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The Demand for Unfair Gambles:
Why Illegal Lotteries Persist

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We show how cheating in illegal gambling can be sustained in equilibrium, even when gamblers are aware of it. Not only is cheating profit-maximizing for operators, but it can also be utility-maximizing if it provides gamblers the opportunity to engage in other related activities that generate non-monetary rewards, such as practicing superstitions. This, in turn, suggests why legalizing gambling might not fully capture the gains from the illegal market - operators and gamblers both prefer cheating, but this would be harder to hide in a legalized environment. We illustrate the model, generate results, and verify them empirically, using the example of *jueteng*, an illegal numbers game in the Philippines.

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1. INTRODUCTION

Can legal or state-sponsored lotteries ever substitute for illegal gambling? Advocates of legalization usually cite the potential tax revenues that could be obtained if underground activities are brought into the legal environment. Even if such revenues are indeed sizeable[1], can one guarantee that illegal versions of the activity will not persist alongside the legal counterparts, thereby limiting the actual tax gains?

Probably not. The general reason is that illegal markets allow consumers and producers to avoid costly rules and regulations. The particular reason that this paper provides is that, in illegal gambling, no rules means that rigging the outcomes is easy and, hence, unfair gambles are more likely.

Levitt [2004] and Kuypers [2000] show that if the bookmaker in sports betting is able to distort prices, she will earn higher profits if she skews the odds such that the team that attracts higher wagers has a lower probability of winning. That is, unfair gambles are profit-maximizing. Note that this is possible only if the bookmaker has an advantage over the bettor in that she is better able to predict the winner.

What we show, however, is that even if bettors had the same information, cheating is still possible. This is because bettors also demand unfair gambles. When bettors derive utility not just from winning but also from other non-monetary or 'psychic' benefits from gambling, they can feel well compensated even if they lose. That is, their betting preferences are endogenously determined by the relative utilities from winning and the psychic gains. In turn, the profit-maximizing gambling operator internalizes such preferences and chooses her strategy to take this into account. Cheating is then (much more) sustainable in equilibrium since it is supported by consumers and producers alike.

Note that it is inherent in much of the literature on gambling utility that risk-averse agents prefer fair play. Precisely, a leading explanation of why agents gamble at all, a la Friedman and Savage [1948], is that agents might have some degree of risk-seeking. On the other hand, Markowitz (1952) justifies gambling behavior by arguing that agents actually maximize changes, rather than levels, of wealth. Most similar to our explanation is

[1] See Desierto and Nye [forthcoming] and Desierto, Lazaro and Cruz [2010] for why this may not even be true.

Conlisk [1993], who shows that when agents do not only consider financial rewards from gambling, but also take into account what Humphreys, Paul and Weinbach (HPW) [2010] call 'consumption benefits', then gambling is utility-maximizing.

HPW provide evidence for the Conlisk hypothesis using betting data from the 2008-9 NCAA basketball season. For this paper, we intepret the notion of consumption or psychic benefits in the particular context of jueteng, a type of lottery which is illegal, albeit very popular, in the Philippines. Section 2 describes the game and provides motivation for why bettors and operators alike might prefer unfair play. Section 3 then proposes a simple game-theoretic model between jueteng operators and bettors and derives the conditions under which operators' cheating is supported. Section 4 empirically verifies if and to what extent such conditions hold, thereby deducing whether the gambles are indeed unfair. Section 5 concludes.

2. SUPERSTITIONS, MIDDLEMEN, AND CHEATING

Jueteng is a type of illegal lottery in the Philippines that is mostly played in rural areas. A bettor chooses one or two numbers between 1 to 37, and places her bets with the designated 'cobrador' of her village who records the bets and turns them over to the operator/banker, or to the latter's agents. One of the operator's agents - the 'bolero' - draws two numbers from two sets of balls, each numbered 1 to 37, from a vial or 'tambiolo'. The tables then record winnings and disburse the payouts to the 'cabos', who in turn hand them over to the cobradors for distribution to the winning bettors.[2]

Two features of the game are noteworthy. One is that the use of superstitions or 'degla' in choosing numbers is not only an accepted norm, but is a regular past time which is intertwined with the game. Pamintuan shows that throughout its Philippine history, jueteng has always been associated with, and played by using, various superstitions.[3] In fact, the cobrador not only receives bets, but as a village mate who maintains strong ties with, and is trusted by, village bettors, also participates in, and encour-

[2] See Pamintuan [2011] for details.

[3] The general Filipino term is 'diskarte', but in Pampanga it is specifically called 'degla' (Pamintuan).

ages, degla-practice. Her notebook contains not only factual information on bets and wins, but also systems of degla which she uses in order to interpret any kind of 'sign' such as dreams of the bettor, particular incidents and meaningful objects. A bettor comes to her and asks her to 'degla' for the bettor, which could mean anything from analyzing what certain signs or trends mean, or giving advice as to which number/s are lucky.

Of course, the use of superstitions in gambling is not uncommon, nor is the proliferation of various 'advice-givers' to bettors (see e.g. Clotfelter and Cook [1990]). What is striking, however, is that in jueteng, the advice itself comes from the cobrador. Assuming that the cobradors' incentives are aligned with the operator's, the fact that the cobrador gives advice to bettors indicates that jueteng operators internalize the costs and benefits of advice-giving.

Another puzzling fact about jueteng is that the draws are held and done in secret. This has not always been the case. In fact, in the earliest recorded jueteng activity in the Philippines, the 1905 Supreme Court case The United States vs., Santiago Palma, et al., it is clearly mentioned that the banker/operator shows the public the entire process of putting a set of thirty-seven balls numbered 1 to 37 in a tambiolo and extracting a number or ball, before immediately announcing it.[4] No one knows for certain when the secret draw started, nor when the game started using two sets of balls and drawing two numbers instead of one. We suggest, however, that the secret draw might have evolved as a mechanism to rig the draw so as to increase the probability of winning, and to favor certain types of bettors, in order to sustain or increase demand and profitability.

To substantiate this, first note that by changing the game from using one set, to two sets, of balls, the probability of winning has decreased. When before, players only had to choose one number out of a set of thirty-seven, now the best possible win involves picking the right number from two sets, and in the right order. Of course, different localities have other variations of winning possibilities - in some places, it is possible to win some amount when only one of two drawn numbers are correctly picked, or when two are picked but in reverse order. The following table lists an example of current payoffs in Philippine pesos Php in Lubao, Pampanga:[5]

[4] The United States vs. Santiago Palma, et al., G.R. No. 2188, May 5, 1905 (en banc), 4 Phil., 269 (1905).

[5] In the City of Pasig in Metro Manila, bettors can only win by playing either "Tum-

Table 1: Payoffs in Lubao, Pampanga

"Tumbok" (bet on two numbers; both drawn in same order)	higher bet x Php350 x 2
"Salud" (bet on two numbers; both drawn in reverse order)	lower bet x Php350
"First Ball" (bet on two nos.; 1st no. drawn first, 2nd not drawn)	bet on 1st no. x Php13
"Diretsa" (bet on one number; drawn either 1st or 2nd)	bet x Php25

Even if the equivalent payoffs in the old style of the game (i.e. one number from 1 to 37) were the same as the current payoffs from, say, "First Ball" or "Diretsa", the current style is actually more confusing to the bettor who now has to choose to bet one or two numbers. The old style just requires the bettor to decide whether to bet or not, and on which number, but the current style requires him to decide whether to bet or not, then decide to bet on one or two numbers, before picking which number/s. That is, although the probability of winning conditional on having chosen to bet on just one number might be the same before and now, the ex ante probability of winning is actually lower now.

And yet the demand for jueteng has increased tremendously. Pamintuan [2011] notes that while jueteng operations were initially confined in the 1900-1920s to several small villages, it started expanding into whole provinces and regions in the 1930s. By the 1970s, total annual revenues were estimated to be around Php 200 to 300 million.[6] Except for a brief drop in reported cases in the Martial Law era under President Marcos[7], reports on jueteng activities and large scale scandals involving politicians have continued to proliferate. It has been alleged that by 1992, individual provinces alone could rake in Php 2 million daily.[8] In 1995, Secretary Rafael Alunan III of the Department of Interior and Local Government alleged that operators in the region of Luzon earned PhP 60 million daily,[9]

bok" or "Salud". For "Tumbok" ("Salud"), the bettor wins an amount equal to the higher (lower) bid times Php800. In the province of Cavite, bettors can only win by playing "Tumbok".

[6] See "Jueteng, Past and Future," of Herman Laurel, *Today* (Manila), 19 November 1995, 11.

[7] Pamintuan argues that Presidential Decree 1602 during Martial Law which imposed tougher penalties on those involved in illegal gambling probably explains the drop in reports and gambling cases in the Supreme Court, but it might also be because government controlled media at that time.

[8] See "Batangas tops Survey on Jueteng Profits," *Manila Chronicle* (Manila), 9 November 1992, 7.

[9] See "The Politics of Jueteng" by Adrian Cristobal, in the *Philippine Daily Inquirer*

while Rep. Roilo Golez claimed that the alleged biggest operator, Rodolfo "Bong" Pineda, earned annual revenues of Php 4.38 billion.[10] More recently, Senator Miriam Defensor Santiago estimates that as of 2010, gross receipts from just the seven top jueteng-earning provinces amount to Php 63.5 million daily, which implies an average total annual revenue of at least Php 23 billion.[11]

Of course, one might attribute the proliferation of jueteng simply to a general increase in consumer preferences, perhaps coupled with a decrease in the effectiveness of enforcement efforts. A survey conducted by the Social Weather Stations (SWS) in 2005 indicates that 14% of the population play jueteng. Meanwhile, the lotto, which is legal lottery, has a customer base of about 32% of the population. If the same percentages hold at present, then approximately 14 million Filipinos play jueteng, who each bet on average about Php 1,600 annually.[12] Meanwhile, about 32 million play the lotto, but with an approximate annual spending per person of only Php875.[13] That illegal jueteng appears to generate higher demand per person than the legal lotto must mean that bettors' enjoyment from jueteng is large - even larger than from the lotto, and/or the risk of getting caught playing jueteng is low.

It is precisely our purpose to look at how secret draws might contribute to the net utility of the bettor. However, we argue that its contribution is primarily to raise the enjoyment and/or payoff from betting, and not so much to decrease the risk of getting caught. This is because while hiding the draws might help conceal part of the operations, there seems to be far more effective 'avoidance' mechanisms that operators have persistently

(Manila), 20 November 1995, A8.

[10] See "Jueteng King Earns P12M Daily, says Solon" by Armand Nocum, in the *Philippine Daily Inquirer* (Manila), 21 November 1995, A1.

[11] See the Senator's September 2010 press release at http://www.senate.gov.ph/press_release/2010/0922_santiago1.asp).

[12] The current approximate population is 100 million, while note that by Senator Santiago's, estimates, total revenues are at least Php23B. Hence, $23000/14 = 1,642$ per person annually.

[13] As reported in "PCSO targets P6.2 billion revenue this year" by Ehda M. Dagooc in *The Freeman*, 5 October 2009, url: http://www.philstar.com/Article.aspx?articleid=511333, the Philippine Charity Sweepstakes Office (PCSO) aims to raise Php 24 billion nationwide in 2009, at least a ten percent increase from the Php 22 billion revenue in 2008. Assuming revenues have grown to Php28 billion in 2010 (and noting that PCSO's revenues do not only come from lotto operations, but also sweestakes lotteries and others), a conservative estimate of yearly spending of each of the roughly 32 million customers of lotto is $28000/32 = 875$ pesos.

adopted in order to escape detection.

Specifically, it is apparent that the primary method involves bribery of enforcement officials and politicians. Evidence of this has existed as early as 1913, where police official A.J. Robertson pretended to receive bribe money to entrap a certain Te Tong who drew "from his pocket a roll of bills amounting to P500 and delivered it to Robertson".[14] While the bribe then was not actually received, a Supreme Court case in 1916 describes another instance in which policeman Andres Pablo actually received P5 as bribe money.

In the early 1900s, bribery was already commonly acknowledged to be associated with illegal gambling, as indicated in various Philippine poetry and prose.[15] From the 1920s to the present time, reported incidences of bribery have increased and have widened its reach to include higher public officials, and allegations of jueteng money being used to fund election campaigns have been expressed as early as 1929. (See Pamintuan for a detailed review; also Lambsdorff [2007].) In 1993, Senator Ernesto Maceda alleged that Mayor Antonio Sanchez of the province of Laguna had benefited from jueteng money estimated at Php1 billion[16]. Even a President has been accused of involvement in jueteng - in an expose by Governor Luis Chavit Singson, President Joseph Ejercito Estrada was alleged to have received Php 400 to 545 million of jueteng money from Nov. 1998 to August 1999.[17] The scandal led to impeachment charges filed against Estrada and his eventual ouster via the 2001 "EDSA II" revolution.

The Philippine National Police (PNP) estimates that as much as 30% of jueteng revenues are used for protection activities, while 15% goes to collectors' commissions, 25% to operators, and 30% to winning bets.[18] Meanwhile, Senator Santiago estimates that 17.2% are paid out specifically

[14] From Supreme Court case The United States v. Te Tong, G.R. No. L-8465, December 29, 1913 (en banc), 26 Phil., 221 (1913).

[15] See, for instance, "Satsatan" by Kulas Kulasisi, in *Bagong Lipang Kalabaw*, 14 December 1907 and "Ang Pangginggera" by Lope K. Santos, in *Ang Pangginggera at mga Piling Tula ni Lope K. Santos,* ed by Virgilio Almario, (Manila: P.T. Martin Publishing Services, 1990), 172. See also Pamintuan for details.

[16] See "Dealing with Jueteng," in *Philippine Daily Inquirer* (Manila), 24 August 1993, 4.

[17] See "Biggest Jueteng Lord" by Christine Herrera, in the *Philippine Daily Inquirer* (Manila), 10 October 2000, 1.

[18] See "The Tentacles of Jueteng" by Irene Javier, *Manila Chronicle* (Manila), 12 November 1995, 1, 6, where Javier refers to a study conducted by the PNP in 1992.

as bribes to public officials (while 34% cover operating expenses).[19] Based on her estimates, annual protection money to public officials as of 2010 can thus be pegged at a rough minimum of Php 4 billion.[20]

The foregoing suggest that the operators' primary tool to avoid detection and punishment is to pay out protection money. That large sums of money are still being spent on bribes even when draws are done in secret indicates that secret draws are probably an ineffective way to protect the supply of jueteng. That is, they probably do not prevent officials from getting wind of operations, nor do they prevent villagers from reporting. Besides, to prevent villagers from squealing, operators seem to rely more on trying to gain loyalty by regularly giving favors and distributing goods to them. (See Pamintuan for details.)

The more likely explanation for why draws are done in secret is that it serves as a demand tool - simply put, jueteng customers must prefer secret draws. Ignoring the possibility that bettors are excessive risk-takers or are irrational, it must be that bettors prefer (or tolerate) secret draws because this increases (or at least does not decrease) their overall expected payoffs from playing. Note that such expected payoffs need not only come from winning, but also from the betting experience itself. That is, players can derive both monetary and 'psychic' benefits from jueteng. If the draws are rigged, it must mean that bettors prefer such unfair gambles over fair play to the extent that it maximizes their overall utility from playing.

If unfair gambles increase both monetary and psychic benefits for one type of bettor, then unequivocally a separating equilibrium would exist in that this bettor would have higher demand than other types. Similarly, if it increases monetary gains (and decreases psychic benefits) for one type, but increases psychic benefits (and decreases monetary gains) for another, then the result depends on the relative magnitude of the net gains. If the sum of monetary and psychic benefits are still higher (lower) for one type, then she has higher (lower) demand. However, if the relative gains exactly offset each other, such that the sum of utilities is the same across all bettors, then types are not distinguishable. That is, in equilibrium, demand is simply

[19] She itemizes this according to recipients, both at the national and provincial levels. However, it is unclear whether it is 17.2 percent of gross receipts, or of receipts net of operating costs. It is likely that she meant the former, to be more consistent with the PNP study.

[20] That is, 17.2 percent of the 23 billion estimated minimum gross receipt.

pooled for all players.

The foregoing describes the conditions under which unfair gambles might be supported by the betting population. For such equilibria to hold, they must also be consistent with the profit-maximizing behavior of the operator. Note that since non-random winning patterns are evident in other games like sports betting, lotteries and quiz shows, this suggests that cheating can be profitable.[21]

Of course, it may be that the operator only wants to increase the total bets without actually favoring one type over another.[22] However, if there are distinguishably different types of players, a profit-maximizing operator would want to favor the type who bets less - in this manner, the operator enjoys higher wagers from the other type, but her payouts (and hence, costs) are smaller since the lower bets win. Levitt and Kuypers each make this point in their analyses of the football betting market. "If bettors exhibit systematic biases, a profit maximizing bookmaker does not want to equalize the money bet on both sides. Rather, the bookmaker intentionally skews the odds such that the preferred team attracts more wagers but wins less than half of the time." (Levitt)

Denoting p as the probability that a particular football team wins the game, and f the fraction of total wagers that go to this team, Levitt shows that if bettors are biased (when play is fair), such that $f(p = 0.5) > 0.5$, then it is profit-maximizing for the bookmaker to set the spread such that $p < 0.5$.[23] Note that what are crucial in this result are the assumptions that (1) bookmakers are better at predicting the outcomes of the game, such

[21] See, for instance, Levitt, Kuypers, Gray and Gray [1997], Golec and Tamarkin [1991], and Tedlow [1950]. See also "The World's Worst Lottery Scandals" in Black Belt Review, by Jason Buckland, Feb. 23, 2011. url: http://blackbeltreview.wordpress.com/2011/02/23/worst-lottery-scandals/ and "Cracking the Scratch Lottery Code" in Wired Magazine, by Jonah Lehrer, Jan. 31, 2011. url: http://www.wired.com/magazine/2011/01/ff_lottery/all/1

[22] Lee and Smith [2002] make the point that bookmakers in sports betting "set the point spread to equalize the number of dollars wagered on each team" since they want to earn profits regardless of who wins. Levitt also mentions this argument, but allows for the possibility that if bookmakers are better than bettors at predicting outcomes and are able to predict bettors' preferences for teams, they can earn higher profits by skewing the odds. See subsequent discussion.

[23] In US football betting, the win depends on the point spread. "For instance, if the casino posts a betting line with the home team favoured by 3 points, a bettor can choose either (1) the home team to win by more than that amount, or (2) the visiting team to either lose by less than three points or to win outright." (Levitt). Setting p is thus tantamount to picking the betting line. Note that it is assumed that bookmakers are better at predicting the outcomes of the game.

that they can set $p < 0.5$ even when bettors believe $p = 0.5$, and that (2) they can easily see bettors' preferences, e.g. $f(p = 0.5) > 0.5$. If (1) does not hold, then bettors can also adjust their wagers accordingly to reflect the true probability of winning, and there is no scope for bookmakers to outsmart bettors.

However, in jueteng, it is possible to have Levitt's profit-maximizing result even when we relax assumption (1). That is, even if bettors are equally good at predicting the results, the operator can still get away with skewing the odds. Using Levitt's notation, it is possible that $p < 0.5$ when $f(p < 0.5) > 0.5$, or $p > 0.5$ when $f(p > 0.5) < 0.5$. This is essentially because of two differences in our model. Firstly, we define bettors' utility functions not only in terms of winning, i.e. p, but also add the psychic benefits and costs they derive from engaging in degla. Thus, it is possible for degla-users to bet systematically less, or have less demand, than non-degla users while still being more favored to win. If, say, the benefits from degla are not very high, or the costs are high, this does not induce the degla-user to bet more, or demand jueteng more, than the non-degla user, even if the operator favors the degla-user to win. Note that if winning were all that mattered, then a bettor would always want to bet on the jueteng numbers that the operator favors, if any. Thus, the second difference in our model is that we see the equilibrium as the result of a game being played between bettors and operators. We uphold assumption (2) by letting the operator be the first-mover who solves her profit-maximizing problem anticipating the preferences of bettors, but relax assumption (1) by letting the bettors maximize their utility after observing the operator's choice. In contrast, while Levitt lets bookmakers take into account the actions of the bettors in maximizing profit, bettors' choices are exogenous.

Our model is actually based on the accounts and beliefs of bettors in Lubao, Pampanga. From interviews conducted by Pamintuan, one gets the impression that it is common knowledge among bettors that the draws there are rigged. The general notion is that the operator (or his banker and other similar agents) chooses the winning numbers in advance, then relays it to the cobrador, who then decides to whom this information is relayed. Some avid degla users think that the cobrador uses degla to give tips to the bettor. Others think that the cobrador chooses the winning numbers that have garnered the lower bets, since this would entail smaller payouts.[24] Note, however, that degla usage seems exogenous. That is, it seems that past wins do not affect bettors' decision to engage in degla or not - there are just some bettors who use it more intensely than others. These bettors tend to enjoy degla more when their degla sometimes works, but if at times it does not, they just change their particular degla strategy. Whereas some 'casual' degla users say that sometimes they do not degla because they have not thought of anything, and not because their previous degla did not work.

To reconcile the belief of the bettors, we posit that degla-users tend to win more because they actually place systematically lower bets, and are thus favored by profit-maximizing operators. Section 3 thus describes the formal model that can generate this result, while Section 4 uses data from Lubao, Pampanga to estimate the equilibrium demand/betting behavior of jueteng bettors and deduce whether the draws are skewed, and to which type of bettor.

3. A MODEL

Let $\theta \in [0, 1]$ capture the probability that a type 1 bettor wins over a type 2 bettor (and $(1 - \theta)$ the probability that a type 2 wins over type 1), where $\theta = 0.5$ implies no cheating, $\theta > 0.5$ implies that the operator favors the type 1 bettor, and $\theta < 0.5$ the type 2. Let $q_1(\theta)$ be the quantity demanded, or the amount of bet placed, by the type 1 bettor and $q_2(\theta)$ of type 2, and assume $q_1(\theta), q_2(\theta) > 0$ for all θ.[25] The operator chooses θ, the bettors observe the pattern of winnings, i.e. θ, and then each type decides how much quantity to demand (or amount of bet to place). That is, they play a sequential/dynamic game. We solve the subgame perfect Nash equilibrium (SPNE) of the game by backward induction. That is, type 1 and type 2 each choose q_1 and q_2 that maximize their respective utilities, taking θ as given, which generates their reaction functions $q_1(\theta)$ and $q_2(\theta)$, respectively, while operator chooses θ to maximize its profit, taking into account $q_1(\theta)$ and $q_2(\theta)$.

[24] Since the cobrador is an agent of the operator, the operator ex ante choosing is the same as when the cobrador consults his notebook for profiles of his customers and advices the operator which numbers to pick.

[25] That is, all bettors derive inherent utility from playing/betting itself, regardless of the probability of winning.

Denote the 'official' unit price of jueteng as p, which is the price paid to the operator by both types of bettors.[26] However, the marginal costs incurred by the operator can differ across types, depending on the pattern of cheating. That is, let the marginal costs be denoted by $c_1(\theta), c_2(\theta)$, where $c_1(\theta = 0.5) = c_2(\theta = 0.5) = c$, $c < \frac{c_1(\theta)+c_2(\theta)}{2}$ for all θ, and $\frac{\partial c_1}{\partial \theta} > 0$, $\frac{\partial c_2}{\partial \theta} < 0$. In other words, favoring one bettor-type over another translates to relatively higher marginal costs incurred by the operator from the favored type. (Ensuring non-random play is costly, and letting a player win (lose) is a relative cost (benefit) to the operator. Meanwhile, pure random play incurs the same marginal cost c from both types). Finally, assume that $p > c_1, c_2$ at all values of θ.

The total profit of the operator is simply the sum of profits from type 1 and type 2 bettors. Thus, the profit-maximizing problem of the operator is given by:

$$\max_{\theta} \pi = [p - c_1(\theta)]q_1(\theta) + [p - c_2(\theta)]q_2(\theta). \tag{1}$$

Now let D_i capture the intensity with which the bettor type $i = 1, 2$ uses degla. Consider then their respective net utilities from engaging in jueteng:

$$U_1 = q_1(f_1(\theta) - p) + q_1(B + h_1(D_1)) - q_1(w + g_1(D_1)) \tag{2a}$$

$$U_2 = q_2(f_2(\theta) - p) + q_2(B + h_2(D_2)) - q_2(w + g_2(D_2)) \tag{2b}$$

The first terms of (2a) and (2b) capture the expected utility from winning, where the net gain per unit played/demanded is equal to expected gross winnings per unit given by function $f_1(\theta)$ for type 1 and $f_2(\theta)$ for type 2, less per unit cost p. Let $f_1 = 0$ for $\theta = 0$, $f_2 = 0$ for $\theta = 1$, $f_1 = f_2$ for $\theta = 0.5$, and $\frac{\partial f_1}{\partial \theta} > 0$, $\frac{\partial f_2}{\partial \theta} < 0$. (The expected gross winning per unit is zero if there is no probability of winning; the same across bettors if play is purely random; and greater for the favored bettor if there is cheating.) The second terms are the total (gross) 'non-monetary' or psychic benefit of i, which comes from just playing, i.e. B, which is assumed to be the same across types, and engaging in degla with the cobrador, $h_i(D_i)$, which

[26] This price can be seen as the minimum bet allowed, which is currently 1 peso in Lubao, Pampanga.

may be different per type. Assume that $h_i(D_i = 0) = 0$, $\frac{\partial h_i}{\partial D_i} > 0$, and $\frac{\partial h_1}{\partial D_1} \neq \frac{\partial h_2}{\partial D_2}$. That is, both bettor types derive some positive utility from degla, but one type enjoys it more. The last terms of (2a) and (2b) are the total costs from playing/betting and from degla, where w is the unit cost of other alternative commodities (such that $q_i w$ is player $i's$ total value of foregone consumption) and $g_i(D_i)$ the cost of engaging in degla, with $g_i(D_i = 0) = 0$, $\frac{\partial g_i}{\partial D_i} > 0$, and $\frac{\partial g_1}{\partial D_1} \neq \frac{\partial g_2}{\partial D_2}$. That is, for all bettors, engaging in (any positive amount of) degla with cobrador is costly, with the cost rising with the intensity of degla with cobrador, but one type finds it less costly at all levels of degla.

Let bettor 1 choose q_1 to maximize U_1 and 2 choose q_2 to maximize U_2. This gives rise to the following first-order conditions (FOCs):

$$MB_1 \equiv f_1(\theta) + B + h_1(D_1) = p + w + g_1(D_1) \equiv MC_1 \tag{3a}$$

$$MB_2 \equiv f_2(\theta) + B + h_2(D_2) = p + w + g_2(D_2) \equiv MC_2 \tag{3b}$$

where MB_i denotes marginal benefit of i and MC_i marginal cost of i from playing jueteng. Meanwhile, note that $[h_i(D_i) - g_i(D_i)]$ is the net utility of i from engaging in degla. (The net marginal utility solely from this activity is then $\frac{\partial h_i}{\partial D_i} - \frac{\partial g_i}{\partial D_i}$.) Given B, p, w, the utility-maximizing level of q_i thus depends on the marginal gains from winning, f_i, and the net utility from degla, $[h_i(D_i) - g_i(D_i)]$. Note that from our assumptions on $\frac{\partial h_i}{\partial D_i}$ and $\frac{\partial g_i}{\partial D_i}$, it is possible for $[h_1(D_1) - g_1(D_1)] \gtreqless [h_2(D_2) - g_2(D_2)]$. Also, depending on the observed value of θ, $f_1 \gtreqless f_2$. The following lemmas 1 and 2 thus establish the utility-maximizing behavior of the bettors, depending on $[h_i(D_i) - g_i(D_i)]$ and f_i:

Lemma 1. *If* $[h_1(D_1) - g_1(D_1)] + f_1(\theta) = [h_2(D_2) - g_2(D_2)] + f_2(\theta)$, *then the utility-maximizing strategy of bettors is to choose quantities such that* $q_1 = q_2$.

Proof. Note that $(MB_1 - MC_1) = (MB_2 - MC_2)$ if $[h_1(D_1) - g_1(D_1)] + f_1(\theta) = [h_2(D_2) - g_2(D_2)] + f_2(\theta)$. Hence the (total) marginal utilities from betting/playing are the same and $q_1 = q_2$. ∎

Lemma 2. *If* $[h_1(D_1) - g_1(D_1)] + f_1(\theta) \gtrless [h_2(D_2) - g_2(D_2)] + f_2(\theta)$, *then the utility-maximizing strategy of bettors is to choose quantities such* *that* $q_1 \gtrless q_2$.

Proof. Note that $(MB_1 - MC_1) \gtrless (MB_2 - MC_2)$ if $[h_1(D_1) - g_1(D_1)] + f_1(\theta) \gtrless [h_2(D_2) - g_2(D_2)] + f_2(\theta)$. If $(MB_1 - MC_1) \gtrless (MB_2 - MC_2)$, then this induces bettor 1 (2) to have higher (lower) demand, i.e. $q_1 \gtrless q_2$. ∎

By lemmas 1 and 2, bettors consider the sum of net utility from degla and marginal utility from winning. If this sum is unequivocally higher for one type, that type demands more. If it is the same, then both players behave the same way, that is, demand is the same.

Corollary 1. *When* $\theta \gtrless 0.5$, *then the utility-maximizing behavior of bettors is to choose quantities such that* $q_1 \gtrless q_2$ *if* $[h_1(D_1) - g_1(D_1)] \gtreqless [h_2(D_2) - g_2(D_2)]$.

Proof. By our assumption, $\theta \gtrless 0.5$ implies $f_1 \gtrless 0.5$. If $[h_1(D_1) - g_1(D_1)] \gtreqless [h_2(D_2) - g_2(D_2)]$, then $[h_1(D_1) - g_1(D_1)] + f_1(\theta) \gtrless [h_2(D_2) - g_2(D_2)] + f_2(\theta)$ which, by Lemma 2, yields $q_1 \gtrless q_2$. ∎

Corollary 2. *When* $\theta \gtrless 0.5$, *then the utility-maximizing behavior of bettors is to choose quantities such that* $q_1 \lesseqgtr q_2$ *if* $[h_2(D_2) - g_2(D_2)] - [h_1(D_1) - g_1(D_1)] \gtrless f_1(\theta) - f_2(\theta)$.

Proof. By our assumption, $\theta \gtrless 0.5$ implies $f_1 \gtrless 0.5$. If $[h_2(D_2) - g_2(D_2)] - [h_1(D_1) - g_1(D_1)] \gtrless f_1(\theta) - f_2(\theta)$, then $[h_1(D_1) - g_1(D_1)] + f_1(\theta) \lesseqgtr [h_2(D_2) - g_2(D_2)] + f_2(\theta)$ which, by Lemma 2, yields $q_1 \lesseqgtr q_2$. ∎

That is, by corollary 1, if the degla-intensive bettor (i.e. the bettor with relatively higher net utility from degla) is favoured to win, then she unequivocally demands more. But by corollary 2, even if she is less favoured to win, she can still demand more if her net utility from degla is high enough such that her relative smaller marginal utility from winning is more than offset by her relatively higher net utility from degla.

The foregoing lemmas and corollaries describe the choice of bettors as functions of their observed θ. That is, they generate reaction functions $q_1(\theta)$ and $q_2(\theta)$.

The profit-maximizing operator as first mover chooses θ anticipating how bettors will react, that is, by taking $q_1(\theta), q_2(\theta)$ into account. Thus, at the profit-maximizing level of θ, the following FOC holds:

$$TMR \equiv p(\frac{\partial q_1}{\partial \theta}+\frac{\partial q_2}{\partial \theta}) = \frac{\partial c_1}{\partial \theta}q_1(\theta)+\frac{\partial c_2}{\partial \theta}q_2(\theta)+c_1(\theta)\frac{\partial q_1}{\partial \theta}+c_2(\theta)\frac{\partial q_2}{\partial \theta} \equiv TMC, \tag{4}$$

where TMR is the total marginal revenue from type 1 and 2 bettors, and TMC is the total marginal cost incurred. Thus, the profit-maximizing level of θ equates the net marginal benefit of the operator from both types. The following lemmas establish the profit-maximizing behavior of the operator:

Lemma 3. *If $q_1(\theta) = q_2(\theta)$, then the profit-maximizing strategy of the operator is to choose $\theta = 0.5$.*

Proof. We show that the operator's profit when $\theta \neq 0.5$ is less than her profit when $\theta = 0.5$. For $\pi_{\theta \neq 0.5} < \pi_{\theta=0.5}$, it must be that $cq_1(\theta) + cq_2(\theta) < c_1q_1(\theta) + c_2q_2(\theta)$, which when $q_1(\theta) = q_2(\theta)$ can be expressed as $2cq_1(\theta) < (c_1 + c_2)q_1(\theta)$. This inequality is true since $c < \frac{c_1+c_2}{2}$. ∎

Lemma 4. *If $q_1(\theta) \gtrless q_2(\theta)$, then the profit-maximizing strategy of the operator is to choose $\theta \lesseqgtr 0.5$.*

Proof. When $q_1(\theta) > q_2(\theta)$, TMC in equation (4) is higher since $\frac{\partial c_1}{\partial \theta} > 0$ and $\frac{\partial c_2}{\partial \theta} < 0$. This then induces the operator to lower θ. On the other hand, when $q_1(\theta) < q_2(\theta)$,TMC is lower, which induces operator to increase θ. Specifically, if $q_1$rises (and $q_2$falls) from an amount at which $q_1 = q_2$, TMC increases, and θ decreases to $\theta < 0.5$. If q_2 rises (and q_1 falls) from $q_1 = q_2$, TMC decreases, and θ increases to $\theta > 0.5$. ∎

Corollary 3. *Assume that $\frac{\partial q_i}{\partial \theta} > \frac{\theta}{q_i}$ for $i = 1, 2$. A necessary condition for $q_1(\theta) \gtrless q_2(\theta)$ is $\frac{\partial q_1}{\partial \theta}\frac{\theta}{q_1} \gtrless \frac{\partial q_2}{\partial \theta}\frac{\theta}{q_2}$.*

Proof. It must be that $\frac{\partial q_1}{\partial \theta} \gtrless \frac{\partial q_2}{\partial \theta}$ when $q_1(\theta) \gtrless q_2(\theta)$, otherwise, when $\frac{\partial q_1}{\partial \theta} \lesseqgtr \frac{\partial q_2}{\partial \theta}$, $q_1(\theta) \gtrless q_2(\theta)$ cannot be maintained since there will be some value θ^0 at which $q_1(\theta^0)$ and $q_2(\theta^0)$ intersect. For $\frac{\partial q_i}{\partial \theta} > \frac{\theta}{q_i}$, $\frac{\partial q_1}{\partial \theta} \gtrless \frac{\partial q_2}{\partial \theta}$ implies $\frac{\partial q_1}{\partial \theta}\frac{\theta}{q_1} \gtrless \frac{\partial q_2}{\partial \theta}\frac{\theta}{q_2}$. ∎

Thus, by lemma 3, a profit-maximizing operator will not want to rig the draws if bettors have the same demand. If demand across types are different, by lemma 4, the operator will want to favor the bettor with the relatively lower demand. This is because letting the higher demand-type win more often increases the cost of the operator more than when she favors the lower demand-type. That is, if winning bets are large, the payout of the operator is also high. Whereas, if winning bets are small, the payouts are small. And since the higher-demand type will always demand (i.e. bet) more whatever her chances of winning, then it is profit-maximizing for the operator to pocket the bets than pay them out. Meanwhile, it makes sense to sustain the demand from the lower-demand type by letting her win more often. This poses relatively smaller costs to the operator since the bets from this type are smaller. Thus, by corollary 3, the operator will want to favor the bettor with the relatively less elastic demand because doing so would not raise their bets too much and, hence, would not need a large costly payout from the operator.

The SPNE of the game are values of θ^*, q_1^*, q_2^* which are both profit-maximizing for the firm and utility-maximizing for both bettor types (where utilities depend on observed θ, and profit is computed by anticipating $q_i(\theta)$). There are two types of SPNE - separating (where $q_1^* \neq q_2^*$) and pooled (where $q_1^* = q_2^*$). The following main result describes the separating SPNE:

PROPOSITION 1. *If* $[h_1(D_1)-g_1(D_1)]+f_1(\theta) \lesseqgtr [h_2(D_2)-g_2(D_2)]+f_2(\theta)$ *or* $[h_2(D_2) - g_2(D_2)] - [h_1(D_1) - g_1(D_1)] \gtreqless f_1(\theta) - f_2(\theta)$, *then the SPNE is characterized by* $\theta^* \gtreqless 0.5, q_1^* \lesseqgtr q_2^*$.

Proof. By lemmas 2 and 4, and corollary 2. ∎

That is, by Proposition 1, bettors that always have a higher sum of net utility from degla and marginal utility from winning enjoy playing/betting more and, hence, always play/bet more, regardless of whether they win or lose more. The profit-maximizing operator then takes advantage of this by letting them lose more, so as to limit the winnings they pay out (since larger bets require larger payments if they win).

The next Proposition establishes the existence of a pooled SPNE:

PROPOSITION 2. *: If* $[h_1(D_1) - g_1(D_1)] + f_1(\theta) = [h_2(D_2) - g_2(D_2)] + f_2(\theta)$, *then the SPNE is characterized by* $\theta^* = 0.5, q_1^* = q_2^*$.

Proof. By lemmas 1 and 3. ∎

That is, it is possible for there to be no distinct, or separated, types of bettors in equilibrium. Because the difference in net utilities from degla is exactly equal to the difference in marginal utilities from winning, then demand is the same. The profit-maximizing operator cannot limit her costs by rigging the draws - the 'average marginal cost' of trying to favor one bettor over another would be $\frac{c_1+c_2}{2}$, which is higher than when play is random (i.e. c). Another way to look at it is that it is difficult for the operator to distinguish between bettors. This is because perfect arbitrage is possible. For instance, degla-intensive bettors would be willing to share winnings, up to the value of their extra utility from degla, with less degla-intensive bettors if the former do all the playing. That is, the amount of bet is just enough to reflect the same representative sum of utility from degla and winning, and so the operator faces the same bettor (or type of bet) each time. In contrast, arbitrage is not possible with the separating equilibrium since there are those who always want to bet more, or bet at higher intensity, which allows the operator to distinguish between bettor-types. Thus, it is not possible to share winnings perfectly, since those who bet more actually lose, and those who win do not have enough winnings to share since the bets they place are lower.

From the above propositions, we can summarize the SPNE outcomes depending on the bettors' relative magnitudes of their net utility from degla $(h_i - g_i)$ and of their marginal utility f_i from winning:

Table 2: Subgame-perfect Nash Equilibria

	$f_1 > f_2$	$f_1 = f_2$	$f_1 < f_2$
$(h_1 - g_1) > (h_2 - g_2)$	$\theta^* < 0.5, q_1^* > q_2^*$	$\theta^* < 0.5, q_1^* > q_2^*$	$\theta^* \lesseqgtr 0.5, q_1^* \gtreqless q_2^*$
$(h_1 - g_1) = (h_2 - g_2)$	$\theta^* < 0.5, q_1^* > q_2^*$	$\theta^* = 0.5, q_1^* = q_2^*$	$\theta^* > 0.5, q_1^* < q_2^*$
$(h_1 - g_1) < (h_2 - g_2)$	$\theta^* \lesseqgtr 0.5, q_1^* \gtreqless q_2^*$	$\theta^* > 0.5, q_1^* < q_2^*$	$\theta^* > 0.5, q_1^* < q_2^*$

Note that when a bettor has both higher (lower) net utility from degla and higher (lower) marginal utility from winning, then that bettor always demands more (less) or has more (less) elastic demand, and the draws are skewed against (towards) her. When net utilities from degla are the same, the bettor that has the higher marginal utility from winning demands more and is less favored to win. Similarly, if marginal utilities are the same, the bettor that has relatively higher net utilities from degla demands more.

However, if a bettor has higher net utility from degla but lower marginal utility from winning relative to another bettor, then results are ambiguous. It could happen that the difference in net utilities from degla is exactly offset by the difference in marginal utilities from winning, in which case there is no separating equilibrium - all bettors have the same demand, and a profit-maximizing operator does not discriminate. Otherwise, if the sum of the net utility from degla and marginal utility from winning for one bettor type is higher than another's, then the former demands more and is less favored to win.

Note, then, that if there is a separating equilibrium, the draw will always be skewed towards the bettor-type with lower demand (elasticity). Thus, in this sense, having $(h_1 - g_1) - (h_2 - g_2) \neq f_2 - f_1$ is a sufficient condition for cheating to take place. On the other hand, if the equilibrium is characterized by pooled bettors, the model predicts that draws are random.

4. SOME EVIDENCE

4.1. Identification

While we cannot directly verify whether draws are rigged, we can provide indirect evidence by showing that there is a separating equilibrium. In turn, we can establish this by showing that $(h_1 - g_1) - (h_2 - g_2) \neq f_2 - f_1$. If this is true, then $q_1 \neq q_2$, that is, the equilibrium is separating, which suggests that a profit-maximizing operator might prefer the draws to be non-random. To which bettor-type the operator might want to skew the draws depends on the relative total marginal utilities from playing, that is, for two types 1 and 2, $(h_1 - g_1) + f_1 \gtrless (h_2 - g_2) + f_2$, would imply $\theta \lesseqgtr 0.5$.

Note that differences in $(h_i - g_i) + f_i$ can be decomposed into the (net) utility derived from the degla activity and the marginal utility from winning itself[27]. Thus, by controlling for these, it is straightforward to identify (a) whether there is a separating equilibrium in the demand for jueteng and, if so, (b) infer which type is likely favored by the operator in the draws. Using data from a number of bettors $j = 1, 2, ...n$ over time $t = 1, 2, ..T$, we estimate a linear approximation of the demand function for jueteng:

[27] Assuming constant p, B, w. Recall bettors' first-order conditions.

$$y_{jt} = \beta_0 + \beta_1 x_{jt} + \mathbf{z}_{jt}\gamma + \varepsilon_{jt} \tag{5}$$

where y is the demand for jueteng, x the degla-intensity of the bettor, $\mathbf{z}$ a vector of controls that capture the costs of doing degla and the marginal utility from winning, and ε is random error. Thus, $\mathbf{z}_{jt}\gamma$ approximates the marginal utility f from winning and the cost g of doing degla, so that $\beta_1 x$ is the (gross) benefit h from degla.

If $\beta_1 \neq 0$, then degla matters in the demand for jueteng. That is, we can identify bettor types, or bettors are separated, to the extent of degla that they use. If $\beta_1 > 0$, then the more degla-intensive bettor has higher demand. By the results of our model, a profit-maximizing operator skews the draws against her. If $\beta_1 < 0$, then the more degla-intensive bettor has lower demand, which makes her more favored to win by the operator.

4.2. Data

We use the data set of Pamintuan - a random sample of forty bettors in Lubao, Pampanga interviewed in two time periods, March and June 2009, for a total of eighty observations.

To proxy for the demand for jueteng, we obtain the average bet the individual placed in the current week and take its logarithm to create the variable lnBet. Our variable of interest, degla, which captures the degla-intensity of the individual, is a binary variable that equals 1 if she engaged in or used degla that week, 0 otherwise. A casual comparison of the the value of lnBet for degla users and non-degla users shows that the average (mean) lnBet is higher for non-degla users:

	degla= 1	degla= 0
mean lnBet	4.36	4.55

If the above association is causal, this would imply that bettors are separated, with degla users having relatively lower demand.

To establish such causal relationship, we have to control for the cost of using degla and the bettor's marginal utility from winning. To proxy for the former, we use the average income of the bettor in the current week and take its logarithm to form the variable lnInc. (We also use the untransformed value, inc, as alternative.) One possibility is that higher income could capture higher opportunity cost from engaging in degla. However, it could also make degla more affordable - degla-users who have higher income have a bigger 'buffer', so they can allot more time to degla than degla-users with lower income. The net effect of lnInc and inc may thus be ambiguous.[28] Indeed, it can be seen in the next two tables that the mean lnBet of degla users with lnInc and inc above (below) the mean values are lower (lower) than those of non-degla users, but among degla-users, those above mean lnInc and inc have higher lnBet.

	degla= 1	degla= 0	
mean lnBet	4.01	3.59	below mean lnInc= 7.13
mean lnBet	4.66	5.61	above mean lnInc= 7.13

	degla= 1	degla= 0	
mean lnBet	4.16	3.82	below mean inc= 1577
mean lnBet	4.73	5.55	above mean inc= 1577

Of course, the trend does not take into account the marginal utility from winning. All other things equal, a higher marginal utility from winning tends to induce the player to bet more (since a higher bet also translates to large payoff if the bettor wins). Taking into account degla, however, the marginal utility from winning can either bolster the positive effect of degla on demand, or it can dampen or overturn it. This is because as our model shows, the demand of bettors depends on the relative effects of the net utility from degla and the marginal utility from winning. To control for the effect on demand of the marginal utility from winning, we construct a binary variable Won which takes on one (zero) if the bettor won (lost) in her most recent play prior to the current week. The table below shows that among those who won (lost), the mean lnBet is higher (lower) for degla users than for non-degla users. However, comparing across winners and

[28] We also tried to use data on education levels, types of occupation, gender, and household size as alternative proxies for the cost of doing degla, as these have been found in the sample to have high correlations with degla. However, they are all statistically insignificant in the regressions, and only income proves robust in various specifications. Nevertheless, we use such data as instruments in two-stage least squares regressions - see subsection 4.4.

losers, we find that winners bet more in subsequent play, but only if they do not engage in degla. If they do, winning in the past actually decreases their bet (relative to losing in the past).

	degla= 1	degla= 0	
mean lnBet	5.45	4.09	Won= 1
mean lnBet	4.33	4.57	Won= 0

The above suggests that the effects of degla, and/or winning in the past, are not straightforward. Simultaneously considering the effect of income can also make it harder to predict the final outcome on demand. To tease out the effect of degla on demand, we thus control for the net utility from degla and the marginal utility from winning by running regressions of lnBet on degla, lnInc (and inc), and Won using various functional specifications. We also include a time dummy variable, June, and the (logarithmic) value of the most recent bet prior to the current one - lnprevBet - as additional controls. The next section reports the results.

4.3. Results

The following table shows the results from pooled OLS regressions using eleven specifications, most of which include the interaction of degla with either lnInc or inc to capture the different marginal effects of degla across income profiles.[29] Regression models (3) and (4) also include the interaction variable deglaWon to obtain the marginal effect of degla among those who won in a prior bet against those who lost.

Table 3: OLS Results; Dependent Variable - lnBet; N=80

[29] These regression models were chosen after having passed the Ramsey Reset test for functional form.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
degla	5.08*	-3.09$^+$	-3.11$^+$	-3.11$^+$	-3.15$^+$	-0.15$^\wedge$	-0.68$^\wedge$	-0.14$^\wedge$	0.97$^\wedge$	0.98$^\wedge$	0.90
deglalnInc	-0.73*	0.42$^+$	0.41$^+$	0.41$^+$	0.43$^+$		0.07				
inc	0.00*								0.00*	0.00*	0.00
Won	0.43$^{j\wedge}$	0.46$^{j\wedge}$						0.26$^\wedge$	0.33^{j*}		
deglaWon			1.02^{j*}	1.00^{j+}							
lnprevBet						1.01*	1.00*	1.00*			
June	-0.38	0.41		-0.42	-0.42				-0.41	-0.42	
deglaInc									-0.001*	-0.001*	-0.0
R^2	0.21	0.07	0.05	0.07	0.06	0.93	0.93	0.93	0.22	0.22	0.19

Note: *significant at 5%, +significant at 10%, ^significant at 15%; j*jointly significant with degla at 5%, j+jointly significant with degla at 10%, j^jointly significant with degla at 15%

Some general observations can be made. First, degla appears significant in most of the regressions - at least at the 15% level, and some at 10% and 5%. This suggests that degla users and non-degla users have different demand for jueteng even after controlling for the costs of degla and marginal utility from winning. That is, the data show that there is a separating equilibrium. Second, although the estimated coefficients for Won and deglaWon are positive, they are not individually significant, which suggests that winning in a prior bet (Won) on its own does not affect the demand for jueteng, and nor are degla types further separated by the enjoyment they get from winning. Of course, this may be the result of small variation in the data for Won, and possibly the correlation between degla and other variables such as inc. However, note that Won and deglaWon are *jointly* significant with degla, which suggests that bettors may indeed be simultaneously weighing the relative utilities they get both from degla and from winning. Recall that in our model, there is a degree of substitutability between these two utilities in that a high enough utility from degla (winning) may compensate the bettor from losing (engaging in degla). Thus, if Won were individually significant, result (1) suggests that after controlling for the net utility from degla, any bettor who wins (regardless of type) derives an estimated extra benefit from playing equal to 43%*1 = 43% of her bet if she wins, and 43%*0 = 0% otherwise.

Consider the next table which calculates the marginal effect of degla on lnBet. Note that for most of the regression models, the marginal effect depends on the level of lnInc or inc - for these, the table also provides the cutoff values $\overline{lnInc}$ or $\overline{inc}$ at which the direction of effect of degla on lnBet changes. Except for model (1), the marginal effects below the cutoff points are negative and positive above. This suggests that for lower-income bettors, engaging in degla lowers their bet (or demand for jueteng), but for higher-income bettors degla increases the bet. For model (1), however, the pattern is reversed (recall the positive coefficient on degla and the negative coefficient on deglalnInc in the previous table). It is thus unclear in which direction income acts as a proxy for the cost of degla. From model (1), it seems that higher income increases the opportunity costs of engaging in degla, but from the results of the other regression models, it seems that higher income makes the time spent in degla more 'affordable'.

For models (3) and (4), the table also provides cutoff values of $\overline{lnInc}$ for Won= 1 (first element in the pair) and Won= 0 (second element). Note that the the cutoff points are lower for $Won = 1$ than $Won = 0$. That is, it takes a lower income for the positive effect of degla to kick in when the bettor won in a prior bet. That is, it seems that having won in a prior bet makes degla more 'affordable' even at a lower income. This result is intuitive, since the bettor also takes into account the utility from possibly winning again.

Table 4: Marginal Effect dy/dx of Degla

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
dy/dx	-0.12	-0.1	-0.19	-0.11	-0.11	-0.15	-0.15	-0.14	-0.12	-0.12	-0.2
$\overline{lnInc}$	6.96	7.38	5.14, 7.66	5.04, 7.48	7.39		9.09				
$\overline{inc}$									1405	1399	1296

Generally, however, the marginal effects of degla averaged over the entire sample, i.e. dy/dx in Table 4, are negative in all regression models. This suggests that, overall, bettors who engage in degla systematically bet less or demand less jueteng, approximately 12 to 20 percent by our estimates.

If our model holds, then a profit-maximizing operator would want to increase the probability of winning for degla-users relative to non-degla users. Note that although individually insignificant, our estimated coefficients on deglaWon are positive, which suggest that degla-users enjoy higher marginal utility from winning than non-degla users.

This in turn implies that the cost of engaging in degla must be high enough, and/or the gross benefit from degla is not too high, and/or degla-users do not have very large winnings compared to non-degla users. That is, denoting degla-users to be type 1,then $q_1 < q_2$ when $f_1 > f_2$ must mean that g_1 is high enough, and/or h_1 is not too high, and/or f_1 is not very large, such that $(h_1 - g_1) + f_1 < (h_2 - g_2) + f_2$.

The results seem consistent with the situation, and the beliefs of bettors, in Lubao, Pampanga. The *net* utility from degla may not be very different across bettors, as the entire community accepts degla to be an integral part of jueteng. Thus, any marked differences in betting amounts might be reflecting the perception of the more avid degla users that they can actually win with degla. If it were true that operators are favoring degla users to win, this would give stronger justification as to why cobradors (who are profit-maximizing agents of operators) have developed elaborate systems and codes of degla. If there is indeed cheating that favors degla-users, then cobradors need degla in order to relay information and give tips. At the same time, the differences in marginal utilities from winning may not be very large, since the winning bets are small (if degla-users who have lower bets win more often). It is thus no surprise that some bettors believe that using degla increases their probability of winning, while some believe that operators let the smaller bets win. It may very well be that such beliefs coincide - degla-users bet smaller and win more.

4.4. Robustness

In the model in section 2, degla is assumed exogenous. While casual interviews with some bettors in Lubao, Pampanga leave the impression that there are individuals that (exogenously) engage in degla more, we nevertheless perform additional regressions to check whether degla might be endogenous in our sample (also as with the variables inc and Won, although the latter might already be reasonably exogenous since it uses past data.)

To control for the possible effect of time-constant variables that may be correlated with degla, inc, or Won (e.g. gender, age, education, occupation, household size), we run fixed effects (FE) regressions of the same models

(1) to (11) (omitting the variable June). The following table shows that the results are similar to the OLS estimates.[30]

Table 5: FE Results; Dependent Variable - lnBet; N=80

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
degla	5.06*	-3.09$^+$	-3.08$^+$	-3.08$^+$	-3.15$^+$	-0.11	-0.68$^+$	-0.11	0.97$^\wedge$	0.98$^\wedge$	0.98$^\wedge$
deglalnInc	-0.73*	0.42$^+$	0.41$^+$	0.41$^+$	0.43$^+$		0.08				
inc	0.00*								0.00*	0.00*	0.00*
Won	0.43$^{j\wedge}$	0.46$^{j\wedge}$						0.23$^\wedge$	0.33		
deglaWon			1.00^{j*}	1.00^{j*}							
lnprevBet						1.00*	0.99*	1.00*			
deglaInc									-0.001*	-0.001*	-0.001
R^2	0.19	0.04	0.05	0.05	0.04	0.93	0.93	0.93	0.19	0.19	0.19

Note: *significant at 5%, +significant at 10%, ^significant at 15%; j*jointly significant with degla at 5%, j+jointly significant with degla at 10%, j^jointly significant with degla at 15%

Finally, we also run two-stage least squares (2SLS), using as instruments: the binary variable male= 1 for male respondents, the variable age for age of the respondent, binary variable occup= 1 for full time (and = 0 for part time) employment, indicator variable educ for educational attainment of the respondent (0 for some elementary, 1 for some high school and 2 for some college), and variable hhsize for the number of people in respondent's household. Only the variable June is assumed exogenous. It can be seen in the table below that the 2SLS regressions produce results that are almost identical to the OLS:

Table 6: 2SLS Results; Dependent Variable - lnBet; N=80

[30] Note, however, that results in (6), (7) and (8) are probably biased. Fixed effects regression assumes strict exogeneity of regressors, which is violated since lnprevBet is included.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
degla	5.08*	-3.09+	-3.11+	-3.08+	-3.15+	-0.15^	-0.68^	-0.14^	0.97^	0.98^	0.90
deglalnInc	-0.73*	0.42+	0.41+	0.41+	0.43+		0.07				
inc	0.00*								0.00*	0.00*	0.00
Won	0.43j^	0.46						0.26^	0.33		
deglaWon			1.02^	1.00							
lnprevBet						1.01*	1.00*	1.00*			
June	-0.38	0.41		-0.42	-0.42				-0.41	-0.41	
deglaInc									-0.001*	-0.001*	-0.00
R^2	0.21	0.07	0.05	0.07	0.06	0.93	0.93	0.93	0.22	0.22	0.19

Note: *significant at 5%, +significant at 10%, ^significant at 15%; j*jointly significant with degla at 5%, j+jointly significant with degla at 10%, j^jointly significant with degla at 15%

Thus, whether by OLS, FE or 2SLS, the results suggest that degla-users have lower demand, that is, they systematically place lower bets than non-degla users. By revealed preference, degla-users must be deriving relatively lower utility from betting, even if they have that added enjoyment from degla. Of course, a simple, straightforward explanation might be that the psychic benefit from degla does not rise with the bet, but may actually decrease with the amount of the bet. Perhaps there is something akin to a social stigma that a bettor incurs from his community if he engages in degla too much. That is, perhaps there is a socially acceptable optimal level of degla beyond which the bettor incurs a (psychic) loss. Our casual assessment of the interviews by Pamintuan in Lubao, Pampanga is that at least in that area, there seems to be no clear social stigma associated with intensive degla. A certain resident, Mang Teo, has a reputation there as a degla enthusiast, and yet this seems to be a source of pride for him.

Nevertheless, non-linearities in the utility from degla is approximated in our regressions by our proxies for the cost of degla, and the interaction between the latter and degla. Degla-users having lower demand could just be reflecting the situation in which degla becomes too costly at a certain point. Thus, one could explain the differences in utilities between degla- and non-degla users only in terms of the differences in *net* utility from degla alone - that is, all bettors derive psychic benefits from betting, but degla-users derive extra benefits from degla.

This is not to say, however, that jueteng players do not also derive utility from winning, but if such utility is the same for all bettors, then the marginal difference in bets can only be attributed to differences in degla utility. That is, if on expectation degla-users are winning/losing just as often as non-degla users are (i.e. draws are random), then the only difference between them should be in terms of psychic benefits. We precisely control for the marginal utility from winning to see whether differences in this could also be explaining the differences in demand.

Here the evidence is mixed. On one hand, having won seems to be individually insignificant, on the other, it is jointly significant with degla. The lack of variation in our data on winning might be causing the statistical insignificance. Intuitively, however, the results suggest that at the very least, bettors consider their utility from degla jointly with their utility from winning. Why would they do so if they expect winning to be truly random and over which they have no control?

One plausible explanation might be that even if play is random and no one is winning more than others, there are differences in the psychic benefits from winning. That is, one bettor might enjoy winning more than another, given that the two of them win the same amount, or even given that the former is winning less often that the latter. If this is the case, then the marginal utility from winning may still be different across bettors, even if there is no cheating.

Note, however, that we use other controls (e.g. June variable, lnprevBet in the OLS regressions, and FE for time-constant omitted variables) and instruments that may also arguably capture differences in psychic benefits from winning. In this case, the estimated effect of winning may be due only to more objective monetary rewards. Thus, if there are differences in such effect, it must be because some bettors systematically win more (money) from each bet, which is possible only if draws are skewed towards them.

Most importantly, even if one does not rely on our results on the effects of winning, the fact that there are bettor-types that systematically place lower/higher bets provides an opportunity for profit-maximizing operators to price discriminate among bettors by skewing the outcomes. Note that they can do so if they want to because they can easily identify degla-users from non-degla users through the cobrador (and the draws, after all, are held in secret). Arguably, then, the only reason why operators would not cheat is that they do not want to - that is, cheating would be too costly to be profit-maximizing.

5. CONCLUSIONS

In this paper, we provide a plausible theoretical and empirical confirmation of the belief of jueteng players that draws are rigged to favor some types of bettors. That is, that there is effective price discrimination. For this to be sustained in equilbrium, it must be that bettors can reveal, and operators determine, bettor types; that price discrimination is profit-maximizing for the jueteng operator and utility-maximizing for all bettors; and that arbitraging between types is not possible.

If the draws are indeed rigged, it would be profit-maximizing (or cost-minimizing) to arrange it such that lower bets win more often. Through the cobrador and his notes, it is easy to identify and reveal bettor-types who have lower bets. But note that the cobrador also records, and actively engages in, degla, which suggests that it is also profit-maximizing to do so. One way of reconciling this is to propose that bettor-types, or the amount of bets, are differentiated according to the extent of degla-use. If this is so, then it must mean that bettors themselves choose how much to bet according to how much they engage in degla. It could be that either more intensive degla-users tend to bet less, in which case the operator favors them to win more often, or they bet more, in which case they are less favored by the operator.

Yet why is betting not specialized, that is, if, say, degla-users tend to be favored, why is it that not all bettors are degla-users? This suggests that arbitrage is not possible - non-degla users cannot 'hire' degla-users to bet for them, even if this affords more opportunites for the degla-users to engage in degla. That is, non-degla users cannot offer degla-users more degla utility in exchange for turning over the extra winnings. To 'fool' the operator, the lower-bet intensity must be maintained - the same bet per play, even if the number of plays increase to take into account the plays of non-degla users. This is not possible if non-degla users require higher winnings per play, because they would have to bet more intensely per play. Thus, the fact that we do not see specialized betting indicates that bettors' utilities from winning, relative to utilities from degla, are different. The sustained differences in betting behavior reflect persistently different utility-maximizing behavior across degla types.

Using data from bettors in Lubao, Pampanga, we verify that degla-users tend to place significantly lower bets than non-degla users. This suggests that profit-maximizing operators could be skewing the draws to favor the former. This could then help explain why many bettors think that degla 'works' - by coincidence, superstitions are profit-maximizing and utility-maximizing for degla-users and non-degla users alike.

In a broader sense, our paper provides an additional reason for why legalization of jueteng might not be optimal. A legalized environment which regulates the game and outlaws secret draws could forego the extra profit and utilities from cheating, and encourage underground versions of the game in which draws can be rigged. It is no surprise, then, that even when the Philippine government has initiated the Small Town Lottery (STL) game - a legal version of jueteng - illegal jueteng is still rampant and very much an integral part of community life especially in rural areas.[31]

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[31] Pamintuan notes that the various government-sanctioned paraphernalia for STL are even being used as a front, to cover the jueteng operations that are taking place in its stead.

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