

Brunello, Giorgio; Yamamura, Eiji

Working Paper

Desperately Seeking a Japanese Yokozuna

IZA Discussion Papers, No. 16536

Provided in Cooperation with:

IZA – Institute of Labor Economics

Suggested Citation: Brunello, Giorgio; Yamamura, Eiji (2023) : Desperately Seeking a Japanese Yokozuna, IZA Discussion Papers, No. 16536, Institute of Labor Economics (IZA), Bonn

This Version is available at:

<https://hdl.handle.net/10419/282663>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

DISCUSSION PAPER SERIES

IZA DP No. 16536

Desperately Seeking a Japanese *Yokozuna*

Giorgio Brunello
Eiji Yamamura

OCTOBER 2023

DISCUSSION PAPER SERIES

IZA DP No. 16536

Desperately Seeking a Japanese *Yokozuna*

Giorgio Brunello

Padua University and IZA

Eiji Yamamura

Seinan Gakuin University

OCTOBER 2023

Any opinions expressed in this paper are those of the author(s) and not those of IZA. Research published in this series may include views on policy, but IZA takes no institutional policy positions. The IZA research network is committed to the IZA Guiding Principles of Research Integrity.

The IZA Institute of Labor Economics is an independent economic research institute that conducts research in labor economics and offers evidence-based policy advice on labor market issues. Supported by the Deutsche Post Foundation, IZA runs the world's largest network of economists, whose research aims to provide answers to the global labor market challenges of our time. Our key objective is to build bridges between academic research, policymakers and society.

IZA Discussion Papers often represent preliminary work and are circulated to encourage discussion. Citation of such a paper should account for its provisional character. A revised version may be available directly from the author.

ISSN: 2365-9793

IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

Desperately Seeking a Japanese *Yokozuna**

Using data on wrestlers and tournaments since the early 1970s, we study promotion practices in Sumo, a Japanese traditional sport. We show that, especially since 2010, foreign-born wrestlers trying to attain the second highest rank in Sumo were treated less favorably than Japanese born wrestlers. Similar practices, however, do not apply to foreign-born wrestlers competing for the top rank, probably because of the much higher public scrutiny attracted by promotions to this rank. Together with the 2010 Reform that effectively restricted access to foreign-born wrestlers, existing promotion practices may favor the return of Japanese born players to the top rank of the game.

JEL Classification: J40, J71

Keywords: promotion, Sumo, sports, Japan

Corresponding author:

Giorgio Brunello
Department of Economics and Management
University of Padua
via del Santo 33
35123 Padova
Italy
E-mail: giorgio.brunello@unipd.it

* We are grateful to Marco Bertoni, Yoshiro Tsutsui and to the audience at a seminar at Waseda University for comments. The usual disclaimer applies.

1. Introduction

Professional Sumo, a very traditional Japanese sport, was for long a closed world, managed using internal norms (West 1997, 2004) and in-group consent (Duggan and Levitt 2002; Dietl et al 2020). For about 300 years, all wrestlers were Japanese born. Things have changed dramatically in the past 30 years, especially since the demise of the Soviet Union and its satellite states, which triggered an important inflow of foreign wrestlers, mainly from Mongolia. Nowadays, the top ranked position in Sumo – called *Yokozuna* or grand-champion – is filled only by a foreign wrestler and there has been no Japanese born *Yokozuna* after 2003, except for the period 2017-18 when Japanese born *Kisenosato* was grand-champion (See Appendix Table A1).

Whether the current predominance of Mongolian wrestlers has benefitted the Japanese consumer is not clear. Average quality may have improved, but the lack of a national champion is reducing the popularity of the game. Since a competitive balance among teams and players is important to increase consumer demand for professional sports, rules are often changed to improve this balance, not only in the western countries (Eckard, 2001, Jost, 2021, Kent et al. 2013), but also in Japan (La Croix and Kawaura, 1999).

The Sumo Association, in charge of the sport,¹ has tried to change the current trend by imposing in 2010 a strict limit to the number of foreign-born wrestlers. In this paper, we study the consequences of this policy, and ask whether it was accompanied by less visible measures that

¹ The Sumo Association governs Sumo based on formal written rules and unwritten norms shared by its members (West 2004). The Association chooses whether to obey the formal rules or defect to norms by calculating comparative efficiency (West 1997).

treated differently foreign-born and Japanese wrestlers in their quest for promotion to the top ranks of Sumo.

Using data on promotions in the top division of Sumo from 1990 to 2023, we do not find evidence that foreign-born wrestlers were treated by the Sumo Association less favorably than Japanese born wrestlers competing for the top *Yokozuna* position. We explain this result with the fact that promotion to *Yokozuna* is highly scrutinized by the specialized press and Japanese fans, which makes discrimination difficult. Perhaps as important, previous examples of “unfair” treatments – described below – have made the Sumo Association wary and eager to avoid further scandals.

We find instead evidence that, especially since 2010, foreign-born wrestlers have been treated less favorably than Japanese wrestlers in the promotion to *Ozeki*, the second – highest rank in Sumo. We explain this with the fact that promotion to *Ozeki* is less exposed to public scrutiny than promotion to the highest rank. We argue that, since becoming *Ozeki* is a pre-requisite for promotion to *Yokozuna*, making promotion to *Ozeki* more difficult for foreign-born than for equally capable Japanese wrestlers may be a subtler and more viable strategy pursued by the Sumo Association to favor the return of Japanese *Yokozuna*.

The paper is organized as follows: Section 2 is an overview of the world of Sumo, Section 3 reviews the relevant literature, Sections 4 and 5 introduce the data and the empirical strategy. The results are presented in Section 6, followed by a short Section 7 devoted to robustness exercises. The paper ends with a discussion and conclusions.

2. *Overview of the world of Sumo*

2.1. *The arrival of foreign wrestlers*

Before opening the country to the world in mid-19th century, Sumo wrestling has been a popular entertainment in Japan. Even after the Meiji restoration, the traditional features of Sumo society have been kept more or less intact until now (Oinuma, 1994). For instance, Sumo wrestlers belong to a stable (*beya*) and are obliged to live together with other wrestlers. They must obey the written and unwritten rules of the Sumo society (West 1997).² In the post-World War II period, when a new constitution was established to regulate Japanese society, the Sumo world has broadly kept its norms and organization, remaining closer and more traditional than the ordinary one.

However, as in other professional sports (see for instance Schmidt and Berri, 2005; Berlinschi et al., 2013), the vital impact of international labor mobility, the miraculous economic growth of Japan and international factors such as the collapse of the former Soviet Union and its satellite states have affected Sumo as well, attracting a growing inflow of foreign wrestlers.

In 1968, a young Hawaiian American boy, Jesse James Wailani Kuhaulua, was admitted into the Sumo world and received the professional name *Takamiyama*. He was the first non-Asian to enter the Sumo top division (*Makuuchi*), which consists of a fixed number of wrestlers (42).³ As shown by Figure 1, after *Takamiyama* the percentage of foreign wrestlers in the top division of Sumo increased slowly to close

² The description of Sumo in this Section is based on the Grand Sumo Encyclopedia, 2001, and Mizuno and Kyosu, 2022, unless otherwise stated.

³ Besides *Makuuchi*, there are five divisions in Sumo: *Jūryō* (28 wrestlers), *Makushita* (120 wrestlers), *Sandanme* (200 wrestlers), *Jonidan* (about 230 wrestlers), and *Jonokuchi* (about 80 wrestlers). Totally, approximately 730 wrestlers participate to each tournament. Except for *elite* players – or the top class of amateur wrestlers – new wrestlers typically start their career from the lowest division, *Jonokuchi*, and are promoted to higher divisions if their performance is above the required standard.

to 10 percent in the late 1990s and surged to close to 40 percent in 2010, driven mainly by the inflow of Mongolian wrestlers.

Wrestlers in the top division of Sumo are ranked according to performance, from *Yokozuna* (the highest status in the top division), to *Ozeki* (the second-highest status), *Sekiwake* (the third-highest one) and *Komusubi* (the fourth-highest one). *Yokozuna* is the outstanding status and the symbol of Sumo. *Ozeki*, *Sekiwake* and *Komusubi* are also called “*Sanyaku*”, or the three premium statuses. Below *Sanyaku*, wrestlers are classified as *Maegashira*.

After four years, in 1972 the young foreign wrestler *Takamiyama* made it to *Sekiwake* but did not manage to go any further in his career. The first foreign *Ozeki* was instead *Konishiki*, who also came from Hawaii and was promoted to the second highest rank in 1987. Although his performance was quite good, he never made it to the top rank. Many Japanese think that his failure to be promoted to *Yokozuna* was due to racial discrimination against foreign players, something that brought considerable criticism to the Sumo Association.

However, a competing explanation of the unsuccessful bid by *Konoshiki* for the top rank is that he was unlucky enough to face a considerable tightening of the standard for promotion, triggered by the so called *Futahaguro* scandal – see below. In 1993, another Hawaiian-born player, *Akebono*, finally made it to *Yokozuna*.

From the late eighties and early nineties onwards, the presence of foreign wrestlers in the top two Sumo ranks has changed considerably, also because of the inflow of a sequence of powerful Mongolian wrestlers leaving their country after the end of the Soviet regimes in Asia. As shown by Figure 2, the percentage of foreign *Ozeki* reached 40

percent of the total in 1990, declined rapidly in the nineties – partly because of their rapid promotion to *Yokozuna* - and increased sharply again in the new millennium, reaching close to 60 percent in 2010 to decline again afterwards. On the other hand, the share of foreign *Yokozuna* increased monotonically from the early nineties to the mid-2000s, when it reached 100 percent. Except for a temporary decline in the mid-2010s, this percentage has remained unaltered until today (see Figure 3).

2.2. *The promotion and demotion of wrestlers*

Sumo tournaments are usually held six times a year, every two months. Below the top two ranks, a wrestler is promoted to a higher rank if his wins in a tournament outnumber losses and is automatically demoted to a lower rank if losses outnumber wins.⁴ The rules for promotion to *Yokozuna* and *Ozeki* are more complicated and less automatic, giving the Sumo Association deciding promotions a higher degree of discretion.

Promotion to *Ozeki* requires at least 33 (out of 45 bouts) wins in the past three tournaments. This threshold, however, is applied rather flexibly and on an ambiguous case-by-case basis (Nagayama 2023). As shown in Appendix Table A2, some wrestlers have been promoted with less than 33 wins. Although not reported in the table, there are also wrestlers who have not been promoted even with more than 33 wins.

Promotions to *Yokozuna* are decided by a committee of the Sumo Association, the *Yokozuna Deliberation Council*. The standards for promotion to the highest rank are also ambiguous and tend to change

⁴ In a tournament involving the top *Makuuchi* division, there are fifteen bouts or matches. The promotion rule generates an incentive for match rigging (Duggan and Levitt 2002, Dietl et al., 2010).

with circumstances. As shown in Appendix Table A1, wrestlers could be promoted with less than 36 wins in the past three tournaments or could be upgraded even without having recently won a championship.

An emblematic example is the Japanese wrestler *Futahaguro*, who was promoted very young (21 years old), with the expectation that his performance would drastically improve. However, at the end of 1988, he got in trouble with his stable master, and suddenly retired. The incident damaged the prestige of *Yokozuna*, triggering a barrage of criticism against the Sumo Association. In response, the Yokozuna Deliberation Council tightened the *Yokozuna* promotion standard in late 1989 by requiring *Ozeki* wrestlers to win two consecutive tournaments to qualify for promotion (Nagayama, 2023). From 1990 and until quite recently, most of the candidates promoted to *Yokozuna* have met this tougher standard.

Ozeki wrestlers are demoted if losses outweigh wins in two consecutive tournaments.⁵ After demotion, they can be reinstated to their previous rank if they win at least 10 bouts in the next tournament. This rule was applied in several cases.⁶ A key privilege of top ranked *Yokozuna* is that they cannot be demoted. Rather, they typically retire if their performance does not meet the expectations of the Sumo Association and the Japanese public. Since retirement cannot be forced upon a wrestler, an implicit requisite for promotion to the highest rank is that

⁵ This mechanism is exposed to rigging behavior (see Duggan and Levitt 2002; Dietl et al 2020).

⁶ Appendix Table A2 excludes cases of promotion based on this special rule. This rule was applied for Mienoumi, Takanonami, Musoyama, Tochiazuma (twice), Tochinoshin, Takakeisho. On the other hand, Kaiketsu (1975 and 1977) and Terunofuji (2015 and 2021) were promoted back to *Ozeki* twice, without using the rule.

the candidate should have internalized the code of behavior typical of somebody who represents Sumo traditions.

2.3. *The 2010 reform*

From 2003 to 2016 there was no Japanese born *Yokozuna*. During that period, and after a brief spell by Japanese born *Kisenosato*, who retired in 2019, the top rank in this traditional Japanese sport has been occupied exclusively by foreign wrestlers, mostly from Mongolia. Understandably, this situation has fostered over time the frustration and disappointment of Japanese Sumo fans, eager to see the next Japanese *Yokozuna*, and reduced the popularity of this sport.⁷ An indicator of this frustration is the significantly lower percentage of viewers of Sumo broadcasts by the national television during the years 2000 to 2017 than during the 1990s (Figure 4), when the two Japanese grand-champions *Takanohana* and *Wakanohana* were active.

After the collapse of the former socialism countries, many promising foreign young boys were admitted the Sumo. Mongolian wrestlers rapidly became dominant after 2000, filling most of the top ranks (Iizuka 2022, Koto-ohshu 2014, Ohshima 2015, Terunofuji 2021). The Japanese Sumo Association – in an effort to reduce the inflow of foreign players – introduced in 2002 the rule that each Sumo stable could host at most one foreign wrestler. However, this rule was largely ineffective as many players circumvented it by acquiring the Japanese nationality. As a consequence, during the early 2000s the share of foreign players in the top division did not decline but increased sharply from about 10 to about 40 percent.

⁷ In other professional sports, the inflow of foreign players has reduced domestic demand (Foley and Smith 2007, Tainsky and Winfree 2010).

This loophole was closed in 2010, when it was established that each stable could have at most one foreign-born player. This measure was quite effective, as the share of stables with more than one foreign-born wrestler declined from 19.2% in 2009 to 4.6% in 2023. The number of foreign-born wrestlers also declined sharply, from close to 60 in the late 2000s to 26 in 2023 (see Figure 5). This reduction, however, was less pronounced in the top division (from 14 to 10 players). Since upbreeding is the rule in Sumo, the expectation is that, over time, the percentage of foreign-born wrestlers competing for *Ozeki* and *Yokozuna* will fall further, thus increasing the opportunities of promotion for Japanese born players.

A potential side effect of the 2010 reform has been the reduction in the number of *Ozeki* competing for promotion to *Yokozuna* in each tournament (see Figure 6). If one looks at the list of wrestlers participating to the January 2023 tournament, for the first time since January 1993 there were only one *Yokozuna* and one *Ozeki*, while the norm is two to three *Yokozuna* and three to four *Ozeki* wrestlers (Nagayama, 2023).

With a declining number of *Ozeki* who could be candidates for promotion to the highest rank, the criterion of winning two tournaments in a row – established in 1990 after the *Futahaguro* scandal – was considered by the Sumo Association too tight to ensure a minimum number of *Yokozuna* and was abandoned already with the promotion to *Yokozuna* of wrestler *Kakuryu*, who made it in 2014 with 37 wins in the past three tournaments and a single championship won during the same period.

3. Previous literature

The rules of promotion and demotion in Sumo have generated incentives to rig bouts.⁸ However, after the scandal of rigging matches was covered by media, rigging behavior decreased (Duggan and Levitt 2002; Dietl et al 2020), suggesting that the Sumo world rationally reacted to criticism by Japanese society and fans triggered by media scrutiny. The sensitivity to the opinion of fans is in line with findings by studies of favoritism in sports, indicating that social pressure from the audience can induce referees to tilt decisions in favor the home team (Garicano et al., 2005, Bose et al., 2022).

When the closed and tightly knitted Sumo society encountered globalization, its labor market was substantially influenced (Yamamura 2014). Competitive pressures led a closed society such as Sumo to use potentially more productive immigrants, previously unavailable due to political reasons, laws and norms. The racial integration of players in sports has drawn substantial interest from researchers (e.g., Goff et al. 2002, Holms and Kane 2023). Research has pointed out that poor performance by a team can trigger the employment of foreign players (Goff et al. 2002, Hansen and Meehan 2009). For instance, in Japanese Professional Baseball, losing teams are more inclined to use foreign players in the following season (Kawaura and La Croix, 2016).

Prior to globalization, racial discrimination in sports was studied in classical papers in economics, such as Scully 1974 and Kahn, 1991. One point made by these papers is that, when labor markets in professional sports become competitive, the wage bill of the team is likely to align with average productivity regardless of the race of players. In the

⁸ Similar rigging behaviors are observed in professional football leagues in Europe, especially in countries with higher corruption (Elaad et al. 2018).

English Premier Football League (EPL), for instance, the higher the rate of black players, the better the team's performance (Szymanski 2000).

Employers could be motivated to prefer white players than equally skilled colored ones if fans are racially prejudiced and prefer teams composed of white players. However, studies of the EPL examining whether discrimination originates from the preferences of employers or fans have found little evidence of either (Preston and Szymanski 2000 and Bryson and Chevalier 2015).

In the US Major Professional Baseball League (MLB), there is evidence instead of racial discrimination in employer's cross-assignment (Bodvarsson et al. 2014). Quantile regression estimation reveals that wage discrimination of black players is observed for those in the lower half of the wage distribution (Holmes 2011). The study of voting behaviors for the National Baseball Hall of Fame also shows evidence of racial discrimination (Findlay and Reid, 1997).

Partly due to increased market competition, discrimination has declined over time (Groothuis and Hill 2008). Although returns to hiring black players are high, their integration has been slow because employers have been willing to sacrifice profits to satisfy their preferences (Lanning 2010).⁹ On the other hand, votes by fans for the annual All-stars games and demands for baseball cards show a decrease in the discriminatory attitude (Hassen and Anderson 1999, Van Scyoc and Burnett 2013).

Concerning promotion patterns, MLB is characterized by a pyramidal structure with multiple minor leagues under the top "Major" league. Although there is evidence that both blacks and Hispanics faced

⁹ There is evidence that sales of tickets and attendance varied with the number of foreign players added to the roster (Foley and Smith 2007, Tainsky and Wnfree 2010).

discrimination in promotion to the top league, this tendency seems to be declining (Bollemore 2001). In the National Football League (NFL), non-white players experienced hiring discrimination but were treated more equally in the promotion decisions by employers (Conlin and Emerson 2006).

Overall, the literature suggests that racial discrimination in professional sports does exist, but its importance is declining (Hassen 1998; Goff et al. 2002; Kawaura and La Croix, 2016). We contribute to this literature by investigating whether foreign wrestlers in Sumo have been treated less favorably than Japanese wrestlers, especially after the 2010 reform that substantially restricted access to non-Japanese players.

4. *Data*

We study discrimination in promotion by using individual tournament – level data from the website “Sumo Reference”,¹⁰ which includes information on each wrestler’s status and division, wins and losses,¹¹ date of birth, year and month of debut, nationality, and stable of affiliation. We check the reliability of these data by consulting the Grand Sumo Encyclopedia, 2001 and the Directory of Sumo Wrestlers (Mizuno and Kyosu 2011).

We focus on Sumo top division and investigate whether there are significant differences by nationality (foreign-born versus Japanese born) in the promotions to the top two ranks (*Ozeki* and *Yokozuna*). We select our working sample to cover the period when the pool of candidates for promotion included foreign wrestlers. For promotion to

¹⁰ Source of data is <https://Sumodb.Sumogames.de/> (accessed during May 30th -July 5th, 2023).

¹¹ Usually, six Grand Sumo Tournaments (*basho*) are held each year, except for the COVID-19 pandemic period.

Ozeki, we consider the pool of eligible *Sekiwake* during the period 1972-2023, because the first foreign-born *Sekiwake* wrestler (*Takamiyama*) emerged in 1972. For promotion to *Yokozuna*, we consider the pool of *Ozeki* during the period 1990 to 2013 for two reasons: first, the first foreign *Ozeki* who could be promoted to the highest rank was Hawaiian born *Konishiki* in 1987. Second, at the end of 1989 the rule for promotion to *Yokozuna* were drastically changed after the *Futahaguro* scandal.¹²

While promotion to *Yokozuna* is an absorbing state, promotion to *Ozeki* is not. We make the latter an absorbing state too by excluding all records after the first promotion. Our working sample consists of 626 records (tournaments by wrestlers) for promotion to *Ozeki* and 671 records for promotion to *Yokozuna*.

Table 1 illustrates a few characteristics of the two samples, the one consisting of *Sekiwake*, who compete for promotion to *Ozeki*, and the other consisting of *Ozeki*, who compete for promotion to *Yokozuna*, before and after the 2010 Reform and separately for domestic and foreign-born wrestlers.

Consider first the former group (upper panel in the table). We find that foreign-born players are more likely to be promoted than Japanese born players, have a higher average number of wins per tournament and require less time (in years) to be promoted to their current rank, which we take as an indicator of Sumo-specific ability. Over time, however, the advantage enjoyed by foreign-born *Sekiwake* in the promotion to *Ozeki* has declined substantially, from close to 30 percentage points (70 - 40.5) before 2010 to 3 percentage points from 2010 onwards (36.3 - 33.3).

¹² Results based on the period 1987-2013 are very similar to those discussed in the text.

Turning to the sample of *Ozeki* (bottom panel in the table), we confirm that foreign-born wrestlers outperform on average Japanese-born wrestlers in the number of wins per tournament and in the probability of winning at least one championship in the past three tournaments. They require on average less time to become *Ozeki* and have a higher probability of promotion to the highest rank than Japanese born wrestlers. As in the case of the former group, the positive gap in the probability of promotion has declined after 2010, from more than 50 percentage points (80 - 27.2) to 40 percentage points (50 - 10), but much less than for *Sekiwake* competing for *Ozeki*.¹³

5. The Empirical Approach

Starting in 2010, the Sumo Association effectively restricted access by foreign-born wrestlers to professional Sumo. In this section, we ask whether this restriction was accompanied by an *implicit* change in the promotion policy, with the purpose of making it more difficult for foreign-born wrestlers to attain the two top Sumo rank, *Ozeki* and *Yokozuna*, and thus facilitating the promotion of Japanese born wrestlers. A differential treatment of foreign-born and Japanese born wrestlers can occur in two ways: first, similar achievements contribute differently to promotion depending on whether the player is domestic or foreigner; second, although achievements contribute the same, players with the same results and characteristics are treated differently depending on their origin.

¹³ In either case, the observed decline occurs in spite of potential positive selection (with fewer slots for foreign-born players, only the best foreign wrestlers are in the top division game).

To illustrate, consider the following empirical promotion function

$$\pi_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 W_{it} + \beta_3 C_{it} + \beta_4 (W_{it} \times F_i) + \beta_5 (C_{it} \times F_i) + \beta_6 F_i + u_{it} \quad (1)$$

where π is the probability of promotion; X is a vector of time invariant and time varying characteristics; W is a binary variable equal to 1 if the total number of wins in the past three tournaments attains a minimum threshold (33 for promotion to *Ozeki* and 36 for promotion to *Yokozuna*) and to 0 otherwise; C is the number of championships won in the past three tournaments; F is a binary variable equal to 1 if the player is foreign-born and 0 if he is Japanese born, and u is a random error.

The first type of differential treatment occurs if parameters β_4 and β_5 are different from zero. For instance, $\beta_4 > 0$ indicates that attaining the minimum number of wins contributes more to promotion for a foreign-born than for a Japanese born wrestler, and $\beta_5 < 0$ suggests that winning a tournament contributes less to promotion for the former than for the latter. The second type of differential treatment occurs instead if β_6 is different from zero: conditional on observed characteristics and measured performance, foreign-born wrestlers have a lower probability of promotion if $\beta_6 < 0$.

A problem with directly estimating Eq. (1) is that omitted individual unobservables that correlate with foreign-born status F will bias not only parameter β_6 but also parameters β_4 and β_5 . To avoid this, we adopt a two-step procedure. In the first step, we estimate the linear probability model

$$\pi_{it} = \beta_0 + \beta_1 Y_{it} + \beta_2 W_{it} + \beta_3 C_{it} + \beta_4 (W_{it} \times F_i) + \beta_5 (C_{it} \times F_i) + v_i + \varepsilon_{it} \quad (2)$$

where Y is a vector containing only the time-varying variables in X , ε are white noise residuals and v are individual fixed effects, which control

for all the time invariant confounders that could be correlated with foreign status.¹⁴

In the second step, we estimate parameter β_6 by regressing the estimates of the individual fixed effects, \hat{v}_i , on the dummy F and a vector of time invariant controls Z

$$\hat{v}_i = \gamma_0 + \beta_6 F_i + \beta_7 Z_i + \varphi_i \quad (3)$$

using either robust standard errors or weighted least squares to control for the heteroscedasticity of errors (see Levin and Linzen, 2005).

6. Results

We estimate equations (2) and (3) separately for promotion to *Ozeki* and *Yokozuna*.

6.1 Promotion to *Ozeki*

Starting with the former, since the candidates to promotion to *Ozeki* have typically attained the lower rank of *Sekiwake*, we only consider players with this rank. As mentioned above, we restrict our attention to the period 1972 to 2023 - when at least one foreign *Sekiwake* was present - and estimate (2) both in the full sample 1972 to 2023 and in two sub-samples, 1972 to 2009 and 2010 to 2023,¹⁵ before and after the 2010 reform.

We control for the year and the month of the tournament using year and month fixed effects and include in vector Y both the player's body mass index (BMI) and the number of players with at least a *Sekiwake* rank in the stable to which the player belongs. Weight is clearly important in

¹⁴ When estimating Eq. (2) we always cluster standard errors at the individual level.

¹⁵ We assign players to each sub-period by using the latest year for which we have data. We assign the player to the former or latter sub-period depending on whether this year is earlier than 2010 or not.

professional Sumo, and having many strong wrestlers in the stable could facilitate promotion both by providing good training opportunities and because wrestlers of the same stable are typically not paired together during tournaments.

Table 2 presents the summary statistics for the variables used in the empirical analysis of promotion to *Ozeki*. The full sample consists of 118 wrestlers and, on average, 5.31 observations per wrestler. The percentage of *Sekiwake* promoted to *Ozeki* is close to 8 percent, higher in the earlier than in the later sub-period. A key change between the first and the second sub-period is the increase in the share of foreign-born *Sekiwake*, from 11.9 to 31.4 percent.

Table 3 reports the first step estimates for the promotion to *Ozeki*. The table is organized in three columns, one for the full sample and one each for the two sub-samples. We find that winning at least 33 bouts in the past three tournaments contributes substantially to the probability of promotion to *Ozeki* (marginal effect: 0.769).

This probability increases further (marginal effect: 0.265) if these wins lead to at least one championship. In the full sample, there is no evidence that the price of wins (β_4) and championships (β_5) varies with whether the wrestlers is foreign or Japanese born. When we separate the sample into the two sub-periods, however, we find that the price of winning at least 33 matches in the last three tournaments is higher for foreign-born than for Japanese born wrestlers in the former sub-period (0.967 versus 0.739) and lower for foreign-born wrestlers (0.609 versus 0.972 for Japanese born) after the 2010 reform restricted their access to the game. In either sub-period, these differences are statistically significant at the conventional level of confidence.

On the other hand, the price of winning championships is always higher for Japanese than for foreign-born wrestlers, although the difference is never statistically significant. These results indicate that foreign-born wrestlers competing during the years 2010 to 2023 could expect from winning at least 33 bouts in the past three tournaments a significantly lower probability of promotion to *Ozeki* than foreign-born wrestlers with a similar performance who competed from 1972 to 2009. Japanese born wrestlers competing more recently could instead expect a higher payoff from winning at least 33 bouts and a lower payoff from winning championships than native wrestlers who performed in the earlier period.

We retrieve from the estimates of (2) in the two sub-periods the estimated individual fixed effects and regress them on the wrestler's age, a binary variable indicating whether the stable to which the wrestler belongs has a higher than median number of top players, a foreign-born dummy, a sub-period dummy (0 for the period 1972-2009 and 1 for the period 2010-2023) and the interactions of this dummy with the age, stable type and foreign status.¹⁶ Table 4 shows our results. The first column reports the OLS estimates with robust standard errors and the second column shows the WLS estimates, using the reciprocal of the estimated standard errors in the first stage as weight.

Results across the two columns are very similar. We find that the coefficient associated with foreign-born status, which corresponds to β_6 in (2), attracts a negative and statistically significant coefficient (-0.157 and -0.156 in the first and second column), which does not change

¹⁶ Figures A1 and A2 in the Appendix plot the estimated residuals against age both for *Sekiwake* and for *Ozeki*.

significantly in the second sub-period (the interaction of the foreign-born dummy with the second period is positive but not statistically significant). This finding suggests that foreign-born status has penalized wrestlers during the entire sample period. This penalty was attenuated before 2010 and exacerbated from 2010 onwards by the higher and lower price (β_4) associated with winning at least 33 bouts.

6.2 Promotion to Yokozuna

For the reasons mentioned above, we consider in this study the period 1990 to 2023, after the important changes in the promotion rules for *Yokozuna* that occurred at the end of 1989. The pool of applicants to promotion consists of players with the rank *Ozeki*. Table 5 presents the summary statistics for the variables used in the empirical analysis of promotion to *Yokozuna*. The sample consists of 30 *Ozeki*, with an average of close to 20 observations per *Ozeki*. Comparing the two sub-periods, we notice that the share of foreign-born wrestlers is much higher in the latter than in the former period (37.5 versus 31.2). We observe also a decline over time in the probability of promotion (from 2.2 to 1.1 percent), in the probability of winning at least 36 matches in the past three tournaments (from 10.9 to 2.5 percent) and in the number of championships won (from 0.278 to 0.145). There is also an increase in the number of years required to attain the *Ozeki* rank, suggesting that the average quality of the pool of applicants may have declined over time.

Table 6 reports our first step estimates (Eq. (2)). The table is organized in three columns, one for the full sample and one each for the two sub-samples. We find that both winning at least 36 bouts and winning championships in the past three tournaments contribute to the probability of promotion to *Yokozuna*. In the full sample, the price of

winning championships (β_5) is also significantly higher for foreign-born than for Japanese born players (0.159 versus 0.045).

When we separate the sample into two sub-periods, however, we find that the price of winning championships in the last three tournaments is higher for foreign-born than for Japanese born wrestlers both in the earlier sub-period (0.217 versus 0.141) and in the later sub-period (0.076 versus 0.015), although the difference is statistically significant only in the former case. On the other hand, winning at least 36 bouts in the past three tournaments pays off more for Japanese born than for foreign-born wrestlers before 2010 (0.141 versus -0.007) and more for foreign-born wrestlers from 2010 onwards (0.522 versus 0.247). In either case, however, the difference between the two groups is not statistically significant. Independently of whether the wrestler is foreign or Japanese born, the evidence suggests a decline over time in the importance of winning championships and an increase in the importance of winning at least 36 matches, in line with the changes in the promotion rules discussed above.

As for the promotion to *Ozeki*, we retrieve from the estimates of (2) in the two sub-periods the estimated individual fixed effects and regress them on the wrestler's age, a binary variable indicating the stable with a higher than median number of top players, a foreign-born dummy, a sub-period dummy and the interactions of this dummy with the age, foreign status and stable type. Table 7 shows our results. We find that the coefficient associated with foreign-born status, which corresponds to β_6 in (3), attracts a positive but imprecisely estimated coefficient (0.110 in the first column), which declines somewhat since 2010 (0.094, also imprecisely estimated). While these findings do not allow us to draw

firm conclusions because of their imprecision, they imply that foreign-born status probably did not damage wrestlers in their bid for promotion to *Yokozuna*. This and the higher price associated with winning championships before 2010 and with winning at least 36 bouts from 2010 onwards suggest that foreign-born players competing for *Yokozuna* were treated somewhat more favorably than Japanese born players, contrary to what happened for the promotion to *Ozeki*.

7. Robustness analysis

While the two - step methodology adopted in this paper guarantees that the estimates of parameters β_4 and β_5 are consistent, the estimate of parameter β_6 may still be biased if we omit time invariant unobservables that are correlated with foreign-born status, such as for instance individual wrestling ability. To address this threat, we add to vector Z in (3) as measure of this ability the time from debut to the attainment of the position of *Sekiwake* (when examining the probability of promotion to *Ozeki*) or *Ozeki* (when considering promotion to *Yokozuna*). Columns (3) and (4) in Tables 4 and 7 report the results when the baseline specification is augmented with measured ability and its interaction with the period. In either table, we find that adding these variables affects only marginally our results.

Estimated individual fixed effects converge to true fixed effects when the number of observations per individual is sufficiently large. In our case, we have on average about 5 observations per individual for promotion to *Ozeki* and about 20 observations for promotion to *Yokozuna*. In this situation, it is useful to check the robustness of our results by using Bayes shrinkage (see for instance Gilraine et al, 2020). We apply this method by assuming a prior normal distribution with 0

mean and standard deviation equal to 100 for the regression parameters in (2). We then retrieve the estimated fixed effects for the second step regression. The estimates reported for both samples in Appendix Tables A3 (first step) and A4 (second step estimates) confirm our results.

8. Discussion and conclusions

The dramatic increase in the number of foreign wrestlers in Japanese Sumo during the past twenty years – triggered in part by the collapse of the Soviet Union and the consequent inflow of powerful Mongolian wrestlers – has led to the (temporary) disappearance of the Japanese born *Yokozuna* in a very traditional Japanese sport, raising concerns about the dwindling popularity of a sport that cannot thrive too long without a domestic grand-champion.

One potential way to favor the emergence of new Japanese born *Yokozuna* would have been for the Sumo Association to discriminate foreign-born wrestlers competing for the top position, by making their promotion, conditional on performance, harder than for Japanese born wrestlers. We believe, however, that the progressive opening of Japanese society, together with the events unfolding in the late 1980, when a foreign-born Hawaiian *Ozeki*, *Konishiki*, could not make it to the top rank despite very good performance, and a Japanese born *Ozeki*, *Futahaguro*, was promoted without having attained the expected performance, have made this route rather perilous.

Our empirical evidence of all promotions to the top rank from 1990 to 2023 suggests that, perhaps due to the pressure of the public opinion triggered by these events, foreign-born wrestlers were not treated on average less favorably than Japanese born wrestlers, which of course

contributed to the (temporary) disappearance of the Japanese born *Yokozuna*.

Based upon our empirical results, we believe that perhaps the Sumo Association may have been pursuing a different – longer run – strategy, which is less likely to attract strong criticism by the specialized media and the Japanese public. This strategy consists of two components: first, the 2010 Reform made it more difficult for young foreign-born wrestlers to enter the game, as each stable can in principle accommodate only a single foreigner. In the long run, this strategy may pay-off by reducing the number of foreign-born candidates for the top positions.

Second, one needs to remember that promotion to *Yokozuna* is restricted to wrestlers who have attained the rank of *Ozeki*. Therefore, one way to make it more difficult for foreign-born wrestlers to become *Yokozuna* is to somewhat resist their promotion to *Ozeki*. This strategy may be more feasible than resisting promotions of foreign-born players to *Yokozuna* because public scrutiny of promotions of *Ozeki* is not nearly as strong as the scrutiny attracted by promotions to *Yokozuna*.

Our empirical results provide supporting evidence that, especially since 2010, foreign-born wrestlers trying to attain the *Ozeki* rank were not treated as favorably as Japanese born wrestlers with the same measured performance. We conclude that, in the long run, the combination of restricted access to foreign-born wrestlers and unfavorable treatment of these wrestlers in the promotion to *Ozeki* could change the pool of candidates for the position of *Yokozuna*, making the return of the Japanese born *Yokozuna* more likely.

This interpretation of recent events in the Sumo world attributes the disappearance of the Japanese born *Yokozuna* to the inflow of powerful

foreign-born wrestlers. However, one could argue that a concurrent reason for this disappearance is that Japanese youngsters are losing interest in Sumo as a career. If this was the case, we should see a decline over time of Japanese born Sumo freshmen who enter the sport. Yet Figure 7 shows that the percentage of Japanese born freshmen has been persistently over 90 percent from 1972 to 2023, with a brief exception in the early 2000's, suggesting that this explanation is unlikely to explain our results.

References

- Berlinschi, R., Schokkaert, J., Swinnen, J., 2013. When drains and gains coincide: migration and international football performance. *Labour Economics* 21 (1), 1-14.
- Bodvarsson, O, Papps, K, Sessions, J. 2014. Cross-Assignment Discrimination in Pay: A Test Case of Major League Baseball. *Labour Economics*, 28, 84-95.
- Bollemore, F. 2001. Racial and Ethnic Employment Discrimination: Promotion in Major League Baseball. *Journal of Sports Economics*, 2(4), 356-368.
- Bose, P., Feess, E, Mueller, H. 2022. Favoritism towards High-Status Clubs: Evidence from German Soccer. *Journal of Law, Economics, and Organization*, 38(2), 422-478.
- Bryson, A., Chevalier, 2015, Is there a Test for Racial Discrimination amongst Employers? *Labour Economics*, 34(c), 51-63.
- Conlin, M, Emerson, P, 2006. Discrimination in Hiring Versus Retention and Promotion: An Empirical Analysis of Within-Firm Treatment of Players in the NFL. *Journal of Law, Economics and Organization*, 22 (1), 115-136.
- Dietl, H, M., 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.
- Eckard, E. Woodrow. 2001. Free Agency, Competitive Balance, and Diminishing Returns to Pennant Contention. *Economic Inquiry*, 39(3), 430-443.
- Elaad, Guy, Krumaer, Alex., Kantor, Jeffrey. 2018. Corruption and Sensitive Soccer Games: Cross-Country Evidence. *Journal of Law, Economics and Organization*, 34(3), 364-394.

- Foley, M, Smith, F. 2007. Consumer Discrimination in Professional Sports: New Evidence from Major League Baseball. *Applied Economics Letters*, 14(13-15), 951-955.
- Findlay, D, Reid, C 1997. Voting Behavior, Discrimination and the National Baseball Hall of Fame. *Economic Inquiry*, 35(3), 562-578.
- Garicano, L, Palacios-Herta, I, Prendergast, C. 2005. Favoritism under Social Pressure. *Review of Economics and Statistics*, 87(2), 208-216.
- Gilraine, M, Gu, J and McMillan, R, 2020, A new method for estimating teacher value-added, NBER Working Paper 27094.
- Goff, B.L., McCormick, R., Tollison, R. 2002."Racial Integration as an Innovation: Empirical Evidence from Sports Leagues. *American Economic Review*, 92(1), 16-26.
- Goff, B.L., Tollison, R. 2009. Racial Integration of Coaching: Evidence from the NFL. *Journal of Sports Economics*, 10 (2), 127-140.
- Grand Sumo Encyclopedia (Ozumo Jinbutsu Daijiten), 2001. Editorial. Tokyo: Baseball Magazine-sha (in Japanese).
- Groothuis, P, Hill, J R. 2008. Exit Discrimination in Major League Baseball: 1990-2004. *Southern Economic Journal*, 75(2), 574-590.
- Hassen, A. 1998. The Cost of Discrimination: A Study of Major League Baseball. *Southern Economic Journal*, 64(3), 603-627.
- Hanssen, A, Meehan, J. 2009. Who Integrated Major League Baseball Faster. *Journal of Sports Economics*, 10(2), 141-154.
- Hanssen, A, Andersen, T. 1999. Has discrimination Lessened Over Time? A Test Using Baseball's All-Star Vote. *Economic Inquiry*, 37(2), 326-352.
- Holmes, P. 2011. New Evidence of Salary Discrimination in Major League Baseball, *Labour Economics*, 18(3), 320-331.
- Holmes, P, Kane, R F. 2023. The Spread of Integration in Major League Baseball. *Journal of Sports Economics*, 24(3), 271-284.

Iizuka, S., 2022. *Nihon de Rikishi ni Narukoto* (Becoming in Sumo Wrestler in Japan). Tokyo: Hobby Japan (in Japanese).

Kahn, L 1991. Discrimination in Professional Sports: A Survey of the Literature. *Industrial and Labor Relations Review*, 44(3), 395-418.

Jost, Peter-J. 2021. Competitive Balance and the Away Goals Rule during Extra Time. *Journal of Sports Economics*, 22(7), 823-863

Kawaura, A, La Croix, S, 2016. Integration of North and South American Players in Japan's Professional Baseball Leagues. *International Economic Review*, 57(3), 1107-1129.

Kent, Ryan A., Caudill, Steven B., Mixon, Franklin G., Jr. 2013. Rules Changes and Competitive Balance in European Professional Soccer: Evidence from an Event Study Approach. *Applied Economics Letters*, 20(10-12), 1109-1112.

Koto-ohshu, T., 2014. *Ima Kokode Katsu koto: Koto-ohshu Jiden* (Now, wining here; Biography of Koto-ohshu). Tokyo: Tokuma Shoten (in Japanese).

La Croix, S, 1999. Rule Changes and Competitive Balance in Japanese Professional Baseball. *Economic Inquiry*, 37(2), 353-368.

Lanning, J, 2010. Productivity, Discrimination, and Lost Profits during Baseball's Integration. *Journal of Economic History*, 70(4), 964-988.

Lewis, J and Linzer, D, 2005, Estimating regression models in which the dependent variable is based on estimates, *Political Analysis*, 13, 345-64

Mizuno, N., Kyosu, T., 2022. *Ozumo Rikishi Meikan* (Directory of Sumo Wrestlers). Tokyo: Kyodo Tsushinsha (in Japanese).

Nagayama, S, 2023. New Promotion Criteria Needed to Keep Top Sumo Ranks Robust. Nippon.Com: Your Doorway to Japan. <https://www.nippon.com/en/in-depth/d00875/>. Jan 10, 2023. Accessed on June 23, 2023.

Nakajima, T., 2003. *Ozumo no Keizai-gaku* (Economics of Sumo Wrestling). Tokyo: Toyokeizai Shimposha (in Japanese).

Norback, P., Olsson, M, Persson, L. 2021. Talent Development and Labour Market Integration in European Football. *World Economy*, 44(2), 367-408.

Oinuma, Y.,1994. *Sumo Shakai no Kenkyu* [Study of Sumo Society]. Fumaido Shuppan.

Ohshima, M., 2014. *Kigatsukeba Legend: Kyokutenho Jiden*(Becoming Legend: Biography of Kyokutenho). Tokyo: Baseball Magazine (in Japanese).

Preston, I, Szymanski, S, 2000. Racial Discrimination in English Football. *Scottish Journal of Political Economy*, 47(4), 342-363.

Schmidt, M.B., Berri, D.J. 2005. Concentration of playing talent: evolution in Major League Baseball. *Journal of Sports Economics* 6 (4), 412-419.

Scully, G, 1974. Pay and Performance in Major League Baseball. *American Economic Review*, 64(6), 915-930.

Szymanski, S, 2000. A Market Test for Discrimination in the English Professional Soccer Leagues. *Journal of Political Economy*, 108(3), 590-608.

Tainsky, S, Wifree, J. 210. Discrimination and Demand: The Effect of International Players on Attendance in Major League Baseball. *Social Science Quarterly*, 91(1), pp.117-128.

Terunofuji, H., 2021. *Naraku no Soko Kara Miageta Asu* (Regaining Status in Sumo World). Tokyo: Nihon Shashin Kikaku (in Japanese).

Van Scyoc, L.J., Burnett, N.J. 2013. How Times Changed: Racial Discrimination in the Market for Sports Memorabilia. *Applied Economics Letters*, 20(7-9), 875-878.

West, M.D., 1997. Legal Rules and Social Norms in Japan's Secret World of Sumo. *Journal of Legal Studies*, 2(1), 165-201.

West, M.D., 2004. *Law in Everyday Japan: Sex, Sumo, Suicide, and Statutes*. Chicago: University of Chicago Press.

Yamamura, E. 2014. Is body mass human capital in Sumo? Outcome of globalization and formation of human capital in Japan, *Journal of Japanese and International Economies* 31, 53-71.

Figure 1. The share of foreign-born wrestlers in Sumo top division (percent)

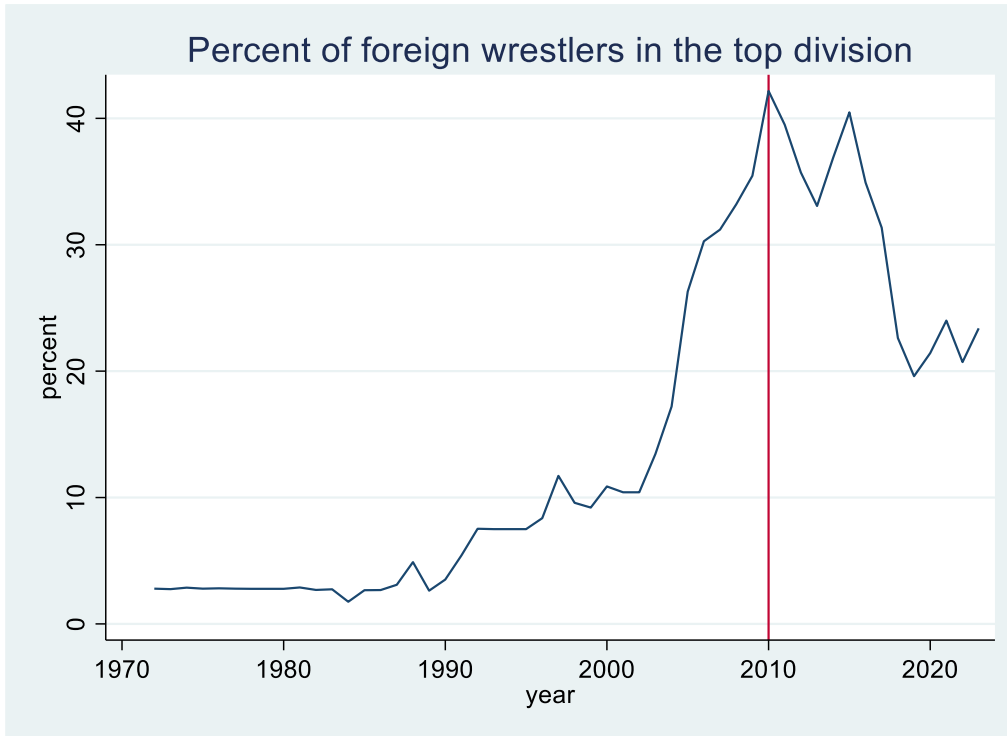


Figure 2. The share of foreign-born *Ozeki* in Sumo top division (percent)

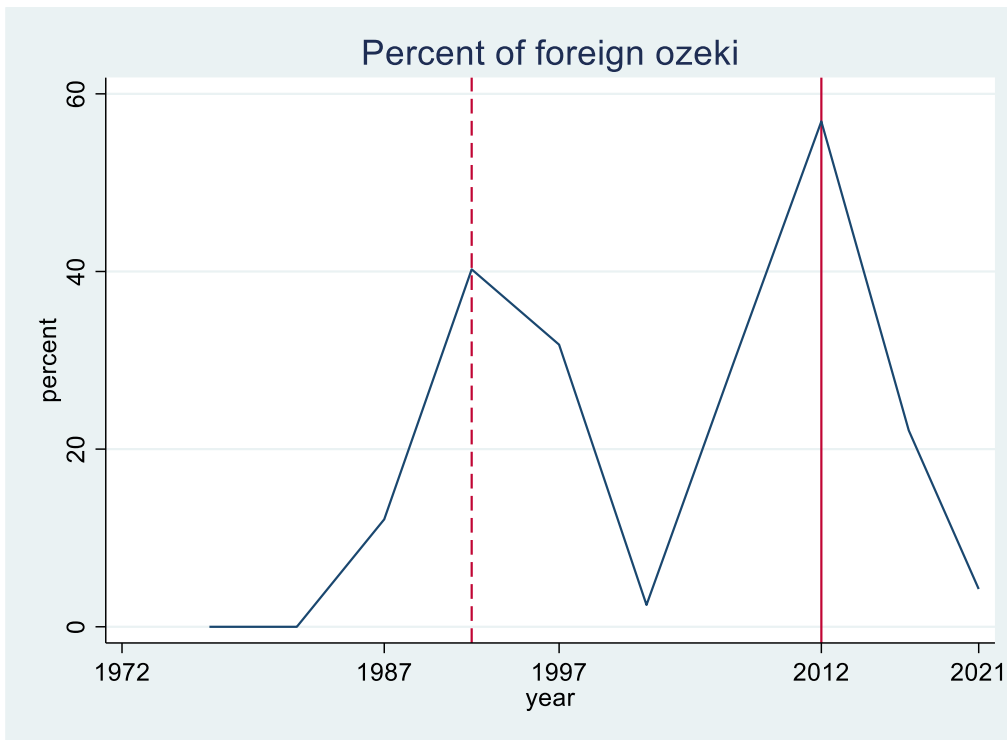


Figure 3. The share of foreign-born *Yokozuna* in Sumo top division (percent)

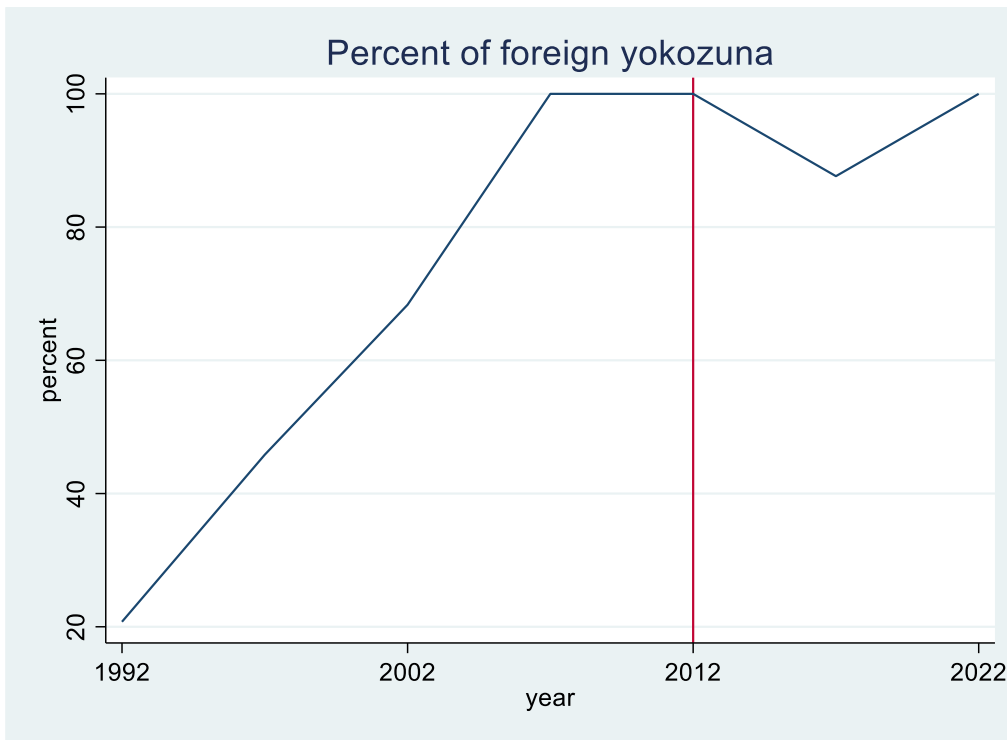
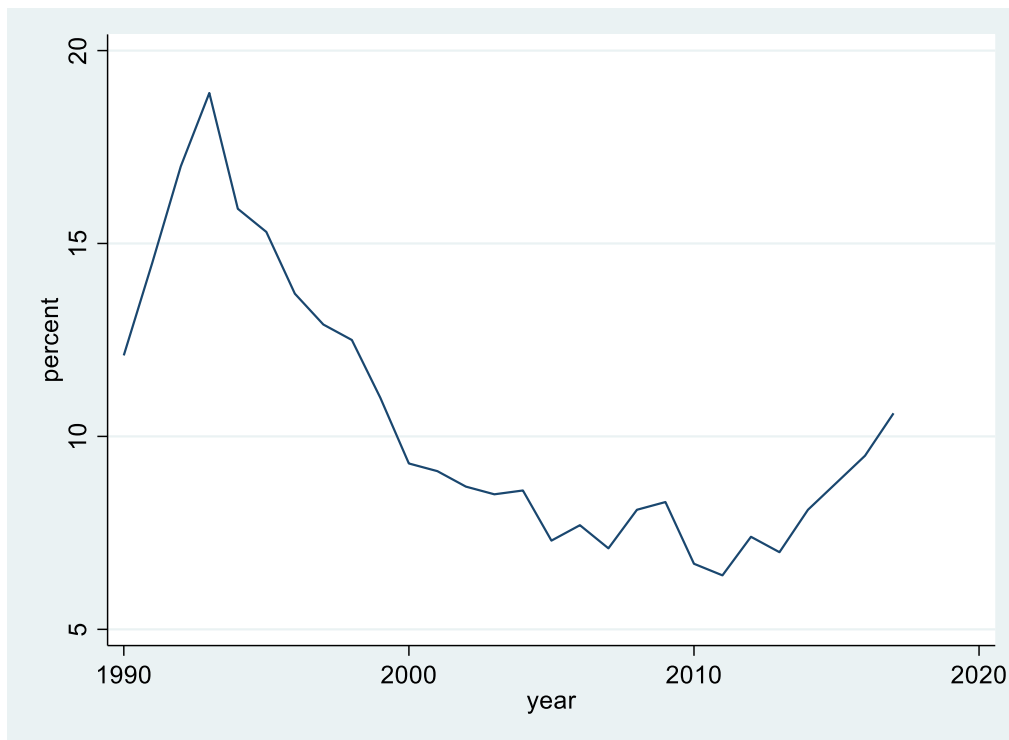


Figure 4. Percent of viewers of Sumo TV broadcasts



Source: <https://www.videor.co.jp/digestplus/tv/2017/08/3781.html>

Figure 5. Number of foreign wrestlers in all Sumo divisions.

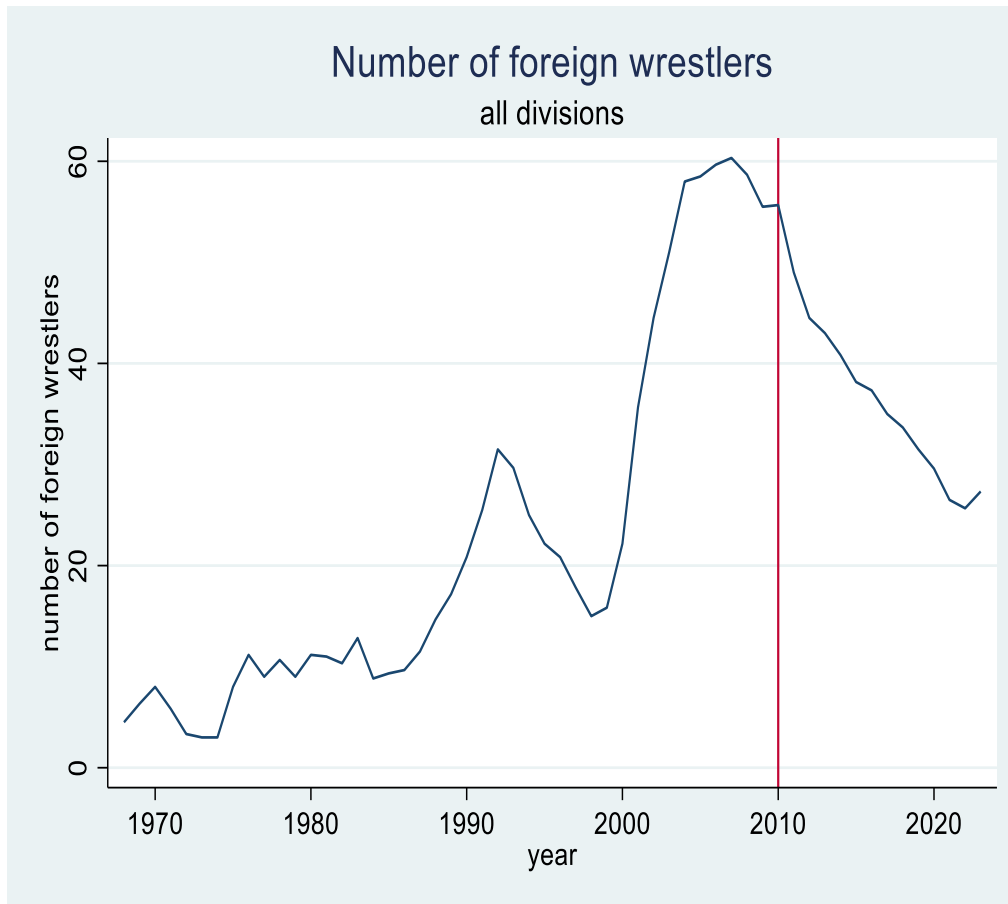


Figure 6. The average number of *Ozeki* and *Yokozuna* in a tournament.
Sumo top division

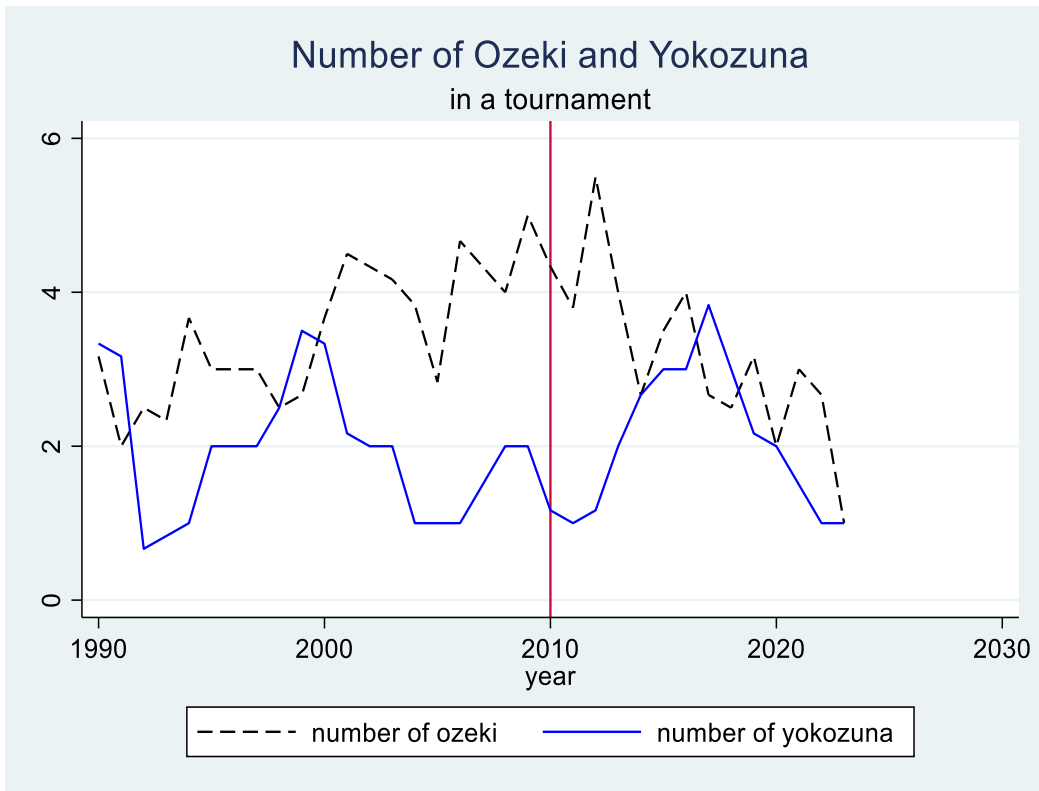


Figure 7. Percent of Sumo freshmen who are Japanese born (all divisions).

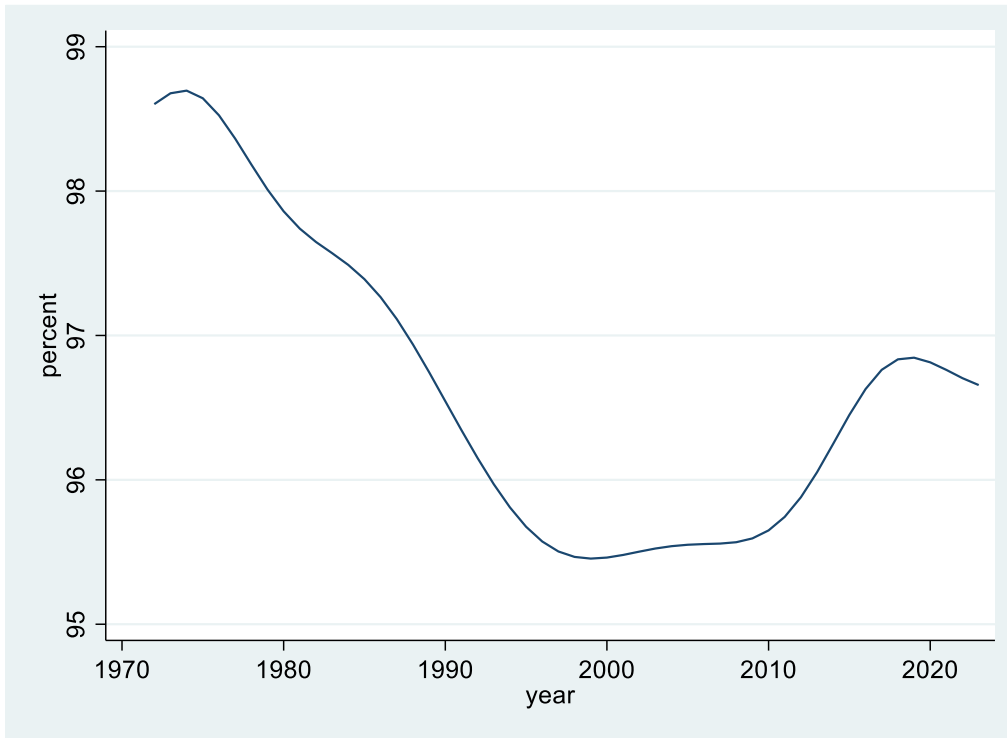


Table 1. Average performance of domestic and foreign *Sekiwake* and *Ozeki*

	Percent promoted	Percent winning at least one tournament	Wins per tournament	Years to attain current rank for first time
<i>Sekiwake</i>				
<i>1972-2009</i>				
Japanese born	40.5	1.4.9	7.242	9.036
Foreign-born	70.0	10.0	8.586	5.686
<i>2010-2023</i>				
Japanese born	33.3	12.5	7.515	8.910
Foreign-born	36.3	27.3	8.766	7.831
<i>Ozeki</i>				
<i>1990-2009</i>				
Japanese born	27.2	63.6	8.77	6.651
Foreign-born	80.0	100	10.43	4.533
<i>2010-2023</i>				
Japanese born	10.0	50.0	7.88	8.533
Foreign-born	50.0	83.3	8.20	7.416

Table 2. Summary statistics. *Sekiwake* wrestlers competing for promotion to *Ozeki*

Variables	Full sample	Sub-sample 1972 to 2009	Sub-sample 2010-2023
Promotion to <i>Ozeki</i>	0.078 (0.269)	0.081 (0.273)	0.070 (0.255)
At least 33 wins in past three tournaments (M)	0.075 (0.263)	0.077 (0.267)	0.070 (0.255)
Championships won in past three tournaments (T)	0.081 (0.273)	0.070 (0.256)	0.110 (0.314)
Foreign wrestler	0.176 -	0.119 -	0.314 -
Age	26.175 (3.011)	25.760 (2.943)	27.273 (2.920)
BMI	43.847 (5.623)	43.251 (6.008)	45.421 (4.060)
Stable with higher than median number of top players	1.313 0.747	1.388 (0.829)	1.116 (0.402)
Time to promotion to <i>Sekiwake</i> (years)	6.812 (3.506)	6.769 (3.516)	6.925 (3.487)
Number of observations (player x tournament)	626	454	172
Number of wrestlers	118	118	118

Notes: means are computed using the original data (individuals x tournaments), except for the foreign share, which is computed on the collapsed sample of individuals.

Table 3. Factors affecting promotion to *Ozeki*, in the full sample and by sub-period. First step estimates

Variables	Full sample	Sub-sample 1972 to 2009	Sub-sample 2010-2023
At least 33 wins in past three tournaments (M)	0.769*** (0.080)	0.739*** (0.090)	0.972*** (0.067)
Championships won in past three tournaments (T)	0.265** (0.107)	0.303** (0.131)	0.148 (0.161)
M * foreign dummy (F)	0.046 (0.115)	0.228** (0.087)	-0.363** (0.161)
T * F	-0.165 (0.116)	-0.148 (0.126)	-0.034 (0.173)
M+M*F	0.815***	0.967***	0.609***
T+T*F	0.100	0.080**	0.114
Test joint significance T*F M*F	0.364	0.033	0.032
Observations	626	454	172
R-squared	0.651	0.719	0.512

Note: one, two and three stars for statistical significance at the 10, 5 and 1 percent level of confidence. Each regression includes year and month dummies, individual BMI (body mass index) and the number of top ranked players in the stable. Standard errors are clustered by player.

Table 4. Second step estimates of factors affecting individual fixed effects. Promotion to *Ozeki*

Variables	OLS with White standard errors	Weighted least squares	OLS with White standard errors	Weighted least squares
Age (A)	-0.005 (0.008)	-0.006 (0.006)	-0.008 (0.008)	-0.009 (0.007)
Strong stable (S)	0.016 (0.040)	0.005 (0.037)	0.022 (0.040)	0.011 (0.030)
Foreign wrestler dummy (F)	-0.157** (0.066)	-0.156*** (0.054)	-0.150*** (0.066)	-0.150*** (0.055)
Time to promotion to current rank (T)			0.004 (0.004)	0.003 (0.004)
A * 2010-23	0.011 (0.013)	0.014 (0.016)	0.027* (0.016)	0.030 (0.021)
S* 2010-23	0.190* (0.097)	0.225* (0.119)	0.196** (0.091)	0.234* (0.120)
F * 2010-23	0.103 (0.092)	0.085 (0.102)	0.089 (0.091)	0.075 (0.102)
T * 2010-23			-0.018** (0.009)	-0.018 (0.016)
Observations	118	118	118	118
R-squared	0.877	0.804	0.880	0.806

Note: one, two and three stars for statistical significance at the 10, 5 and 1 percent level of confidence.

Table 5. Summary statistics. *Ozeki* wrestlers competing for promotion to *Yokozuna*

Variables	Full sample	Sub-sample 1972 to 2009	Sub-sample 2010-2023
Promotion to <i>Yokozuna</i>	0.016 (0.127)	0.022 (0.148)	0.011 (0.105)
At least 36 wins in past three tournaments (M)	0.064 (0.245)	0.109 (0.311)	0.025 (0.157)
Championships won in past three tournaments (T)	0.207 (0.454)	0.278 (0.515)	0.145 (0.383)
Foreign wrestler dummy	0.343 -	0.312 -	0.375 -
Age	28.162 (3.453)	26.994 (2.402)	29.184 (3.392)
BMI	47.434 (7.303)	47.976 (8.425)	46.961 (6.130)
Number of top players in the stable	0.560 (0.999)	0.914 (1.233)	0.251 (0.583)
Time to promotion to current rank (years)	7.457 (3.063)	6.338 (2.402)	8.434 (3,243)
Number of observations (player x tournament)	671	313	358
Number of wrestlers	30	15	15

Notes: means are computed using the original data (individuals x tournaments), except for the foreign share, which is computed on the collapsed sample of individuals.

Table 6. Factors affecting promotion to *Yokozuna*, in the full sample and by sub-period. First step estimates

Variables	Full sample	Sub-sample 1990 to 2009	Sub-sample 2010-2023
At least 36 wins in past three tournaments (M)	0.172** (0.074)	0.141 (0.083)	0.247 (0.150)
Championships won in past three tournaments (T)	0.045* (0.023)	0.072** (0.033)	0.015 (0.034)
M * foreign wrestler dummy	-0.023 (0.125)	-0.148 (0.099)	0.275 (0.230)
T * foreign wrestler dummy	0.114** (0.045)	0.145* (0.076)	0.061 (0.038)
M+M*F	0.149	-0.007	0.522***
T+T*F	0.159***	0.217***	0.076***
Observations	671	313	358
R-squared	0.347	0.341	0.587
Test joint significance interaction	0.0486	0.0427	0.213

Note: one, two and three stars for statistical significance at the 10, 5 and 1 percent level of confidence. Each regression includes year and month dummies, individual BMI (body mass index) and the number of top ranked players in the stable. Standard errors are clustered by player.

Table 7. Second step estimates of factors affecting individual fixed effects. Promotion to *Yokozuna*.

Variables	OLS with White standard errors	Weighted least squares	OLS with White standard errors	Weighted least squares
Age (A)	0.022* (0.012)	0.018 (0.011)	0.011 (0.018)	0.016 (0.017)
Strong stable (S)	0.040 (0.076)	0.046 (0.066)	0.033 (0.080)	0.043 (0.074)
Foreign wrestler dummy (F)	0.110 (0.068)	0.094 (0.060)	0.115 (0.074)	0.097 (0.070)
Time to promotion current rank (T)			0.017 (0.014)	0.004 (0.020)
A * 2010-23	-0.013 (0.013)	-0.009 (0.012)	-0.009 (0.015)	-0.014 (0.018)
S* 2010-23	-0.000 (0.080)	-0.006 (0.070)	0.027 (0.084)	0.015 (0.078)
F * 2010-23	-0.070 (0.076)	-0.058 (0.069)	-0.075 (0.082)	-0.060 (0.079)
T * 2010-23			-0.008 (0.015)	0.004 (0.021)
Observations	30	30	30	30
R-squared	0.865	0.908	0.877	0.911

Note: one, two and three stars for statistical significance at the 10, 5 and 1 percent level of confidence.

Appendix

Table A1. Wrestlers promoted to *Yokozuna*, by number of wins and championships won before promotion (1972-2023)

year	name	Nationality	Total wins	Championships won	Consecutive championships
1973	Kotozakura	Japan	37	2	1
1973	Wajima	Japan	39	1	0
1974	Kitanoumi	Japan	36	1	0
1978	Wakanohana	Japan	40	0	0
1979	Mienoumi	Japan	37	0	0
1981	Chiyonofuji	Japan	38	1	0
1983	Takanosato	Japan	39	1	0
1986	Futahaguro	Japan	36	0	0
1987	Ohnokuni	Japan	40	1	0
1987	Hokutoumi	Japan	36	1	0
1990	Asahifuji	Japan	36	2	1
1993	Akebono	USA	36	2	1
1994	Takanohana	Japan	41	2	1
1998	Wakanohana Jr	Japan	36	2	1
1999	Musashimaru	USA	34	2	1
2003	Asashoryu	Mongolia	38	2	1
2007	Hakuho	Mongolia	38	2	1
2012	Harumafuji	Mongolia	38	2	1
2014	Kakuryu	Mongolia	37	1	0
2017	Kisenosato	Japan	36	1	0
2021	Terunofuji	Mongolia	38	2	0

Note: Total wins: total number of wins in the past three tournaments. Championships won: number of championships won in past three tournaments. Consecutive champion: 1 if two consecutive tournaments won before promotion, 0 otherwise.

Table A2. Wrestlers promoted to *Ozeki*, by number of wins and championships won before promotion (1972-2023)

year	name	Nationality	Total wins	Championship won
1972	Takanohana	Japan	33	0
1972	Wajima	Japan	33	0
1973	Daiju	Japan	34	0
1974	Kitanoumi	Japan	32	1
1975	Kaiketsu	Japan	30	1
1975	Mienoumi	Japan	32	1
1976	Asahikuni	Japan	33	0
1977	Kaiketsu*	Japan	36	0
1977	Wakamisugi	Japan	33	0
1980	Masuiyama	Japan	31	0
1981	Kotokaze	Japan	31	1
1981	Chiyonofuji	Japan	35	1
1982	Wakashimazu	Japan	34	0
1982	Takanosato	Japan	33	0
1983	Asashio	Japan	35	0
1983	Hokutenyu	Japan	37	1
1985	Futahaguro	Japan	35	0
1985	Onokuni	Japan	31	0
1986	Hokutoumi	Japan	36	0
1987	Asahifuji	Japan	33	0
1987	Konishiki	USA	33	0
1990	Kirishima	Japan	34	0
1992	Akebono	USA	34	1
1993	Takanohana	Japan	35	0
1993	Wakanohana	Japan	32	0
1994	Takanonami	Japan	35	0
1994	Musashimaru	USA	33	0
1999	Dejima	Japan	33	1
1999	Chiyotaikai	Japan	32	1
2000	Miyabiyama	Japan	34	0
2000	Kaioh	Japan	33	1
2000	Musoyama	Japan	35	1
2001	Tochiazuma	Japan	34	0
2002	Asashoryu	Mongolia	34	0
2005	Koto-ohshu	Bulgaria	36	0
2006	Hakuho	Mongolia	35	0
2007	Kotomitsuki	Japan	35	0
2008	Harumafuji	Mongolia	35	0
2010	Baruto	Estonia	35	0

2011	Kisenosato	Japan	32	0
2011	Kotoshogiku	Japan	33	0
2012	Kakuryu	Mongolia	33	0
2014	Goeido	Japan	32	0
2015	Terunofuji	Mongolia	33	1
2017	Takayasu	Japan	34	0
2018	Tochinoshin	Georgia	37	0
2019	Takakeisho	Japan	34	0
2020	Shodai	Japan	32	1
2020	Asanoyama	Japan	32	0
2021	Terunofuji*	Mongolia	36	1
2022	Mitakeumi	Japan	33	1

Note: Total wins: total number of wins in the past three tournaments. Championship won: 1 if champion in the last tournament before promotion, otherwise 0. * former *Ozeki* promoted again after demotion from the *Ozeki*.

Table A3. Factors affecting promotion to *Ozeki* and *Yokozuna*. Bayes shrinkage. First step estimates

Variables	Sub-sample	
	1972 to 2009	Sub-sample 2010-2023
<i>Sekiwake</i>		
At least 33 wins in past three tournaments (M)	0.747*** (0.020)	0.948*** (0.035)
Championships won in past three tournaments (T)	0.306*** (0.017)	0.162*** (0.044)
M * foreign wrestler dummy	0.232*** (0.034)	-0.305*** (0.050)
T * foreign wrestler dummy	-0.152*** (0.009)	-0.027 (0.069)
Variables	Sub-sample	
	1990 to 2009	Sub-sample 2010-2023
<i>Ozeki</i>		
At least 33 wins in past three tournaments (M)	0.138*** (0.010)	0.241*** (0.019)
Championships won in past three tournaments (T)	0.071*** (0.012)	0.007 (0.012)
M * foreign wrestler dummy	-0.150*** (0.022)	0.295*** (0.020)
T * foreign wrestler dummy	0.146*** (0.019)	0.069*** (0.006)

Note: one, two and three stars for statistical significance at the 10, 5 and 1 percent level of confidence. Each regression includes year and month dummies, individual BMI (body mass index) and the number of top ranked players in the stable. Standard errors are clustered by player.

Table A4. Second step estimates of factors affecting individual fixed effects. Promotion to *Ozeki* and *Yokozuna*. Individual fixed effects estimated using Bayes shrinkage

Variables	Promotion to <i>Ozeki</i>	Promotion to <i>Yokozuna</i>
Age (A)	-0.005 (0.007)	0.025** (0.011)
Strong stable (S)	0.010 (0.039)	0.023 (0.081)
Foreign wrestler dummy (F)	-0.170*** (0.058)	0.103 (0.070)
A * 2010-23	0.008 (0.013)	-0.017 (0.012)
S* 2010-23	0.172* (0.098)	0.007 (0.086)
F * 2010-23	0.103 (0.090)	-0.062 (0.079)
Observations	118	30
R-squared	0.880	0.397

Note: one, two and three stars for statistical significance at the 10, 5 and 1 percent level of confidence.

Figure A1. Estimated fixed effects and wrestler's age. *Sekiwake*

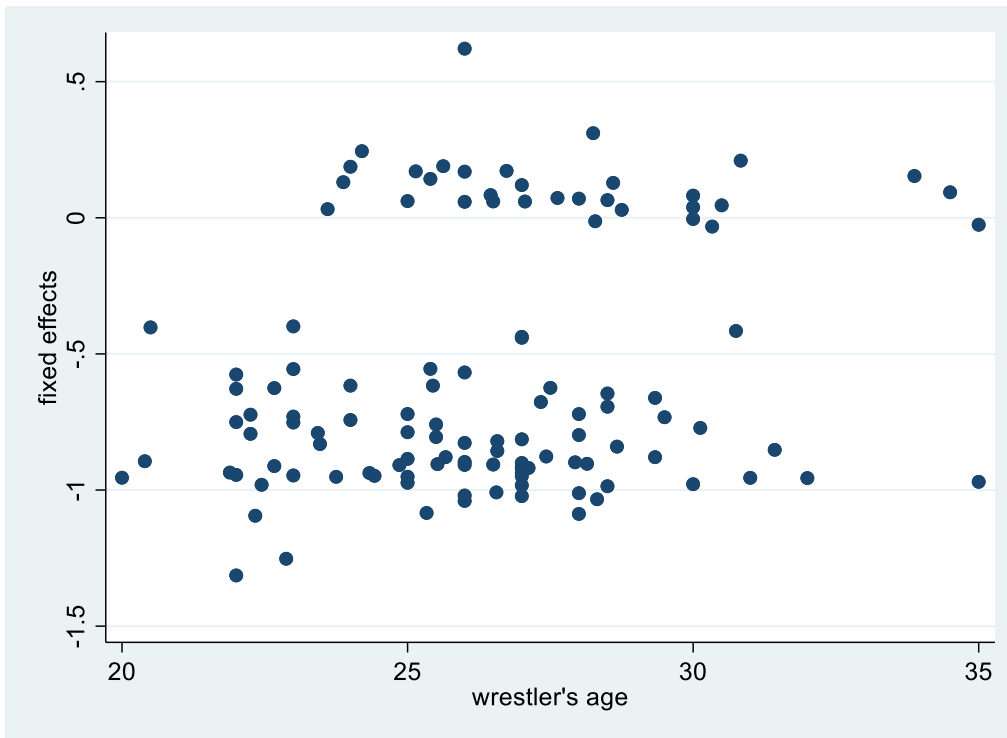


Figure A2. Estimated fixed effects and wrestler's age. *Ozeki*

