$$

The probabilities of fourth and lower places are computed similarly. The expected value can be calculated using these probabilities and the tournament prizes.

Of course, the model abstracts away from many of the features of poker, for example, it implicitly assumes a fixed the bet size and player strategies that do not depend on other players' actions. However, the equations have a simple and appealing intuition.

Most importantly, the model fits the data well when we compare it to the actual outcomes of tournaments. Figure 1 presents the comparison between the model's predictions of a player's final rank in a tournament and empirically observed frequencies of outcomes. We consider all tournaments without a deal and compute model-implied probabilities of a particular outcome using the chip stacks observed the first time only two players remain (top row) or only three players remain in the tournament (two bottom rows). We divided theoretical probabilities into 20 bins, each covering 5% of possible values. The left column of Figure 1 presents a histogram summarizing the number of tournaments that fall within each bin.<sup>38</sup> The right column plots the theoretical probability of taking first place (or one of the top two places) against the frequency of that event actually occurring, computed using tournaments within each bin.<sup>39</sup> Figure 1 indicates that the model describes the empirical frequencies well, at least for two and three players (recall that the majority of deals occur with two or three players remaining).

To further investigate this result, we considered the following test. Let  $y_i$  be a binary variable that

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<sup>38</sup>The bi-modality of the histogram obtained for two players is driven by deal making. Players tend to make deals when their chip stacks and hence the probabilities of winning the tournament are similar. Tournaments with deals are not included in the analysis here.

<sup>39</sup>We also obtained similar graphs by estimating the relationship nonparametrically, using local linear regression.

takes value 1 if a given player takes first place (or one of the top two places). For each tournament, we compute squared deviations of that variable from model-implied probabilities. The average of squared deviations is a measure of how well our model describes the data. Under the null hypothesis that the model holds, we calculate the expected value and variance of each squared deviation and standardize it accordingly. By the central limit theorem, the average of the standardized quantities is asymptotically standard normal.<sup>40</sup> For two players and for the probability of taking first place, the test statistic is -0.497. For three player remaining and the probability of taking first place (or one of the top two places), the test statistic is -0.247 (0.156). Hence, we cannot reject the null hypothesis that the ICM model proposed here holds.

A different model (a generalization of the gambler's ruin problem) could be as follows: With  $n$  players remaining, each wins a hand with probability  $1/n$ . The winning player increases his chip stack by  $n - 1$ , and all others lose one chip. When a player's stack is reduced to zero he is eliminated, and the game continues with  $n - 1$  players. This process is repeated until only one player remains. Unfortunately, to the best of our knowledge, this well-known model has not been solved for the general case of  $n$  players.<sup>41</sup> For this reason, we use the first model to calculate expected values. Luckily, simulations show that the two models give similar probabilities and identical outcomes in the two-player game.

An alternative approach would be to use the empirical probabilities of outcomes as a benchmark. However, the probability of a player finishing in any particular position potentially depends on the entire vector of chip stacks of all remaining players. For more than two players, meaningful estimates of the probabilities of finishing in each position would require far more data than we presently have.

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<sup>40</sup>We compute the test statistic using one player from each tournament (the player with the lowest seat number; seat numbers are assigned randomly), which gives us an i.i.d. sample of players.

<sup>41</sup>See Bruss, Louchard, and Turner (2003). Swan and Bruss (2006) propose a solution for the probability that a player is the first eliminated, but not for the probabilities of finishing in any other position.

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**Table 1. Summary statistics.** This table presents summary statistics for the tournaments in our sample. Prize pool is the total value of all prizes awarded in the tournament. Final nine prizes is the total of prizes paid to players who reach the final table. Buy-in is the amount paid by each player to participate in the tournament. Number of players is the total number of tournament participants. Tournament duration is measured in hours from the start of the tournament until the finish. Final table time is measured in minutes from the start of the final table until the end of the tournament.

	Avg	Std	5th perc	Median	95th perc
# of tournaments	1,246				
Prize pool (\$000)	82.0	171.3	17.2	47.9	206.4
Final 9 prizes (\$000)	51.6	75.1	12.2	32.5	144.1
(% of prize pool)	70.7				
1st prize (\$000)	17.6	26.9	4.1	11.3	48.7
(% of final 9 prizes)	33.8				
2nd prize (\$000)	10.3	14.1	2.4	6.2	27.8
(% of final 9 prizes)	20.0				
Buy-in	77.5	107.2	5.5	55.0	215.0
# of players	947	1,295	154	750	2,104
Tournament duration (hrs)	6.4	1.3	4.7	6.3	8.5
Final table time (min)	70	23	38	67	112

**Table 2. Tournament characteristics in tournaments with and without deals.** This table presents tournament statistics broken up according to the result of any deals. All tournaments are comprised of those in which (i) a deal was completed, (ii) a deal was proposed but not completed, or (iii) there was no proposal. Among tournaments in which there was an unsuccessful proposal, we separate out those in which a proposal was discussed (i.e., the proposal was not ignored but rather there was at least a reply to the proposal, ). For each subset, we report a summary of the main tournament characteristics. Prize skewness is computed by applying the usual skewness formula to the top nine prizes. Ranked players are players who are among top 200 players on the ranking list described at the end of Section 2.2. “Repeat offenders” are players who appear in our sample of final tables more than once. Number of proposals is the number of separate attempts to discuss a deal made at the final table. FT stands for final table.

	All tournaments	Completed Deals	Deal proposed and discussed but not completed	Deal proposed but not completed	No deal proposed
# of tournaments	1,246	386	243	429	431
Fraction of total	100%	31%	19.5%	34.4%	34.6%
Prize pool (\$000), avg	82.0	109.1	83.4	74.4	65.4
Prize pool (\$000), med	47.9	50.0	51.6	50.8	44.1
Prize pool (\$000), std	171.3	249.8	148.7	117.5	119.7
Final 9 prizes (\$000), avg	51.6	61.0	53.6	49.7	45.2
Final 9 prizes (\$000), med	32.5	32.5	34.5	34.1	31.3
Final 9 prizes (\$000), std	75.1	102.2	77.3	63.1	53.5
Prize1-Prize2 (\$), avg	7,355	9,294	7,743	6,985	5,988
Prize1-Prize2 (\$), med	4,700	5,050	5,130	5,130	4,190
Prize1-Prize2 (\$), std	12,970	18,009	13,425	10,650	8,853
Prize skewness, avg	1.338	1.375	1.348	1.341	1.300
Prize skewness, med	1.325	1.388	1.355	1.354	1.230
Prize skewness, std	0.123	0.120	0.124	0.123	0.114
Buy-in, avg	77.5	75.4	80.1	78.2	78.8
Buy-in, median	55.0	22.0	55.0	55.0	109.0
Buy-in, std	107.2	119.3	126.6	113.6	87.4
# of players, avg	947.1	1,256.4	1,028.1	930.9	686.2
# of players, med	750.0	970.0	832.0	767.0	372.0
# of players, std	1,295.0	1,621.3	1,684.0	1,332.3	762.5
Ranked players at FT, avg	0.7	0.5	0.7	0.7	0.8
Ranked players at FT, med	0	0	0	0	0
Ranked players at FT, std	1.0	0.8	1.0	1.0	1.1
Repeat offenders at FT, avg	4.8	4.5	4.8	4.8	5.1
Repeat offenders at FT, med	5	4	5	5	5
Repeat offenders at FT, std	2.1	2.0	2.0	2.1	2.1
# of proposals, avg	1.2	1.8	2.0	1.7	0
# of proposals, med	1	2	2	1	0
# of proposals, std	1.2	1.1	1.2	1.1	0

**Table 3. Probability of a deal as a function of tournament characteristics.** This table presents the estimated marginal effects of a logit model that relates the probability of achieving a deal (Panel A) or discussing a proposal (Panel B) to tournament characteristics. T-statistics are obtained using robust standard errors and are reported in parentheses. Each panel presents full sample estimation results, as well as results obtained for the subsample of tournaments with prize pools lower than \$100,000. The last column reports the fraction of deals (Panel A) or discussions (Panel B) for each specification considered. Independent variables are as defined in Tables 1 and 2. \*\*\*, \*\*, and \* denote that an estimate is significant at the 1%, 5%, and 10% level, respectively.

PANEL A: Probability of Achieving a Deal (logit)

	all tournaments						prize pool < \$100K	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log(prize1-prize2)	0.049*** (2.95)		0.025 (1.45)	0.026 (1.47)	0.047** (2.51)	0.096*** (3.36)	0.015 (0.56)	0.036 (0.89)
Log(top 9 prizes)		0.023 (1.29)						
Prize1/prize2			0.460*** (6.34)					
Prize skewness				0.746*** (6.85)	0.569*** (4.60)	0.293* (1.68)		0.386** (1.97)
Ranked players at final table					-0.050*** (-2.92)	-0.051*** (-2.95)		-0.051** (-2.30)
log(buy-in)						-0.044** (-2.26)		-0.047** (-2.30)
Pseudo $R^2$	0.006	0.001	0.031	0.036	0.042	0.045	0.000	0.051
$N$	1,246	1,246	1,246	1,246	1,246	1,246	1,045	1,045
% deals	31.0%	31.0%	31.0%	31.0%	31.0%	31.0%	29.6%	29.6%

PANEL B: Probability of Discussing a Proposal (logit)

	all tournaments						prize pool < \$100K	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log(prize1-prize2)	0.066*** (3.64)		0.041** (2.12)	0.040** (2.09)	0.062*** (2.86)	0.112*** (3.43)	0.031 (1.01)	0.042 (0.91)
Log(top 9 prizes)		0.034* (1.84)						
Prize1/prize2			0.573*** (6.79)					
Prize skewness				0.891*** (7.27)	0.732*** (5.32)	0.453** (2.39)		0.542** (2.55)
Ranked players at final table					-0.043** (-2.46)	-0.044** (-2.50)		-0.034 (-1.61)
Log(buy-in)						-0.045** (-2.09)		-0.050** (-2.21)
Pseudo $R^2$	0.007	0.002	0.035	0.039	0.043	0.045	0.001	0.045
$N$	1,246	1,246	1,246	1,246	1,246	1,246	1,045	1,045
% deals	31.0%	31.0%	31.0%	31.0%	31.0%	31.0%	29.6%	29.6%

**Table 4. State of the game and player characteristics at the time of a proposal is mode or rejected.** The top half of this table compares the state of the game at the time a proposal is made to a benchmark averaged over all hands of tournaments without a proposal. The bottom half compares the player who made the proposal and the player who rejected a proposal to the benchmark at the time of the proposal or rejection, respectively. T-statistics of differences are based on robust standard errors clustered at the tournament level, and are reported in parentheses. The Gini coefficient is computed using the number of chips each remaining player has. The number of ranked players is normalized by dividing by the number of remaining players. Chip leader dummy is an indicator variable for whether a given player has the most chips at the table, and is normalized by subtracting  $1/n$ .  $s_i$  is the number of chips a given player has, and  $\bar{s}_i$  is the average number of chips per player at the table. The number of hands a player has recently won is divided by the average number of hands won by all remaining players. Ranked player dummy is equal to 1 when the player is among the top 200 players in the ranking described in Section 2.2. Number of players eliminated, change in the Gini coefficient, change in a player's chip stack, and the number of hands a player has won are computed over the 10 hands preceding the given hand. \*\*\*, \*\*, and \* denote that an estimate is significant at the 1%, 5%, and 10% level, respectively.

	Non-proposals (benchmark)	All proposals	Proposals - benchmark	Rejected proposals	Rejections - benchmark
State of the game					
# of remaining players	4.889	3.663	-1.227*** (-18.89)	3.561	-1.329*** (-15.09)
Gini coefficient	0.349	0.272	-0.077*** (-12.81)	0.283	-0.065*** (-7.49)
$\Delta$ Gini (last 10 hands)	0.007	-0.074	-0.081*** (-17.51)	-0.064	-0.071*** (-8.79)
# of players eliminated (last 10 hands)	0.582	1.036	0.454*** (17.98)	1.084	0.502*** (11.70)
# of ranked players/n	0.101	0.063	-0.037*** (-3.83)	0.073	-0.028** (-2.35)
Time since start of final table (min)	38.019	48.164	10.145*** (9.33)	48.915	10.895*** (7.26)
Player characteristics					
	Benchmark	Proposer	Proposer - benchmark	Rejector	Rejector - benchmark
Chip leader dummy (normalized)	0	-0.072	-0.072*** (-6.28)	0.113	0.113*** (5.65)
$s_i/\bar{s}$	1	0.926	-0.074*** (-6.11)	1.111	0.111*** (5.51)
$\Delta(s_i/\bar{s})$ (last 10 hands)	0	-0.113	-0.113*** (-10.54)	-0.172	-0.172*** (-8.63)
hands won/ avg(hands won) (last 10 hands)	1	0.994	-0.006 (-0.41)	1.066	0.066*** (2.78)
Ranked player dummy	0.101	0.048	-0.053*** (-5.32)	0.120	0.019 (1.53)

**Table 5. Success of a proposal versus state of the game and proposing player characteristics.** The unit of observation in this table is the proposal. Proposals are divided into those agreed to and those not accepted. Not accepted proposals are further divided into those that were discussed and rejected and those that were ignored. Values presented here are averages computed at the time of a proposal. T-statistics, based on robust standard errors clustered at the tournament level, are reported in parentheses. Variables presented in this table are as defined in Table 4. \*\*\*, \*\*, and \* denote that an estimate is significant at the 1%, 5%, and 10% level, respectively.

	Accepted proposals (A)	Not accepted (N)	Discussed and rejected (D)	Ignored (I)	A-N	A-D	D-I
# of observations	386	1,067	499	568			
State of the game							
# of remaining players	2.687	4.016	3.523	4.449	-1.329*** (-17.64)	-0.837*** (-9.78)	-0.926*** (-8.39)
Gini coefficient	0.201	0.298	0.284	0.310	-0.097*** (-10.75)	-0.084*** (-7.99)	-0.026*** (-2.60)
$\Delta$ Gini (last 10 hands)	-0.144	-0.047	-0.063	-0.032	-0.097*** (-9.14)	-0.081*** (-6.63)	-0.031*** (-3.03)
# of players eliminated (last 10 hands)	1.070	1.023	1.088	0.962	0.047 (0.97)	-0.018 (-0.32)	0.126** (2.34)
# of ranked players/n	0.039	0.072	0.071	0.073	-0.033*** (-3.98)	-0.032*** (-3.27)	-0.001 (-0.15)
Time since start of final table (min)	58.835	44.304	48.927	40.243	14.531*** (10.30)	9.908*** (6.20)	8.684*** (6.12)
Proposing player characteristics							
Chip leader dummy (normalized)	-0.050	-0.081	-0.083	-0.079	0.031 (1.16)	0.033 (1.09)	-0.004 (-0.15)
$s_i/\bar{s}$	0.990	0.903	0.928	0.882	0.086*** (4.25)	0.062*** (2.64)	0.046* (1.68)
$\Delta(s_i/\bar{s})$ (last 10 hands)	-0.123	-0.110	-0.101	-0.117	-0.013 (-0.55)	-0.021 (-0.78)	0.016 (0.67)
hands won/ avg(hands won) (last 10 hands)	1.006	0.990	1.027	0.955	0.017 (0.62)	-0.021 (-0.65)	0.071** (2.12)
Ranked player dummy	0.042	0.050	0.038	0.060	-0.008 (-0.67)	0.003 (0.26)	-0.022* (-1.65)

**Table 6. Probability of success of a proposal as a function of state of the game and proposing player characteristics.** This table presents estimated marginal effects of a logit model that relates the probability of achieving a deal (Panel A) or discussing a proposal (Panel B) to tournament, proposal, and proposing player characteristics. T-statistics, based on robust standard errors clustered at the tournament level, are reported in parentheses. Surplus is the sum of all remaining prizes at the time of the proposal minus  $n$  times the  $n$ th prize. Time to proposal is the number of minutes from the beginning of the final table until the proposal. All other independent variables are as defined in Tables 1, 2, and 4. The number of observations varies for different specifications because some of the variables can not be computed (e.g., if a proposal occurs within the first 10 hands of the final table, the change in the Gini coefficient can not be computed). The last row reports the fraction of deals (Panel A) or discussions (Panel B) for the available sample in each specification. \*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% level, respectively.

PANEL A: Probability of Making a Deal (logit)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log(# remaining players)	-0.398*** (-14.62)	-0.399*** (-14.50)	-0.361*** (-12.74)	-0.362*** (-11.21)	-0.386*** (-11.09)	-0.374*** (-11.99)	-0.295*** (-8.82)	-0.386*** (-6.64)
# of ranked players/n		-0.308*** (-3.82)	-0.326*** (-3.99)	-0.342*** (-3.96)	-0.318*** (-3.73)	-0.446*** (-4.00)	-0.324*** (-4.04)	-0.443*** (-3.90)
Gini coefficient			-0.550*** (-8.00)	-0.535*** (-5.42)	-0.558*** (-8.10)	-0.550*** (-7.48)	-0.523*** (-7.76)	-0.489*** (-4.97)
$\Delta$ Gini				-0.083 (-0.93)				-0.097 (-1.11)
# of players eliminated (last 10 hands)				0.018 (1.20)				0.041*** (2.65)
# of previous proposals				0.021 (0.87)				-0.015 (-0.62)
Log(surplus)					0.014 (1.05)			0.003 (0.21)
Prize skewness					0.182* (1.89)			0.183* (1.87)
$s_i/\bar{s}$ (proposer)						0.083** (2.51)		0.076** (2.32)
$\Delta(s_i/\bar{s})$ (proposer)						-0.004 (-0.13)		0.005 (0.15)
Ranked player dummy						0.139** (2.04)		0.143** (2.07)
Log(time to proposal)							0.090*** (3.00)	0.141*** (4.31)
Pseudo $R^2$	0.122	0.132	0.172	0.163	0.176	0.167	0.179	0.182
$N$	1,453	1,453	1,453	1,401	1,453	1,399	1,453	1,399
% deals	26.6%	26.6%	26.6%	27.5%	26.6%	27.4%	26.6%	27.4%

Table 6, continued

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log(# remaining players)	-0.419*** (-12.83)	-0.421*** (-12.87)	-0.404*** (-12.28)	-0.357*** (-9.41)	-0.488*** (-11.18)	-0.400*** (-10.98)	-0.361*** (-7.99)	-0.384*** (-6.18)
# of ranked players/n		-0.200** (-2.41)	-0.215** (-2.55)	-0.216*** (-2.60)	-0.220** (-2.49)	-0.165* (-1.69)	-0.211** (-2.53)	-0.160 (-1.55)
Gini coefficient			-0.468*** (-5.37)	-0.420*** (-3.47)	-0.486*** (-5.62)	-0.416*** (-4.84)	-0.460*** (-5.28)	-0.370*** (-3.04)
$\Delta$ Gini				-0.153 (-1.35)				-0.157 (-1.38)
# of players eliminated (last 10 hands)				0.044** (2.57)				0.064*** (3.34)
# of previous proposals				0.091*** (2.95)				0.052 (1.63)
Log(surplus)					0.050*** (2.77)			0.039** (2.00)
Prize skewness					0.353*** (2.84)			0.304** (2.42)
$s_i/\bar{s}$ (proposer)						0.078** (2.23)		0.080** (2.22)
$\Delta(s_i/\bar{s})$ (proposer)						0.027 (0.73)		0.046 (1.15)
Ranked player dummy						-0.064 (-0.85)		-0.070 (-0.91)
Log(time to proposal)							0.044 (1.50)	0.080** (1.96)
Pseudo $R^2$	0.098	0.101	0.116	0.113	0.127	0.107	0.118	0.128
$N$	1,453	1,453	1,453	1,401	1,453	1,399	1,453	1,399
% deals	60.9%	60.9%	60.9%	62.4%	60.9%	62.3%	60.9%	62.3%

**Table 7. Tournament, proposal, and proposer characteristics at the time of a deal.** Deals are comprised of those that were equal divisions (E), proportional divisions (D), and others (O). This table presents averages and differences in averages, as well as t-statistics (reported in parentheses and obtained using robust standard errors) for the tournament, proposal, and proposing player characteristics. Amount divided is the sum of the remaining prizes divided in a deal. Surplus per player is the average value of the remaining prizes minus the lowest remaining prize. Other variables are as defined in Tables 1, 2, and 4. \*\*\*, \*\*, and \* denote that an estimate is significant at the 1%, 5%, and 10% level, respectively.

	All deals	Equal (E)	Proportional (P)	Other (O)	E-P	E-O	P-O
# of deals	386	126	136	124			
% of total	100.00	32.64	35.23	32.12			
Tournament characteristics							
Amount divided, \$000	37.319	22.399	49.516	39.103	-27.117*** (-3.60)	-16.704*** (-2.86)	10.413 (1.13)
Surplus per player, \$000	5.146	2.898	7.050	5.342	-4.152*** (-3.64)	-2.445*** (-2.95)	1.708 (1.24)
Prize1-Prize2, \$000	9.294	5.252	12.821	9.533	-7.570*** (-3.50)	-4.282*** (-2.73)	3.288 (1.25)
Buy-in	75.355	62.163	87.911	74.990	-25.748** (-1.99)	-12.827 (-0.90)	12.922 (0.76)
Prize skewness	1.375	1.344	1.388	1.393	-0.044*** (-2.99)	-0.049*** (-3.28)	-0.005 (-0.31)
State of the game							
# of remaining players)	2.648	2.262	2.794	2.879	-0.532*** (-5.97)	-0.617*** (-5.81)	-0.085 (-0.73)
Gini coefficient	0.201	0.096	0.226	0.279	-0.130*** (-9.21)	-0.183*** (-11.39)	-0.053*** (-3.02)
$\Delta$ Gini (last 10 hands)	-0.144	-0.244	-0.116	-0.071	-0.127*** (-6.17)	-0.172*** (-8.01)	-0.045** (-2.19)
# of players eliminated (last 10 hands)	1.070	1.032	1.081	1.098	-0.049 (-0.49)	-0.066 (-0.66)	-0.017 (-0.17)
# of ranked players/n	0.039	0.028	0.047	0.042	-0.019 (-1.20)	-0.014 (-0.89)	0.006 (0.31)
Time since start of final table (min)	58.835	63.324	57.121	56.153	6.203** (2.16)	7.171** (2.32)	0.968 (0.33)
Proposing player characteristics							
Chip leader dummy (normalized)	-0.050	0.003	-0.111	-0.036	0.113** (1.97)	0.038 (0.63)	-0.075 (-1.35)
$s_i/\bar{s}$	0.990	0.989	0.987	0.993	0.002 (0.07)	-0.004 (-0.10)	-0.006 (-0.13)
$\Delta(s_i/\bar{s})$ (last 10 hands)	-0.123	-0.115	-0.125	-0.128	0.010 (0.19)	0.013 (0.25)	0.003 (0.07)
hands won/ avg(hands won) (last 10 hands)	1.006	1.022	1.020	0.975	0.002 (0.03)	0.047 (0.94)	0.046 (0.83)
Ranked player dummy	0.042	0.040	0.044	0.040	-0.004 (-0.17)	-0.000 (-0.01)	0.004 (0.15)

**Table 8. Terms of a deal as a function of player characteristics.** This table reports regression coefficients relating the amount each player obtains in a deal (standardized by the average amount obtained),  $c_i/\bar{c}$ , to player characteristics. For each tournament, fitted values must sum up to the same value as the dependent variable, so each variable is demeaned at the tournament level and the regressions are estimated without a constant term. T-statistics, based on robust standard errors, are clustered at the tournament level and are reported in parentheses.  $EV_i/\bar{EV}$  is the ratio of player  $i$ 's expected value of continuing the tournament (in the absence of a deal) to the average expected value computed over all players remaining in the tournament.  $\Delta s_i/\sum_j s_j$  is a players recent increase in chips as a fraction of all chips on the table. The proposer (ranked player, smallest stack) dummy is equal to 1 if a given player is the one who initiated the proposal that led to the deal (is among top 200 players on the ranking list, has the smallest number of chips of all players in the tournament). \*\*\*, \*\*, and \* denote that an estimate is significant at the 1%, 5%, and 10% level, respectively.

	all deals			two-player deals		3+ player deals		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$EV_i/\bar{EV}$	1.147*** (30.74)	1.242*** (25.13)	1.223*** (23.04)	0.827*** (23.58)	0.918*** (22.54)	1.197*** (28.76)	1.266*** (22.34)	1.220*** (17.07)
$\Delta s_i/\sum_j s_j$		-0.027** (-2.01)	-0.029** (-2.20)		-0.011 (-1.00)		-0.019 (-0.69)	-0.024 (-0.85)
Proposer dummy		-0.001 (-0.37)	-0.001 (-0.23)		-0.003 (-1.04)		0.001 (0.24)	0.002 (0.43)
Ranked-player dummy		0.023** (2.29)	0.025*** (2.58)		0.019* (1.71)		0.023 (1.61)	0.031** (2.42)
Smallest-stack dummy		0.035*** (6.10)	0.040*** (7.45)		0.014*** (4.67)		0.033*** (3.98)	0.033*** (4.04)
Chip-leader dummy			0.012** (2.27)					0.021** (2.14)
$R^2$	0.890	0.901	0.902	0.823	0.834	0.907	0.912	0.914
$N$	1,019	1,019	1,019	426	426	593	593	593

**Table 9. Deviation of deal terms from players' expected values.** The dependent value in this regression is the sum of the absolute deviations of the amounts players obtain in a deal from their expected values of continuing to play (and not making a deal), standardized by the total amount distributed in the deal:  $\sum_i |c_i - EV_i| / \sum_j c_j$ . T-statistics, based on robust standard errors, are presented in parentheses. Independent variables are as defined in Tables 2 and 7. \*\*\*, \*\*, and \* denote that an estimate is significant at the 1%, 5%, and 10% level, respectively.

Constant	-0.030** (-2.06)
# of players	0.035*** (7.67)
Gini coefficient	0.063*** (6.78)
Log(per player surplus)	-0.003** (-2.31)
Prize skewness	0.024** (2.49)
# of ranked players/n	0.002 (0.21)
$R^2$	0.336
$N$	385

**Figure 1. Model probabilities vs empirical frequencies.** The graphs below compare the theoretical probabilities of tournament outcomes implied by the model from Appendix B to empirically observed frequencies. The first row presents the probability of taking first place when there are two players remaining, the second (third) row presents the probability of taking first (first or second) place when there are three players remaining. Results are based on all tournaments that did not have a deal. Model probabilities are computed using chip stacks right after a third player is eliminated (first row) or right after a fourth player is eliminated (second and third row) and are divided into 20 bins. Histograms in the first columns depict the number of tournaments with model probabilities that fall within each bin. The second column plots theoretical probabilities against the empirical frequency of taking first or second place computed using tournaments from each bin, as long as the bin contains at least five tournaments. 45-degree line is superimposed on the graphs.

