Are *yokozuna* sacred?

Further evidence on match-rigging in *sumo* wrestling

Masahiro Hori and Koichiro Iwamoto [†]

Abstract

This paper looks for statistical evidence of match-rigging by *yokozuna* (grand champions) in Japanese *sumo*, which previous studies have not yet examined. The results suggest that *yokozuna*, too, have been involved in match-rigging, suggesting that economic incentives play an important role in shaping human behavior in almost any institution.

1. Introduction

In an article popular with people in the know, Duggan and Levitt (2002) provided evidence of pervasive match-rigging in Japanese professional sumo wrestling, a sport with many ritual elements.[1] The study provided rare empirical evidence of corruption and illustrated that economic incentives play a role in almost any institution.

Although the study proved quite popular in academic circles, its scientific evidence was ignored by the sumo community in Japan and had little impact on the awareness of match-rigging until it was clearly proven in February 2011 by mobile phone text message records confiscated from related parties by the National Police Agency. Even after the revelation of the scandal, the executives of the *sumo kyokai* (Japan Sumo Association) tried to draw the curtain on it, claiming that "this disgraceful affair is an entirely new problem by some impudent wrestlers," and that no involvement by other wrestlers could be found, including marquee wrestlers such as those at *yokozuna* (grand champion) level.

While the evidence by Duggan and Levitt (referred to as D&L hereafter) for the existence of match-rigging by *hiramaku* (rank-and-file wrestlers in sumo's highest division) appears to unveil an inconvenient truth about professional sumo, it lacks the

---

[1] See West (1997) for details on the official rules and informal norms in Japanese sumo.

finishing touch, since it does not prove the existence of match-rigging by marquee wrestlers, especially by *yokozuna*, the highest ranking wrestlers and symbol of sacredness in sumo. While subsequent studies such as Dietl et al. (2010) and Hori and Iwamoto (2013) supported D&L's findings and found further that more recently match-rigging has declined, they also do not present evidence of match-rigging by *yokozuna*, who face incentives that are entirely different from those of *hiramaku* wrestlers.

Against this background, this paper attempts to provide evidence of match-rigging by *yokozuna*. Although *yokozuna* face very different incentives from *hiramaku*, they nevertheless also do face incentives to rig matches, and if it were possible to show match-rigging by such a symbol of sacredness, this would provide further evidence that economic incentives play an important role in shaping human behavior even in very unlikely places such as the ancient tradition of *sumo* wrestling.

The remainder of this paper is organized as follows. The next section presents the data used in the analysis and presents the difference in wrestlers' performance by tier at the *makuuchi* level, the top division of professional sumo. Section 3 briefly explains our empirical strategy, while Section 4 presents the results. Section 5 concludes.

2. Data

The data used in the following analysis comes from the detailed "Sumo Reference" information (about wrestlers, rankings, and matches) available publicly on the internet.[2] Taking data availability and the time span used in the D&L study into account, we chose to conduct our analysis using *makuuchi* match data from January 1989 through January 2011.[3] Table 1 provides an overview of the number of observations used in the analysis. Our dataset spans a period that is almost twice as long as that in the D&L study and covers a total of 205 wrestlers and 39,000 matches.

In a *sumo* tournament, each wrestler competes in 15 matches, and D&L in their study highlighted the link between the skew in the win-loss distribution (7-8 records are few and 8-7 records unusually common) and the non-linearity of the payoff arising from a win. Figure 1 shows the win-loss distribution (panel (a)) and the marginal effect on the official ranking for the next tournament of one extra win (panel (b)) using our data. As can be seen, the pattern pointed out by D&L holds only for *hiramaku* wrestlers, while that for higher-ranked wrestlers looks very different, suggesting that the empirical strategy employed by D&W is applicable only to rank-and-file wrestlers.

---

[2] See <http://sumodb.sumogames.de/>.
[3] D&L's analysis focuses on matches by *sekitori*, wrestlers ranked in one of the top two professional divisions, *makuuchi* and *jūryō*. However, in this paper, we focus only on *makuuchi* wrestlers, since a *jūryō* wrestlers will not face a *yokozuna*, because they compete in different divisions.

3. Background and empirical strategy

Theoretical models presented in earlier studies (e.g., Nakajima, 2003; Hori and Iwamoto, 2013) suggest that match-rigging is more likely to occur when the importance of a match differs between the wrestlers. In a match between two *hiramaku* wrestlers, the difference is typically large when, on the final day of a tournament, a wrestler who has exactly seven wins meets a wrestler who does not have exactly seven wins. However, in the case of a *yokozuna*, as illustrated in Figure 1(b), an eighth win does not have critical importance. Instead, *Yokozuna*, who not only have a lot of prestige but are also financially well off as a result of their rank, usually need more than 11-12 wins; if a *yokozuna* does not reach this number in a tournament, this will lead to advice from the Yokozuna Deliberation Council to retire. Therefore, a *yokozuna* has an incentive in most matches to purchase a win from a *hiramaku* wrestler, as long as the *hiramaku* wrestler is willing to throw the match if properly compensated.

These considerations suggest that the incentives for match-rigging in sumo differ depending on a wrestler's rank and that *yokozuna*, too, have an incentive to purchase a win. However, we would not be able to detect any such match-rigging employing the strategy developed by D&W, which focuses on wrestlers on the verge of *kachikoshi*, that is, earning more wins than losses (i.e., an 8-7 record). We therefore propose a

different empirical strategy, which focuses on examining all matches between *yokozuna* and *hiramaku*. If a *yokozuna* rigs his matches against *hiramaku*, his winning record is likely to differ between matches against "corrupt" wrestlers and against "clean" wrestlers. Therefore, if we could find a way to distinguish between corrupt and clean wrestlers reasonably well, comparing the records of *yokozuna* against corrupt and clear wrestlers should tell us whether *yokozuna* are involved in match-rigging.

4. Results

4.1 Corrupt wrestlers vs. clean wrestlers

Because of the illicit nature of match-rigging, wrestlers who engage in it attempt not to leave a trail. Therefore, it is usually impossible to distinguish between corrupt and clean wrestlers with complete confidence. However, a section in D&W (2002) shows that the allegations made by two *sumo* insiders appear to be truthful. Further, Hori and Iwamoto (2013) empirically show that wrestlers who were punished after the match-rigging scandal in 2011 were more likely to have been involved in match-rigging. Therefore, the information publicly available about match-rigging in sumo appears to be relatively reliable.

In order to examine whether this is indeed the case, even for our dataset, we use the

information from publically available sources to divide wrestlers into three categories: corrupt, clean, or status unknown. Specifically, based on this information, 98 of the 199 *hiramaku* wrestlers in our sample are classified as corrupt, 41 as clean, and the remaining 60 as "status unknown." We then run a regression for matches between *hiramaku* wrestlers that is essentially the same as that employed by D&W (2002), but includes interaction variables between whether a match is on the bubble and the different possible combinations of wrestlers in a match (corrupt vs. corrupt, corrupt vs. clean, etc.).

Table 2 reports the results of the estimation. Column (a) presents the results without the interaction terms, which suggest that the likelihood of wrestlers on the bubble to win is significantly higher (by 14 percent) than would be expected. However, once we include the interaction terms (column (*b*)), this excess win percentage varies considerably across different wrestler combinations. Specifically, for matches involving a clean wrestler, no significant excess win percentage for wrestlers on the bubble is detected. In stark contrast, when a corrupt wrestler faces a wrestler who is either corrupt or whose status is unknown, the win percentage is significantly higher than would be expected. Specifically, when a corrupt wrestler on the bubble faces another corrupt wrestler, the excess win percentage reaches 25 percent, suggesting that our

identification of corrupt wrestlers is reliable.

4.2 Winning rate of yokozuna against hiramaku wrestlers

Having confirmed that our classification of wrestlers predicts patterns of match-rigging among *hiramaku* wrestlers well, we now turn to the pattern of matches between *yokozuna* and *hiramaku*. If *yokozuna* were also involved in match-rigging, we would expect significant differences in their match winning records against corrupt and clean wrestlers.

Therefore, in Table 3, we compare *yokuzuna* match records against both types of *hiramaku* wrestlers. Column (*a*) shows that the winning rate of *yokozuna* (against *hiramaku*) is about 29 percent higher than the baseline, i.e., *hiramaku* vs. *hiramaku* and *yokozuna* vs. *yokozuna*, indicating the strength of *yokozuna*. However, more interestingly, column (*b*) illustrates that the winning rate of *yokozuna* against corrupt *hiramaku* is about 6 percentage points higher than that against clean *hiramaku*, and the difference is statistically significant.

Public allegations of match-rigging by sumo insiders were directed not only at *hiramaku* wrestlers, but also at marquee wrestlers. Based on these allegations, we divide *yokozuna* into "clean *yokozuna*" (of which there are two) and "other *yokozuna*" (eight)

and compare their winning rates in columns (*c*) and (*d*). We find that for clean *yokozuna*, the excess winning rate against corrupt *hiramaku* is negative and insignificant, while for the other *yokozuna* it is larger than for the sample of all *yokozuna* and significant. These findings appear to suggest that some of the yokozuna were also involved in match-rigging.

5. Conclusion

To detect match-rigging by *yokozuna*, the highest-ranking sumo wrestlers and a symbol of sacredness, we examined matches between *yokozuna* on the one hand and *hiramaku* wrestlers with and without involvement in match-rigging on the other. Our results suggest that allegations by sumo insiders appear to be truthful and that *yokozuna*, too, have been involved in match-rigging.

The finding lends further support to D&L's argument that combining a clear understanding of the incentives facing actors and the creative use of data can reveal clear statistical evidences of corruption. Econometrics appears to have reached a stage that enables us to substantiate rumors of dishonest behavior and combat corruption in the real world.

References

Dietl, H., Lang, M., Werner, S., 2010. Corruption in Professional Sumo: An Update on the Study of Duggan and Levitt. **Journal of Sports Economics** 11(4), 383-396.

Duggan, M., Levitt, S.D., 2002. Winning Isn't Everything: Corruption in Sumo Wrestling. **American Economic Review** 92(5), 1594-1605.

Hori, M., Iwamoto, K., 2013. Match-Rigging in Professional Sumo: Elucidation of Incentive Structures and Empirical Analysis. **Japanese Political Economy**, forthcoming.
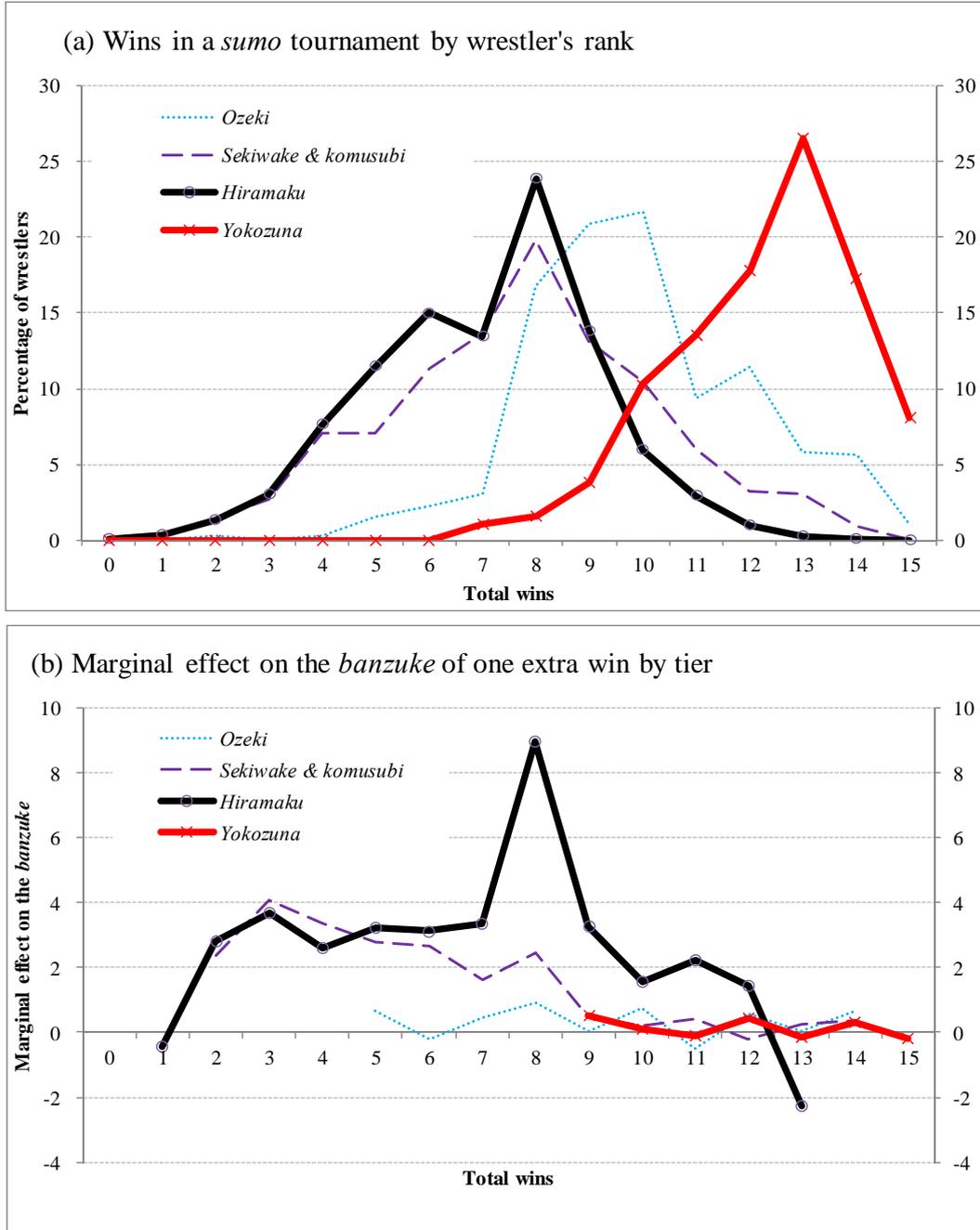
Nakajima, T., 2003. **Economics of the Grand Sumo**, Toyo Keizai Inc. (in Japanese)

West, M.D., 1997. Legal Rules and Social Norms in Japan's Secret World of Sumo. **Journal of Legal Studies** 26(1), 165-201.

Figures and Tables

Figure 1. Win-loss distribution and marginal effect of one extra win

(by tier in the *makuuchi* level, i.e., *yokozuna*, *ozeki*, *sekiwake* & *komusubi*, and *hiramaku*)

Note: The marginal effects on the *banzuke* in panel (b) are obtained by first calculating the average of how much the *banzuke* ranking for the next tournament changed for wrestlers with each number of wins and then taking the difference in the averages for each one additional win.

11

Table 1. Number of observations

		Number of tournaments	Number of wrestlers	Number of match combinations	Number of matches
Observations from Jan. 1989 to Jan. 2011	All *makuuchi* wrestlers	133	205	6,505	39,076
	Yokozuna vs. *Hiramaku*	133	*Yokozuna* 10	381	1,552
	Hiramaku vs. *Hiramaku*	133	*Hiramaku* 199	5,382	23,921

Notes: The sum of "*Yokozuna* vs. *Hiramaku*" and "*Hiramaku* vs. *Hiramaku*" does not add up to the number for "All *makuuchi* wrestlers," since there are *makuuchi* wrestlers other than *yokozuna* and *hiramaku* and a wrestler can appear repeatedly in the different ranks.

Table 2. Excess winning rate on the "bubble" for wrestlers labeled by sumo insiders as "corrupt" or "clean"

	All *hiramaku* matches	
	From Jan. 1989 to Jan. 2011	
	(a)	*(b)*
Wrestler on bubble (on days 13, 14, or 15)	0.144 ***	0.036
	(0.012)	(0.034)
Wrestler on bubble interacted with:		
"Corrupt" vs. "Corrupt" match		0.249 ***
		(0.040)
"Corrupt" vs. "Clean" match		0.022
		(0.041)
"Corrupt" vs. "Status unknown" match		0.098 **
		(0.044)
"Clean" vs. "Status unknown" match		0.074
		(0.052)
"Status unknown" vs. "Status unknown" match		0.026
		(0.076)
Constant	0.500 ***	0.500 ***
	(0.003)	(0.003)
Adjusted R^2	0.037	0.040
Number of observations	47,842	47,842

Notes: All regressions were conducted using OLS. The unit of observation is a wrestler-match. Numbers in parentheses are standard errors, which are corrected to account for the fact that there are two observations per match (one for each wrestler). *** and ** indicate significance at the 1 percent and 5 percent level, respectively. The dependent variable in all regressions is an indicator variable corresponding to whether or not a wrestler wins the match. "Wrestler on bubble" is an indicator variable that equals 1 (-1) if the wrestler (opponent) is on the bubble on days 13, 14, or 15 (has a record of 7-7, 7-6, 6-7, 7-5, 6-6, or 5-7) but the opponent (wrestler) is not, and 0 otherwise. Dummy variables for the interaction terms are based on our corrupt/clean wrestler lists, which were constructed based on multiple sources of information about public allegations (see Appendix 1 for the sources). In additon to the terms reported above, a variable for the difference in wrestlers' rank as well as wrestler and opponent fixed effects are also included in the specifications.

Table 3. Excess winning rate of *yokozuna* by type of opponent *hiramaku* wrestler

All matches between *hiramaku* and *hiramaku*, *hiramaku* and *yokozuna*, and *yokozuna* and *yokozuna* (from Jan. 1989 to Jan. 2011)

	All *yokozuna* in sample		"Clean" *yokozuna*	Other *yokozuna*
	(a)	(b)	(c)	(d)
Yokozuna (against *hiramaku*)	0.286 ***	0.248 ***	0.335 ***	0.227 ***
	(0.032)	(0.036)	(0.076)	(0.041)
Yokozuna interacted with:				
"Corrupt" *hiramaku*		0.057 **	-0.029	0.077 **
		(0.028)	(0.061)	(0.031)
"Status unknown" *hiramaku*		0.067	0.040	0.065
		(0.046)	(0.091)	(0.054)
Constant	0.500 ***	0.500 ***	0.500 ***	0.500 ***
	(0.003)	(0.003)	(0.003)	(0.003)
Adjusted R²	0.061	0.062	0.038	0.055
Number of observations	51,084	51,084	48,590	50,246

Notes: "*Yokozuna* " is an indicator variable that equals 1 (-1) if the wrestler (opponent) is a *yokozuna* but the opponent (wrestler) is a *hiramaku*, and 0 otherwise. A variable for the difference in wrestlers' rank as well as wrestler and opponent fixed effects are also included in the specifications. See notes of Table 2 for other details.

Appendix I.

The following is a list of sources on public allegations of match-rigging by sumo insiders.

板井圭介（2000）『中盆―私が見続けた国技・大相撲の”深奥”』小学館。[Itai, K., 2000. **Chubon: The "Depth" of Grand Sumo**. Shogakukan (in Japanese).]

小菅宏（2011）『７勝７敗の力士が勝ち越す理由』スコラマガジン。[Kosuge, H., 2011. Reasons Why Wrestlers with a 7-7 Record Hardly Ever Lose. **Sukora Magazine** (in Japanese).]

週刊ポスト編集部編（2000）『週刊ポストは「八百長」をこう報じてきた』小学館。[Shukan Post Editorial Office, 2000. Shukan Post Reported "Match-Rigging in Grand Sumo" in this Way. **Shogakukan** (in Japanese).]

田端良彦・相撲愛好会（2011）『大相撲「八百長」の研究―その仕組みと歴史』日本文芸社。[Tabata, Y. and a circle of sumo fans. 2011. **The Study of the "Chusha" System**. Nihon Bungeisha (in Japanese).]

元・大鳴戸親方（1996）『八百長―相撲協会一刀両断』鹿砦者。[ex-Oyakata Onaruto, 1996. **Match-Rigging: Cutting Grand Sumo in Two with a Single Stroke of a Sword**. Rokusaisha (in Japanese).]

『週刊朝日』[*Shukan Asahi.* Various issues (in Japanese).]

『週刊文春』[*Shukan Bunsyun.* Various issues (in Japanese).]

『週刊現代』[*Shukan Gendai.* Various issues (in Japanese).]

『週刊ポスト』[*Shukan Post.* Various issues (in Japanese).]

The list of wrestlers who were punished after the match-rigging scandal in 2011 is available at
http://ja.wikipedia.org/wiki/%E5%A4%A7%E7%9B%B8%E6%92%B2%E5%85%AB%E7%99%BE%E9%95%B7%E5%95%8F%E9%A1%8C