

1-1-2019

## Entertainment Design in Mixed Martial Arts: Does Cage Size Matter?

Paul Gift

Follow this and additional works at: <https://trace.tennessee.edu/jasm>



Part of the [Business Commons](#), [Education Commons](#), and the [Social and Behavioral Sciences Commons](#)

---

### Recommended Citation

Gift, Paul (2019) "Entertainment Design in Mixed Martial Arts: Does Cage Size Matter?," *Journal of Applied Sport Management*. Vol. 11 : Iss. 2.

<https://doi.org/10.18666/JASM-2019-V11-I2-9198>

Available at: <https://trace.tennessee.edu/jasm/vol11/iss2/10>

This article is brought to you freely and openly by Volunteer, Open-access, Library-hosted Journals (VOL Journals), published in partnership with The University of Tennessee (UT) University Libraries. This article has been accepted for inclusion in Journal of Applied Sport Management by an authorized editor. For more information, please visit <https://trace.tennessee.edu/jasm>.

# Entertainment Design in Mixed Martial Arts

## *Does Cage Size Matter?*

Paul Gift

### Abstract

This paper investigates the effect of a change in cage size on fighter performance outcomes in Zuffa-owned mixed martial arts (MMA) promotions. Variation in cage size is observed through different events over time in the Ultimate Fighting Championship (UFC) and World Extreme Cagefighting (WEC). Results suggest that smaller cages lead to more fight finishes (knockouts and submissions) and higher rates of distance knockdowns and choke attempts, all exciting outcomes for viewers. But they also lead to a higher proportion of time with fighters pressed against the cage, a position some viewers may dislike. Since MMA promoters compete with other forms of entertainment, findings have strategic implications for promoter cage-size decisions.

**Keywords:** *Cage size, entertainment, fighter performance, mixed martial arts, Ultimate Fighting Championship (UFC), World Extreme Cagefighting (WEC)*

## Introduction

Sports leagues often alter game parameters in an effort to stimulate fan engagement. Major League Baseball has taken a number of steps in recent years to speed up its games including limiting the number of visits to the pitcher's mound and the breaks between innings, as well as allowing for automatic intentional walks. The NBA has changed the positioning of its three-point line and implemented rules regarding "Hack-a-Shaq" strategies. The NFL restricted timeout usage when icing kickers and the NCAA has altered overtime rules in football and the shot clock in men's basketball.

Unlike most other mainstream sports leagues, the Ultimate Fighting Championship (UFC) and smaller U.S. mixed martial arts (MMA) promoters do not have an ability to alter many aspects of their events. State and tribal athletic commissions regulate the rules set, number of rounds, round length, potential weight classes, and glove, mouthpiece, and groin protector requirements. While these athletic commissions also set minimum and maximum cage/ring sizes, promotion management retains the ability to make strategic decisions on the use of a cage or ring, cage shape, and cage/ring size within the regulated minimum and maximum criteria.

The world's largest MMA promoter, the UFC, maintains two cage sizes for use in its events: A 30-foot octagonal-shaped cage (known as "The Octagon") and a smaller 25-foot version. Cage size and fighter performance metrics are meticulously and rigorously tracked to a high level of detail by the statistical agency, FightMetric LLC, allowing for the investigation of the impact of cage size on various elements of fighter performance, particularly bout outcomes such as knockout or submission finishes, which may be more desirable to a profit-maximizing promoter than a judges' decision.

While growing, prior academic research in MMA has been relatively limited. Collier, Johnson, and Ruggiero (2011) pioneered study of the sport based on in-cage fighter performances using bout-level data to examine the role of various striking and grappling measures on judging decisions. Gift (2018a) improved upon this analysis using performance statistics and judging decisions at the round level and finding evidence of favoritism towards larger betting favorites, fighters with insurmountable leads, and the fighter who won the most recent round.

In demand literature, Watanabe (2012), Tainsky, Salaga, and Santos (2013), and Watanabe (2015) investigated the determinants of UFC pay-per-view buys and found evidence supporting viewer preferences for star fighters, certain weight classes, main event outcome uncertainty, and holiday weekends. Reams and Shapiro (2017) found that PPV demand increased when higher-ranked fighters and former champions appeared on a fight card. UFC attendance decisions were examined by Tainsky, Salaga, and Santos (2012) and Watanabe (2015) who found support for the significance of event timing and location as well as venue capacity. More recently, Gift (2018b) estimated the marginal revenue products (MRPs) of UFC PPV main card fighters and found a sizeable percentage of fighters generated little to no MRP while a small number of stars drove the majority.

Yet none of these studies directly addresses consumer engagement through actual in-cage fighter performances. In work examining MMA spectator motives, Seungmo, Greenwell, Andrew, Lee, and Mahony (2008) and Andrew, Kim, O'Neal, Greenwell, and James (2009) found aesthetics and drama, and to a lesser extent violence, were important motives for spectator attendance of MMA events. The UFC also has a revealed preference for knockout/technical knockout (KO/TKO) and submission finishes in the sample period through its use of two \$50,000 fight night bonuses at the end of each event for the best KO/TKO and submission of the night (KOTN and SOTN, respectively). Knockout blows, locked-in chokeholds, and joint hyperextensions are often climactic events highlighting the beauty, strategy, violence, and drama of the sport, and tend to be more exciting than the sound of the final bell and reading the judges' scoring decisions. One of the newest MMA promotions, the Professional Fighters League, attempts to incentivize KO/TKO and submission finishes through bonus points in the regular season that help determine the seeding of its eventual playoff structure.

In popular media, Gift (2014) reported on the determinants of UFC Fight of the Night (FOTN) awards. FOTN is a monetary bonus awarded at the end of each event to "each of the fighters in the best fight of the night" (UFC, 2014). The report indicated being in a close fight with a high volume of power strikes to the head and legs, visible fighter damage, knockdowns, choke attempts, and a KO/TKO or submission finish all increase the likelihood of a fight being awarded FOTN by UFC management. The strongest performance factor reducing a fight's chance of winning FOTN was idle time spent in the clinch.

While demand-based studies have provided evidence of the factors affecting UFC attendance and PPV buys, the promotion's fight night bonus decisions reveal the fighter performance outcomes management believes generate the "best" fights, including a preference for KO/TKO and submission finishes. It stands to reason these factors should also better enhance consumer engagement. The present study examines the impact of cage size on many of these factors.

### **MMA Industry Background**

The first documented use of the term "mixed martial arts" came from television critic Howard Rosenberg in 1993 (U.S. House of Representatives Committee on Energy and Commerce, 2017), three days after UFC 1 pit various martial arts styles against each other in a no-holds-barred competition. MMA has since evolved to become a legalized and regulated combat sport of striking and grappling in standing positions, against the cage/ropes, or on the ground. While often referred to as "cage fighting," MMA bouts may be held in either a ring or cage (Association of Boxing Commissions, 2009), but all bouts in the current study took place in an octagon-shaped cage.

In early 2001, Frank and Lorenzo Fertitta purchased the UFC, then a struggling MMA promotion, through their company Zuffa LLC and grew it into the largest live pay-per-view event provider in the world (UFC, 2017a). In

December 2006, Zuffa purchased rival promoter World Extreme Cagefighting (WEC) and quickly shifted the new acquisition to lighter weight divisions. The super heavyweight and heavyweight divisions were immediately discontinued. Light heavyweight and middleweight divisions were shuttered by December 2008, and the final welterweight bout took place in March 2009. Zuffa did not use the WEC as a feeder to the UFC, but rather an extension of the UFC into the lower weight classes. Eighty percent of Zuffa's bouts with the WEC took place in the lightweight division or below.

Zuffa also immediately instituted the Unified Rules of MMA and its UFC cage, specifically changing from the WEC's former pentagon shape to the 25' version of the UFC's Octagon. Most UFC events utilized a 30' Octagon, but the company maintained the smaller 25' version for use in tighter venues.

This leads to the two sources of variation in cage size in the present study. Over the sample period, 428 of the UFC's 3,739 bouts (11.5%) took place in the smaller cage. In addition, the WEC held 293 bouts under Zuffa ownership with the same 25' Octagon and rules set until ultimately being absorbed into the UFC at the end of 2010. The featherweight and bantamweight divisions were completely new additions to the UFC, while the WEC lightweight division merged into the UFC's lightweight division, where two former WEC fighters have since held the UFC lightweight title.

### Data

The dataset for the present study encompasses Zuffa-owned and operated promotions with known cage sizes and octagonal shapes from May 4, 2001—when the Unified Rules of MMA were first used in the UFC—through December 31, 2016. Cage sizes varied over time during the sample period, but cage shape and the rules set did not. The number and distribution of bouts by cage size and weight class are presented in Table 1.

Women did not compete at all in the WEC, and they comprise the newest divisions in the UFC. In total, women's bouts made up just 3.5% of the data and were excluded from the analysis. By the end of 2017, the UFC had three women's divisions with regularly occurring bouts (strawweight, flyweight, and bantamweight) and launched and was attempting to fill out a fourth with quality fighters (featherweight). Exploring potential similarities and differences between male and female fighters is an area of possible future research as the number of documented female bout observations grows. Overall, 18.2% of documented men's bouts were contested in the smaller 25' cage.

### FightMetric LLC

Cage size and fighter performance statistics were obtained from FightMetric, the official statistics provider of the UFC. For each round, FightMetric tracks more than 100 performance statistics covering striking, knockdowns, takedowns, grappling, submissions, and time spent in different positions (at distance, in the clinch, on the ground, with control, being controlled, etc.). The statistics are documented

**Table 1***Number of Bouts by Weight Class and Cage Size*

|                      | <b>30'</b><br><b>Octagon</b> | <b>25'</b><br><b>Octagon</b> | <b>Total</b>           |
|----------------------|------------------------------|------------------------------|------------------------|
| Heavyweight          | 324                          | 29                           | 353                    |
| Light Heavyweight    | 357                          | 55                           | 412                    |
| Middleweight         | 494                          | 102                          | 596                    |
| Welterweight         | 668                          | 134                          | 802                    |
| Lightweight          | 692                          | 171                          | 863                    |
| Featherweight        | 288                          | 104                          | 392                    |
| Bantamweight         | 238                          | 105                          | 343                    |
| Flyweight            | 121                          | 7                            | 128                    |
| Women's Bantamweight | 73                           | 3                            | 76                     |
| Women's Strawweight  | 53                           | 11                           | 64                     |
| <b>Men's Total</b>   | <b>3,182</b><br>(82%)        | <b>707</b><br>(18%)          | <b>3,889</b><br>(100%) |
| <b>Women's Total</b> | <b>126</b><br>(90%)          | <b>14</b><br>(10%)           | <b>140</b><br>(100%)   |

Note: For all Zuffa-owned UFC and WEC bouts from May 4, 2001 through December 31, 2016.

and verified using multiple angles of the bout video and slowed down to frame-by-frame speeds if needed (Genauer, 2013).

FightMetric classifies strikes as either jabs or power strikes. They use various cues such as whether it is a kick or a punch, how it is thrown, and the effect on the opponent to make their classification. Any strike that is not classified as a power strike is classified as a jab. Since MMA promoters sell fight entertainment to consumers, this paper examines three types of striking measures they likely value most: Total strikes, power strikes, and knockdowns. Total strikes is simply the total number of strikes landed (jabs plus power strikes). Power strikes landed is examined separately to focus on the strikes more likely to create fight-ending damage. The final striking measure, knockdowns (when a strike directly leads to the opponent falling to the ground), is perhaps the most exciting element of standup fighting. FightMetric records knockdowns that happen at distance as well as those that occur in the clinch.

MMA fighters can also damage their opponents and attempt to win bouts through grappling and submission attempts. FightMetric classifies submission attempts as chokes or joint locks. Chokes attempt to cut off blood flow to the brain or disrupt an opponent's air supply. The most commonly attempted chokes are

guillotines and rear naked chokes. Well-executed joint locks result in fight-ending dislocations, bone breaks, or excruciating pain until an opponent physically or verbally “taps out” to signal the referee to stop the fight. The most commonly attempted locks are armbars and shoulder locks such as kimuras and americanas. Submission attempts mostly occur on the ground, however, guillotine chokes occur with some regularity when a standing fighter attempts a takedown and exposes his neck near the opponent’s ribcage. Table 2 contains complete descriptions of the variables employed in the present study.

### Descriptive Statistics

Descriptive statistics for performance outcomes (dependent variables) and bout characteristics (independent variables) are presented in Table 3. The dataset contains 3,889 men’s bouts resulting in 7,778 fighter-bout observations. While the majority of FightMetric’s dataset is complete, the occasional lack of availability of fighter age, height, reach, stance, fight time, and betting odds information resulted in some missing observations.

Bout characteristics include a fighter’s age, height, reach, and experience, as well as their standard normalization (SN) win probability of Sauer (2005) and indicators for whether the fighter is a southpaw versus an orthodox opponent, whether this is the fighter’s first elite-level MMA bout, whether the bout is five rounds (instead of the usual three), and whether it is a title fight. When regression analyses are performed, AGE, HEIGHT, REACH, LEFTVSRIGHT, EXPER, and 1STFIGHT are the difference in values between the fighter in question and the opponent.

Possibly the most important performance measure from an MMA promoter’s perspective is finishing the fight (KO/TKO or submission), as evidenced by the UFC’s fight night bonuses and the in-cage factors that help determine what UFC management believes to result in the “best” fight. In this spirit, Figure 1 presents a summary of finish rates for large and small cage sizes across the eight men’s weight classes in the final dataset. While purely descriptive, it provides elementary support for the notion that smaller cages sizes may play a role in nudging fighters towards more finishes and fewer decisions.

Within the sample, per Table 3, fighters in the 25’ cage tend to be younger, smaller, and less experienced than those in the 30’ cage. The simple mean shows a higher rate of finishes in the 25’ cage, yet the negative slopes in Figure 1 suggest that smaller fighters tend to be less likely to finish their fights. All of which reinforces the importance of controlling for these potentially confounding factors when examining the impact of cage size on performance measures.

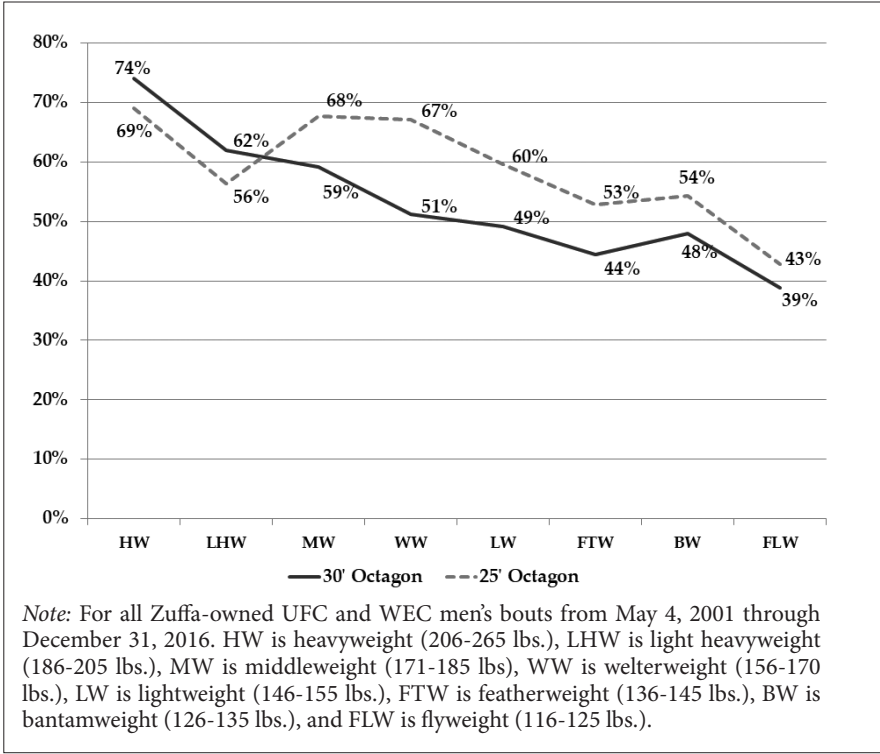
**Table 2**  
*Variable Descriptions*

| <b>Variable Label</b>     | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                        |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i><u>Dependent</u></i>   |                                                                                                                                                                                                                                                                                                                                                                           |
| FINISH                    | Indicator variable equal to one if a fighter won by KO/TKO or submission, and zero otherwise.                                                                                                                                                                                                                                                                             |
| UPSET                     | Indicator variable equal to one if a fighter lost as a betting favorite or won as a betting underdog, and zero otherwise.                                                                                                                                                                                                                                                 |
| TIME                      | Total fight time (in minutes).                                                                                                                                                                                                                                                                                                                                            |
| STRIKES                   | Total strikes landed.                                                                                                                                                                                                                                                                                                                                                     |
| PSTRIKES                  | Total power strikes landed. FightMetric uses various cues such as whether a strike is a kick, knee, elbow, or punch, how the strike is thrown, the effect on the opponent, etc. to determine if a strike has power.                                                                                                                                                       |
| STRIKERATE                | Strikes landed per five minutes of fight time.                                                                                                                                                                                                                                                                                                                            |
| PSTRIKERATE               | Power strikes landed per five minutes of fight time.                                                                                                                                                                                                                                                                                                                      |
| KDRATE                    | Knockdowns per five minutes of standing fight time. Fighters are standing when they are at distance or in the clinch.                                                                                                                                                                                                                                                     |
| DISTKDRATE                | Distance knockdowns per five minutes of distance fight time. Fighters are at distance when they are standing but separated.                                                                                                                                                                                                                                               |
| CLINCHKDRATE              | Clinch knockdowns per five minutes of clinch fight time. Fighters are in the clinch when they are standing and touching each other.                                                                                                                                                                                                                                       |
| CLINCHCPCT                | Percent of total fight time a fighter has control in the clinch (0-100 scale). A fighter has control in the clinch when they are pressing the opponent against the cage. During the sample period, 77.5 percent of clinch time saw one fighter with control.                                                                                                              |
| GROUNDPCPT                | Percent of total fight time a fighter has control on the ground (0-100 scale). Fighters are on the ground when at least one of them is not standing. A fighter has control on the ground when they have top position or have taken the opponent's back. When fighters were on the ground during the sample period, one had control of the other 99.2 percent of the time. |
| CHOKERATE                 | Submission chokes attempted per five minutes of fight time.                                                                                                                                                                                                                                                                                                               |
| LOCKRATE                  | Submission locks attempted per five minutes of fight time.                                                                                                                                                                                                                                                                                                                |
| <i><u>Independent</u></i> |                                                                                                                                                                                                                                                                                                                                                                           |
| SMALLCAGE                 | Indicator variable equal to one if the bout was held inside the 25' Octagon, and zero otherwise.                                                                                                                                                                                                                                                                          |
| AGE                       | Age (in years).                                                                                                                                                                                                                                                                                                                                                           |
| HEIGHT                    | Height (in inches).                                                                                                                                                                                                                                                                                                                                                       |
| REACH                     | Reach (in inches).                                                                                                                                                                                                                                                                                                                                                        |
| LEFTVSRIGHT               | Indicator variable equal to one if a fighter is left-handed fighting against a right-handed opponent, and zero otherwise. It is included because of a possible left-handed advantage.                                                                                                                                                                                     |
| EXPER                     | The number of Zuffa bouts a fighter has in the FightMetric database.                                                                                                                                                                                                                                                                                                      |
| 1STFIGHT                  | Indicator variable equal to one if a fighter is appearing in their first documented Zuffa bout in the FightMetric database, and zero otherwise.                                                                                                                                                                                                                           |
| SNPROB                    | Standard normalization win probability of Sauer (2005).                                                                                                                                                                                                                                                                                                                   |
| 5ROUNDS                   | Indicator variable equal to one if the bout was scheduled for five rounds, and zero otherwise.                                                                                                                                                                                                                                                                            |
| TITLE                     | Indicator variable equal to one if the bout was a title fight, and zero otherwise.                                                                                                                                                                                                                                                                                        |
| WEIGHT                    | Weight class. Used for fixed effects.                                                                                                                                                                                                                                                                                                                                     |

**Table 3***Summary Statistics and Means Tests*

| Variable                  | 25'<br>Octagon |       |       | 30'<br>Octagon |       |       | $\Delta$<br>25' - 30' | p-value |
|---------------------------|----------------|-------|-------|----------------|-------|-------|-----------------------|---------|
|                           | Mean           | S.D.  | N     | Mean           | S.D.  | N     |                       |         |
| <i><u>Dependent</u></i>   |                |       |       |                |       |       |                       |         |
| FINISH                    | .30            | .46   | 1,414 | .27            | .44   | 6,364 | .03                   | .021    |
| UPSET                     | .31            | .46   | 1,310 | .32            | .47   | 6,200 | -.01                  | .500    |
| TIME                      | 9.14           | 6.02  | 1,376 | 10.32          | 6.04  | 6,364 | -1.18                 | .000    |
| STRIKES                   | 42.61          | 37.44 | 1,414 | 49.50          | 41.46 | 6,364 | -6.89                 | .000    |
| PSTRIKES                  | 17.73          | 15.73 | 1,414 | 22.45          | 19.17 | 6,364 | -4.72                 | .000    |
| STRIKERATE                | 23.21          | 13.38 | 1,376 | 23.99          | 13.88 | 6,364 | -.78                  | .072    |
| PSTRIKERATE               | 9.65           | 7.03  | 1,376 | 10.88          | 7.73  | 6,364 | -1.23                 | .000    |
| DISTKDRATE                | .22            | .94   | 1,376 | .18            | .82   | 6,364 | .04                   | .031    |
| CLINCHKDRATE              | .12            | 1.52  | 1,288 | .10            | 1.65  | 6,014 | .02                   | .539    |
| CLINCHCPCT                | 6.27           | 8.79  | 1,376 | 6.31           | 9.03  | 6,364 | -.04                  | .902    |
| GROUNDCPCT                | 19.84          | 23.04 | 1,376 | 16.71          | 20.71 | 6,364 | 3.13                  | .000    |
| CHOKERATE                 | .24            | .56   | 1,376 | .15            | .39   | 6,364 | .09                   | .000    |
| LOCKRATE                  | .11            | .35   | 1,376 | .07            | .31   | 6,364 | .04                   | .000    |
| <i><u>Independent</u></i> |                |       |       |                |       |       |                       |         |
| SMALLCAGE                 | 1.00           | .00   | 1,414 | .00            | .00   | 6,364 | 1.00                  | .000    |
| AGE                       | 28.23          | 3.71  | 1,401 | 29.77          | 4.05  | 6,319 | -1.54                 | .000    |
| HEIGHT                    | 69.97          | 3.03  | 1,413 | 70.88          | 3.16  | 6,361 | -.91                  | .000    |
| REACH                     | 71.53          | 3.60  | 1,135 | 72.86          | 3.68  | 5,656 | -1.33                 | .000    |
| LEFTVSRIGHT               | .13            | .33   | 1,344 | .16            | .37   | 6,140 | -.03                  | .001    |
| EXPER                     | 3.84           | 3.47  | 1,414 | 6.45           | 5.35  | 6,364 | -2.61                 | .000    |
| 1STFIGHT                  | .29            | .45   | 1,414 | .14            | .35   | 6,364 | .15                   | .000    |
| SNPROB                    | 50.00          | 18.76 | 1,310 | 50.00          | 18.94 | 6,200 | .00                   | 1.000   |
| 5ROUNDS                   | .07            | .26   | 1,414 | .09            | .28   | 6,364 | -.02                  | .071    |
| TITLE                     | .06            | .24   | 1,414 | .05            | .23   | 6,364 | .01                   | .438    |

*Note:* For all Zuffa-owned UFC and WEC men's bouts from May 4, 2001 through December 31, 2016. Bout-level observations for each fighter. *STRIKERATE*, *PSTRIKERATE*, *CLINCHCPCT*, *GROUNDCPCT*, *CHOKERATE*, and *LOCKRATE* means are weighted by total time. *DISTKDRATE* and *CLINCHKDRATE* means are weighted by distance time and clinch time, respectively.



**Figure 1.** Finish Rates by Weight Class and Cage Size

## Model

This study uses observational data from the non-experimental laboratories of high-level MMA events. Fighters at the UFC level, and formerly the WEC, are among the best in the world, if not the best. They are typically experienced, well-rounded in a variety of martial arts, and well-conditioned with a sufficient fight camp in preparation to challenge their opponent. The model employed to explain their performance outcomes ( $Y$ ) is:

$$\begin{aligned}
 (1) \quad Y_{fbwt} = & \beta_0 + \lambda_t + \gamma_w + \beta_1 \cdot SMALLCAGE_{bwt} + \beta_2 \cdot AGE_{fbwt} + \beta_3 \cdot HEIGHT_{fbwt} \\
 & + \beta_4 \cdot REACH_{fbwt} + \beta_5 \cdot LEFTVSRIGHT_{fbwt} + \beta_6 \cdot EXPER_{fbwt} \\
 & + \beta_7 \cdot 1STFIGHT_{fbwt} + \beta_8 \cdot SNPROB_{fbwt} + \beta_9 \cdot 5ROUNDS_{bwt} \\
 & + \beta_{10} \cdot TITLE_{bwt} + \varepsilon_{fbwt}
 \end{aligned}$$

where  $fbwt$  denotes fighter  $f$  in bout  $b$  in weight class  $w$  in time period  $t$ .  $\lambda_t$  and  $\gamma_w$  are fixed effects for 16 time periods from 2001-2016 and eight weight classes, respectively.  $SMALLCAGE$  is an indicator equal to one if bout  $b$  is fought in the 25' Octagon. The parameter of interest is  $\beta_1$ , the marginal effect of cage size.

Equation 1 is estimated using logit regressions for binary performance outcomes, Heckman regressions for zero-inflated continuous performance outcomes, and OLS regressions for all other continuous performance outcomes. Standard errors are cluster-corrected at the event level as some productivity error terms are correlated across fighter-bout observations with certainty while others have a likely non-zero correlation. For example, if one fighter's FINISH indicator is "1," the opponent's will be "0," leading to a negative correlation of error terms within bouts. Likewise, there is a positive correlation between the percentage of time a fighter and opponent each have clinch control, implying a likely positive correlation of error terms within bouts when CLINCHPCT is examined.

### Empirical Results

Table 4 presents results for four different regression specifications on the performance outcome likely of the most interest to an MMA promoter—finishing the fight by KO/TKO or submission. The first specification controls for bout characteristics only, the second and third specifications add either year or weight class fixed effects, and the final specification controls for the full panel of bout characteristics and fixed effects.

In all specifications, increased age over the opponent is strongly associated with a lower probability of winning with a finish while more reach, higher SN probability, and being a southpaw versus an orthodox opponent are all strongly associated with higher finishing probabilities. If a bout is scheduled for five rounds, the fighters could fight for up to 25 minutes instead of 15. Finishes are more likely with longer fights, but when those longer fights have the best-of-the-best squaring off against each other for a championship belt, the marginal effect is fewer finishes.

For the parameter of interest, the four specifications reveal the importance of controlling for weight class fixed effects. Utilizing the full set of controls, Specification 4 suggests that a five-foot reduction in cage size generates a 2.7% increase in probability of each fighter winning by finish—as opposed to decision—significant at the 5% level. A typical UFC event card presently averages 11.8 bouts, or 23.6 fighter-bouts. Thus, findings suggest that a 25' cage, relative to its 30' counterpart, would lead to one additional KO/TKO or submission finish, which otherwise would have ended in a decision, roughly every one-and-a-half events (1-in-1.57). The UFC has recently averaged 475 bouts per year, 25.7 more of which would be expected to have a finish rather than go to the judges with a 25' cage instead of 30'.

Table 5 presents regression results for the *SMALLCAGE* variable of interest for all performance outcomes using the full set of controls from Specification 4. Regressions for *KDRATE*, *DISTKDRATE*, *CHOKERATE*, and *LOCKRATE* were estimated with a Heckman model since they contain a large number of zeros (due to less frequent occurrences) and such "non-response outcomes" were likely generated from a time frame that was "too short" as described in Humphreys (2013, p. 11).

Results in Table 5 provide evidence that use of the smaller 25' cage leads to 1:08 shorter average fight times, a higher proportion of fight time with one fighter

**Table 4***Effect of Cage Size on Finishing a Fight*

| <b>Dependent Variable: FINISH</b>          |             |             |             |             |             |             |             |             |
|--------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| <b>Independent Variables</b>               | <b>(1)</b>  |             | <b>(2)</b>  |             | <b>(3)</b>  |             | <b>(4)</b>  |             |
|                                            | <b>Beta</b> | <b>S.E.</b> | <b>Beta</b> | <b>S.E.</b> | <b>Beta</b> | <b>S.E.</b> | <b>Beta</b> | <b>S.E.</b> |
| SMALLCAGE                                  | .114        | .071        | .042        | .074        | .181 **     | .072        | .148 **     | .074        |
| AGE                                        | -.034 ***   | .008        | -.034 ***   | .008        | -.034 ***   | .008        | -.035 ***   | .008        |
| HEIGHT                                     | -.019       | .019        | -.019       | .019        | -.021       | .019        | -.021       | .019        |
| REACH                                      | .043 ***    | .014        | .044 ***    | .014        | .043 ***    | .014        | .043 ***    | .014        |
| LEFTVSRIGHT                                | .161 ***    | .059        | .160 ***    | .059        | .165 ***    | .060        | .164 ***    | .060        |
| EXPER                                      | .003        | .007        | .003        | .007        | .004        | .007        | .004        | .007        |
| 1STFIGHT                                   | .151        | .105        | .157        | .104        | .152        | .105        | .155        | .105        |
| SNPROB                                     | .026 ***    | .002        | .027 ***    | .002        | .027 ***    | .002        | .027 ***    | .002        |
| 5ROUNDS                                    | .565 ***    | .101        | .611 ***    | .103        | .444 ***    | .102        | .455 ***    | .104        |
| TITLE                                      | -.335 **    | .135        | -.445 ***   | .137        | -.243 *     | .135        | -.297 **    | .139        |
| CONSTANT                                   | -1.169 ***  | .029        | -1.756      | 1.108       | -.728 ***   | .062        | -1.310      | 1.031       |
| <b>Average Partial Effect of SMALLCAGE</b> | <b>2.1%</b> |             | <b>0.8%</b> |             | <b>3.3%</b> |             | <b>2.7%</b> |             |
| Year Fixed Effects                         | No          |             | Yes         |             | No          |             | Yes         |             |
| Weight Class Fixed Effects                 | No          |             | No          |             | Yes         |             | Yes         |             |
| N                                          | 5,764       |             | 5,764       |             | 5,764       |             | 5,764       |             |

*Note:* Estimates are from logit regressions of FINISH on the independent variables listed. The parameter of interest is that of SMALLCAGE. Standard errors are cluster-corrected at the event level. \*\*\*, \*\*, and \* indicate significance at the 1, 5, and 10 percent levels, respectively.

controlling the other in the clinch, higher rates of knockdowns, and higher rates of choke attempts, all while overall strikes landed and power strikes landed decline but their rates per five minutes remain statistically unchanged. While the multiple comparisons problem could potentially be a concern from examination of significance across multiple analyses, 8-of-13 estimates in this case are significant at the 5% level or better and the fight story they support is a sensible one.

Relative to the 30' cage, the evidence indicates that a smaller 25' cage leads to more finishes and shorter fight times. The decrease in fight time appears to be due to two effects: (a) more finishes and therefore fewer decisions and (b) finished fights appear to end faster than they otherwise would have. Since fight time is shorter, there are declines in overall strikes landed and power strikes landed in total, but the rate at which fighters landed overall strikes and power strikes is statistically unaffected. The increase in finishes appears to come from two sources: (a) increased distance knockdown rates and (b) higher rates of choke attempts.

Figure 2 is a visual representation of the two cage sizes observed during the sample period. In the first image, Fighter A and Fighter B are standing at distance with Fighter A having taken the center of the cage—a common occurrence. Fighter B has 360 degrees of possible movement—forwards, backwards, sideways,

**Table 5***Effect of Cage Size on Performance Outcomes*

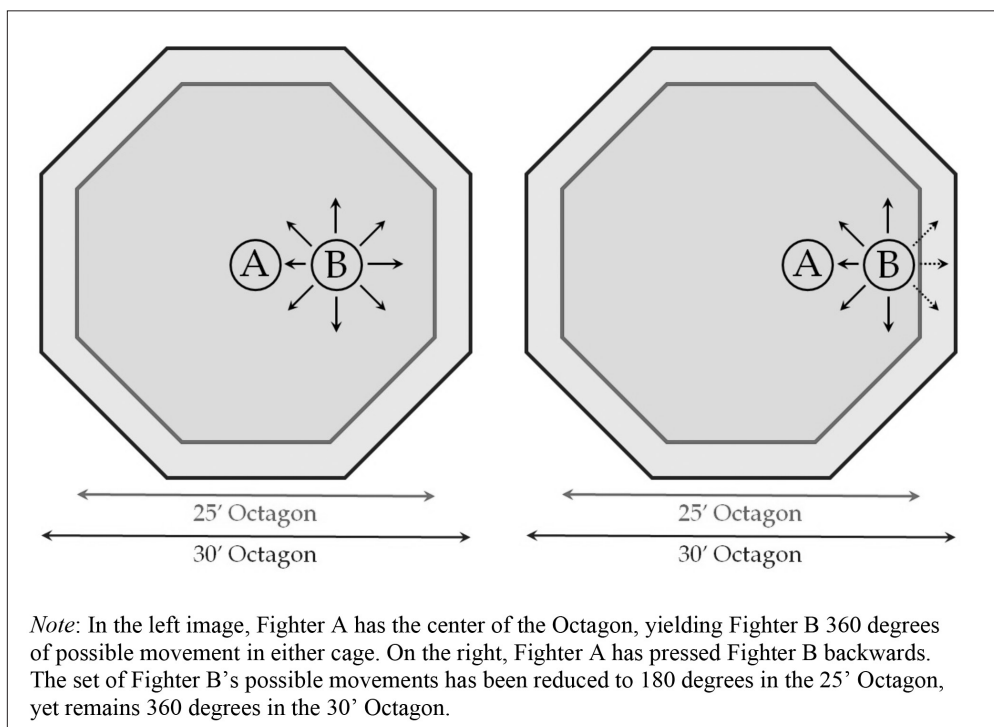
| <b>Dependent Variables</b>         | <b>Marginal Effect</b> | <b>S.E.</b> | <b>25' Avg</b> | <b>30' Avg</b> |
|------------------------------------|------------------------|-------------|----------------|----------------|
| <i>Logit Model</i>                 |                        |             |                |                |
| FINISH                             | .027**                 | .014        | 0.285          | 0.258          |
| UPSET                              | .026                   | .029        | 0.364          | 0.339          |
| <i>OLS Model</i>                   |                        |             |                |                |
| TIME                               | -1.136***              | .335        | 9.6            | 10.7           |
| STRIKES                            | -5.594***              | 1.786       | 45.3           | 50.9           |
| PSTRIKES                           | -2.859***              | .917        | 20.4           | 23.2           |
| STRIKERATE                         | -.169                  | .509        | 23.6           | 23.7           |
| PSTRIKERATE                        | -.260                  | .339        | 10.6           | 10.8           |
| CLINCHCPCT                         | .896**                 | .398        | 7.0            | 6.1            |
| GROUNDPCCT                         | -.108                  | .859        | 16.2           | 16.3           |
| <i>Heckman Zero-Inflated Model</i> |                        |             |                |                |
| KDRATE                             | .042**                 | .020        | 0.20           | 0.16           |
| DISTKDRATE                         | .054**                 | .023        | 0.23           | 0.18           |
| CHOKERATE                          | .037**                 | .016        | 0.18           | 0.14           |
| LOCKRATE                           | -.005                  | .009        | 0.07           | 0.07           |

*Note:* Each row is a separate regression of the dependent variable on the full set of covariates and fixed effects from Table 4. Results shown are marginal effects for the SMALLCAGE covariate of interest. Logit regressions are used for binary dependent variables, Heckman regressions for zero-inflated continuous dependent variables, and OLS regressions for all other continuous dependent variables. STRIKERATE, PSTRIKERATE, CLINCHCPCT, GROUNDPCCT, CHOKERATE, and LOCKRATE regressions are weighted by total time. KDRATE and DISTKDRATE regressions are weighted by standing time and distance time, respectively. Standard errors are cluster-corrected at the event level. \*\*\*, \*\*, and \* indicate significance at the 1, 5, and 10 percent levels, respectively.

or angling in or out. In the second image, Fighter B has been pushed towards the fence and the more rapid decline in defensive maneuverability in a 25' cage environment could explain the increase in distance knockdown rates observed in the data.

## Discussion

Cage size in MMA is not simply an operational issue. The present study provides evidence that it is a marketing issue as well. With athletic commission regulation of the sport of MMA, cage size remains an area where promoters maintain discretion over a bout parameter that can influence fighter performance and consumer engagement (i.e., that can help MMA promoters “make you not take your wife out on Saturday night, not go to a movie, or whatever else you might want to do on Saturday night” per UFC President Dana White [*Le et al. v.*



**Figure 2.** Visual Representation of Octagon Size

Zuffa, LLC, 2018, p. 162]). Findings of the present study are mixed regarding fighter performance factors that can influence the entertainment value of a fight.

Smaller cages tend to generate more fight finishes, something UFC management attempts to incentivize with KOTN and SOTN bonuses, and an important factor in FOTN consideration. They also lead to more knockdowns and choke attempts, all while leaving overall strike and power strike rates unchanged. This suggests that MMA promotions looking to competitively position themselves as having a higher rate of finishes should consider employing a smaller cage.

A tradeoff is that the smaller cage also leads to an increased percentage of fight time with clinch control, a position that referees will break with insufficient action and UFC management appears to penalize for FOTN consideration. In fact, the increased proportion of clinch control results in total clinch time along the cage remaining unchanged. The 1:08 reduction in overall fight time appears to come entirely from the distance and ground positions, with the majority from distance. Thus, while smaller cages tend to generate more exciting outcomes such as finishes, knockdowns, and submission attempts, they can also lead to less desirable positioning as a higher proportion of fights take place along the cage. Profit-maximizing MMA promoters would need to weigh such downside risk when making strategic cage-size decisions.

MMA promoters compete not only with other MMA organizations, but with a variety of other entertainment options available to potential customers. Enhancing the drama and excitement of one's fights could help improve a promoter's customer

acquisition and retention, but they are not the only relevant factors. Anecdotal evidence suggests that some fighters “despise” the 25’ cage, believing it restricts their movement (Doyle, 2017). In the competition to acquire and maintain fighter labor services, fighter satisfaction with the in-cage environment may also be an important consideration. Additionally, a smaller cage may allow for incremental revenue generation from an extra row of seats on the venue floor, another factor excluded from the present study.

A potential caveat to this study is the possibility of equilibrium training adjustments coaches and fighters might make should the UFC ever adopt a marked change to its cage sizing decisions. It appears the UFC did not “proactively” inform fighters of cage sizes for upcoming fights for at least the large majority of the sample period of the present study (Fowlkes, 2014). Advance confirmation or a substantial and credible increase in the percentage of events with smaller cage sizes could potentially allow coaches and fighters to better prepare for the constraints on movement posed by a more limited striking space and the increased likelihood that grappling exchanges will take place closer to the fence.

## Conclusion

Cage size matters in MMA. It can affect fighter mobility in a manner that ultimately influences key aspects of fighter performance. Thus, cage size can influence consumer perceptions of an MMA promotion’s product quality, and possibly the satisfaction of its labor providers.

After controlling for bout characteristics as well as time and weight class fixed effects, results suggest that, relative to a 30’ cage, a smaller 25’ cage would lead to one additional fight finish every 1.57 events, or 25.7 additional finishes over recent UFC years. Fight times would decline an average of 1:08, from 10:43 to 9:35, with no apparent reduction in the rate at which fighters land overall strikes and power strikes. The increase in finishes appears to come from the effect a smaller cage has on the rate of distance knockdowns and choke attempts. A potential drawback is evidence suggesting an increase in the percentage of fight time taking place in the clinch along the cage increases.

MMA is regulated unarmed combat, yet it is also the professional occupation of the men and women who choose to test their martial arts skills inside a locked cage. This study provides evidence of a statistically significant and likely economically significant role of the size of that cage in the MMA industry.

## References

- Andrew, D., Kim, S., O’Neal, N., Greenwell, T., & James, J. (2009). The relationship between spectator motivations and media and merchandise consumption at a professional Mixed Martial Arts event. *Sport Marketing Quarterly*, 18(4), 199–209.
- Association of Boxing Commissions and Combative Sports. (2009). Discussion and review of Unified Rules of Mixed Martial Arts. ABCboxing.com. Re-

- trieved from <http://www.abcboxing.com/committee-report-on-unified-rules-for-mma/>
- Bieler, D. (2016). New York becomes final state to legalize MMA events. *Washingtonpost.com*. Retrieved from <https://www.washingtonpost.com/news/early-lead/wp/2016/03/22/new-york-becomes-final-state-to-legalize-mma-events>
- Doyle, D. (2017). Joe Silva responds to Matt Mitrione's claim that Silva lied about Roy Nelson fight. *MMAfighting.com*. Retrieved from <https://www.mmafighting.com/2017/11/27/16706620/joe-silva-responds-to-matt-mitriones-claim-that-silva-lied-about-roy-nelson-fight>
- Fowlkes, B. (2014). When it comes to the UFC's Octagon, for fighters, size matters. *Mmajunkie.com*. Retrieved from <https://mmajunkie.com/2014/09/when-it-comes-to-the-ufcs-octagon-for-fighters-size-matters>
- Genauer, R. (2013). Personal interview.
- Gift, P. (2014). BE Analytics: The recipe for winning UFC Fight of the Night bonuses. *Bloodyelbow.com*. Retrieved from <https://www.bloodyelbow.com/2014/3/5/5465146/mma-ufc-win-fight-of-the-night-bonus-award>
- Gift, P. (2018a). Performance evaluation and favoritism: Evidence from mixed martial arts. *Journal of Sports Economics*, 19(8), 1147–1173.
- Gift, P. (2018b). Moving the needle in MMA: On the marginal revenue product of UFC fighters. Manuscript submitted for publication.
- Humphreys, B. (2013). Dealing with zeros in economic data. Working paper. Retrieved from <https://pdfs.semanticscholar.org/35c3/8229c8f7393acffc93b4a83120661df1f02c.pdf>
- Le et al. v. Zuffa, LLC*. (2018). 2:15-cv-01045-RFB-PAL. Plaintiffs' Opposition to Zuffa's Motion for Summary Judgment. ECF No. 596, Exhibit 31 (D. Nev. September 21, 2018)
- Reams, L., & Shapiro, S. (2017). Who's the main attraction? Star power as a determinant of Ultimate Fighting Championship pay-per-view demand. *European Sport Management Quarterly*, 17(2), 132–151.
- Sauer, R. D. (2005). The state of research on markets for sports betting and suggested future directions. *Journal of Economics and Finance*, 29, 416–426.
- Seungmo, K., Greenwell, T., Andrew, D., Lee, J., & Mahony, D. (2008). An analysis of spectator motives in an individual combat sport: A study of mixed martial arts fans. *Sport Marketing Quarterly*, 17(2), 109–119.
- Tainsky, S., Salaga, S., & Santos, C. (2012). Estimating attendance for the Ultimate Fighting Championship: A demand theory approach. *International Journal of Sport Management and Marketing*, 11, 206–224.
- Tainsky, S., Salaga, S., & Santos, C. (2013). Determinants of pay-per-view broadcast viewership in sports: The case of the Ultimate Fighting Championship. *Journal of Sport Management*, 27, 43–58.
- Ultimate Fighting Championship. (2017a). The UFC. *Ufc.com*. Retrieved from <http://www.ufc.com/discover/ufc>
- Ultimate Fighting Championship. (2017b). UFC Statement on Fight Night Bonuses. *Ufc.com*. Retrieved from <http://www.ufc.com/news/UFC-Statement-on-Fight-Night-Bonuses>

- U.S. House of Representatives Committee on Energy and Commerce. (2017). Background memo. Energycommerce.house.gov. Retrieved from <http://docs.house.gov/meetings/IF/IF17/20171109/106604/HHRG-115-IF17-20171109-SD003.pdf>
- Watanabe, N. (2012). Demand for pay-per-view consumption of Ultimate Fighting Championship events. *International Journal of Sport Management and Marketing*, 11, 225–238.
- Watanabe, N. (2015). Sources of direct demand: An examination of demand for the Ultimate Fighting Championship. *International Journal of Sport Finance*, 10, 26–41.