SPLITTING THE DIFFERENCE: COMPENSATION and ECONOMIC EXPLOITATION IN ELITE GYMNASTICS

Abstract:

We use a human capital wage model to examine factors that influence earnings in elite level gymnastics. Next, using data from the Olympic Library and from publicly available financial statements, we estimate the marginal revenue product of gymnasts from 1984 to 2016. Lastly, we compare factor income shares from other Olympic sports with gymnastics. We estimate that select Olympic gymnasts earn a wage that is far lower than the average marginal revenue product. Thus, we conclude that some gymnasts are economically exploited.

I. INTRODUCTION AND BACKGROUND

USA Gymnastics was born in 1963 in Tuscon, Arizona with 7,000 practicing athletes across the country. With over 120,000 athletes in its ranks, it declared bankruptcy in 2018 after the sentencing of convicted abuser, Larry Nassar. In January of 2020, the gymnastics organizing body offered the 300+ victims in the pending lawsuit a $215 million settlement. Obviously, elite gymnastics in the United States is undergoing a radical governance transformation because of the crippling dysfunction in its organizing body. If the Chapter 11 process is successful, USA Gymnastics will still have to confront another public relations debacle: are elite gymnasts economically exploited?

Zimbalist (2010) and Greer, Berri, and Harris (unpublished) estimate that professional athletes in basketball and football earn between 58% and 67% of revenues. Harris and Dulin (unpublished) and Harris (forthcoming) estimate that elite swimmers earn 9% of revenues reported by USA Swimming. Swimmer, Michael Andrew, a plaintiff in *Shields, et al. v. FINA, Case No. 18-cv-07393,* put it this way “Very few select swimmers make a living swimming, while FINA is

making a killing."[1] Elite gymnasts are focused on more significant problems in their organization—rightly so. However, we suspect that some gymnasts may be generating more in marginal revenue product for USA Gymnastics than the "wage" they receive. In this sense, some elite gymnasts may be economically exploited. If this is the case, than USA Gymnastics may want to reconfigure their revenue and expenses model just as they reconfigured their board two years ago.

II. LITERATURE REVIEW

Two strands of literature contribute to our research question. We first consider the literature devoted to measurement of MRP and then examine the literature on human capital wage models in sport. Brown (1993) started the modern MRP conversation and continued it with Brown (1994) and Brown and Jewell (2004). These estimates of college football player rents were updated again in Brown (2011). These studies assume that the individual skill levels of players make up a team's total skill level. The authors use a two-stage estimation to account for endogeneity in the recruiting process. Of importance to our work, in the second stage team revenues are estimated to be a function of future draftees, controlling for market characteristics and quality of a team's competition. The initial study reported the economic rent from a premium college football player was about $500,000, though subsequent studies reported rents closer to $1,000,000. Our research design differs from the Brown and Brown & Jewell approach; we use two different panel estimators that return roughly equivalent results to estimate our gymanst MRPs. We find these values range from about $0 to over $163,260.

Lane, Nagel, and Netz (2014) estimate male college basketball player MRPs three different ways. First, they use player statistics and professional salary distribution data; second, they estimate the effect of future drafted players on revenues earned by the team; lastly, they follow a Scully approach. Ultimately they conclude that MRPs range from $5,000 to $400,000 for lower revenue schools and $100,000 to $2,000,000 at high revenue schools. Our research design is

[1] https://swimswam.com/katinka-hosszu-michael-andrew-tom-shields-file-lawsuit-against-fina/ accessed 06/03/2019.

closer to Lane et al.'s first method. We find that some athletes are exploited—not by a college in our research, but by the governing body of the Olympic organizers.

There are a few human capital wage studies in the sports literature.[2] Humphreys (2000) investigates the earnings gap between male and female NCAA head basketball coaches using a human capital wage model. He finds that the gap is not attributable to the coach's gender, but instead is derived from the perception of greater prestige of men's sports, fan discrimination against women's sports and/or the gender of the coach, and the preferences of athletic directors for men's sports.

Harris (forthcoming) examines earnings for the top 30 elite swimmers, also using a human capital wage model. Harris finds that college program is not a significant factor in the variation of earnings in these top athletes, although she does find a significant gender gap. Even though female swimmers in the sample had more endorsement contracts and won more Olympic medals than the males, on average, they earned 240% less overall. Our study does identify a significant gender effect; however, it works in the opposite direction. Female gymnasts earn over $5,100 more per event year than their male counterparts (not including endorsement income).

Another thread in this literature examines whether or not athletes or their employers pay for training costs. Krautmann, Gustafson, and Hadley (2000) estimate the surplus generated by restricted major league baseball players. They compare these estimated surpluses across players and conclude that the surplus can be thought of as the owners' attempt to recover training costs. Our approach differs from Krautmann, et al (2000) in that elite gymnasts (even the youngest athletes) pay for their own training costs. Indeed, by the time these athletes become a part of the National Team they have invested $50,000 in coaching, travel, and USA Gymnastics club fees (on average) in order to become and remain competitive.

[2] See Humphreys, B. R. (2000). Equal pay on the hardwood: The earnings gap between male and female NCAA Division I basketball coaches. *Journal of Sports Economics*, *1*(3), 299-307, for example. Or, Simmons, R., & Forrest, D. (2004). Buying success: team performance and wage bills in US and European sports leagues. International Sports economics comparisons Fort R, Fizel J, eds. Santa Barbara (California): Praeger, 123-140.

III. Data and Method

We use the stipend paid by USA Gymnastics to the National Team members as a proxy for the "wage" earned. We also use revenue, athlete membership and club membership numbers from USA Gymnastics audited financials to estimate a revenue function for the organization. This allows us to estimate the marginal revenue contribution from athlete productivity. Performance metrics for the athletes from 1984 to 2019 are used to estimate marginal productivity.

Thus, our research question is essentially treating Equation 1 as our null hypothesis and Equation 2 as the alternate:

$$Ho: w_{it} = MRP_{it}$$

Equation 1

$$Ha: w_{it} \neq MRP_{it}$$

Equation 2

Where the wage for gymnast *i* in time period *t* is compared to the MRP of gymnast *i* in time period *t* in both equations. Our method follows three steps. First, we estimate a human capital wage model to establish which exogenous variables are most important in determining gymnast outcomes that impact income earned (e.g. did they make the finals, did they earn a medal, etc). This is akin to estimating the marginal product (MP) portion of the MRP. Next, we estimated the marginal revenue (MR) generated from gymnast performances to get an approximation of gymnast MRP (i.e., MP * MR). Finally, using the USA Gymnastics stipend as the proxy for the wage paid to gymnasts (professional and amateur), we compare gymnast MRPs to the stipend to answer our question. We also compare factor income shares from other sports with gymnastics as a robustness check.

Our data include 242 gymnast-year observations. This data was collected from the Olympic Library while World Championships data was gathered at https://www.gymnastics.com. Revenue data was taken from publically available financial statements archived at https://usagym.org/pages/aboutus/pages/finance.html. A snapshot of some of the key independent variables is summarized below in Table 1; our variables are fully defined in Appendix 1.

Table 1. Summary Statistics for Elite Gymnasts, 1984-2019

Variable	*Observations*	*Mean*	*Std. Dev.*	*Minimum*	*Maximum*
Total Earnings	242	7,763	14,179	0	80,000
Age	242	19.74	3.62	14	29
Olympics	242	0.285	0.452	0	1
Meet Finals	242	1.81	1.08	1	5
Gold	242	0.42	0.83	0	5
Silver	242	0.39	0.68	0	3
Female	242	0.517	0.500	0	1

Slightly more than half the gymnasts in our sample are female. The $80,000 in Total Earnings belongs to Nastia Liukin from the 2008 Beijing Olympic Games. Just shy of one third of the sample gymnasts competed in an Olympic Games. More gold medals were earned than silver bronze medals in the sample. The youngest gymnasts in the sample were Kerri Strug in the 1992 World's and Domonique Moceanu in 1995. The oldest gymnast in the sample is Blaine Wilson at the 2003 World Championships. We estimate our basic earnings model as shown in Equation 3.

$$Earnings_{it} = f(Age, Age\ Squared, Medals, Oympics, Meet\ Finals, Female)$$

Equation 3

Earnings for gymnast *i* in time period *t* are as the sum of payments for Olympic and World medals. We expect the following potential impact on earnings for swimmer *i* in time period *t*:

- we expect the estimated coefficient on Age to be positive
- we expect the estimated coefficient on Age Squared to be negative
- we expect the estimated coefficient for Medals (gold, silver, or bronze) to be positive
- we expect the estimated coefficient on Olympics to be positive
- we expect the estimated coefficient on Meet Finals to be positive
- we expect the estimated coefficient on Female to be negative

IV. Results

Our data set presents as an unbalanced panel. We have observations for gymnasts that competed in the World Championships and Olympics in the 1980s as well as observations for gymnasts that competed in these events in the last two years. However, the number of gymnasts we include in each year is stable—it does not increase with time. Therefore, we use a linear regression with absorbed dummy effects (Model 1) to estimate the model and a fixed effects estimator (Model 2) for comparison. Table 2 reports the estimated coefficients from the basic earnings model.

In Model 1, Age of the athlete is not significant in determining earnings. In Model 2, gymnasts earn $9,952 for every birthday they experience up to about 17 or 18 years old. Earnings begin to increase at a decreasing rate by 19 years. For all athletes, Olympic appearances increase income by at least $8,000 up to a little more than $10,000. For each additional silver medal, Model 1 suggests gymnasts' earn $3,626 more whereas Bronze medals do not impact earnings significantly (results not reported). Somewhat surprisingly, female gymnasts earn $4,692 more than their male teammates, other things constant.

Table 2. Estimated Coefficients from Linear and Panel Fixed Effects Estimators Total Earnings Dependent Variable

Variable	***Model 1***	***t***	***P>|t|***	***Model 2***	***t***	***P>|t|***
Age	3,155	1.25	0.211	9,952	2.63	0.010
Age Squared	-74	-1.36	0.219	-218	-2.46	0.015
Olympics	8,737	5.48	0.000	10,357	5.22	0.000
Meet Finals	848	1.24	0.216	3,317	2.75	0.005
Gold	5,796	6.43	0.000	4,454	3.27	0.001
Silver	3,626	3.39	0.001	668	0.43	0.667
Female	4,692	1.99	0.047	n/a		
Model Notes	*R^2 = 0.37, linear reg w/ large dummy (areg stata)*			*R^2 = 036, fixed effects (xtreg stata)*		
	*Dependent variable is **Total Gymnast Earnings;** n=242 gymnast-year observations*					

Competing in meet finals in any event increases athlete income by $1,000 to just over $3,300 according to Model 2. The results from Model 2 depart from the Model 1 primarily with respect

to Age, Silver medal earnings and the importance of Meet Finals. Perhaps both models are confirming what might be obvious to gymnastics fans: earning gold medals and earning a spot on the Olympic team are the most important variables for higher earnings from the sport—especially if you are a female athlete.

The next step in our research design is to estimate the marginal revenue product (MRP) generated by each athlete every year they compete. We do this in three steps. First, we collected annual revenues from USA Gymnastics audited financial statements for every year in the sample. We also collect the number of athletes and clubs reported by USA Gymnastics each year. These observations become the covariates for a basic revenue model. Estimated coefficients are reported in Table 3.

Table 3. Estimated Coefficients from Linear Model of Revenue USA Gymnastics

Variable	***Model 1***	***t***	***P>|t|***
Number Athletes	123	3.32	0.001
Number of Clubs	2480	2.90	0.005
Number Medals	2111	2.40	0.005
Model Notes	*R^2 = 0.95, dependent variable is USA Gymnastics Revenue n = 35*		

Anecdotal evidence suggests that membership in USA Gymnastics (and USA Swimming) increases after Olympic years or any other year where stand-out performances occur. Gold medal performances by the Magnificent Seven in the 1996 Olympics, for example, inspired more young athletes to join USA affiliates and also helped to incentivize the creation of new affiliate clubs.

(With athlete memberships at $65 per year now and club dues at $225, there are clear revenue implications). This is also true for donations to the organizations. Regressing USA Gymnastics Revenue on the number of athlete memberships and the number of clubs results in a model that accounts for 95% of the variation in USA Gymnastics Revenue. We hypothesize the mechanism is medals earned. In our sample, one additional gold medal, for example, increases USA Gymnastics athlete memberships by 7,359 the following year. In similar fashion, one more gold medal performance inspires the creation of 247 more clubs. Once involved, additional revenues are collected from athletes when they compete in sponsored events and regional competitions. Thus, the model indicates that on average, each new athlete any given year contributes $123 in additional income to USA Gymnastics and each new club generates $2,480 in additional revenue each year. The second step in our MRP process is the calculation of marginal revenue for USA Gymnastics from changes in athlete performance holding the other variables constant. The final step is to use these marginal revenue estimates to generate the MRP by multiplying MR and MP where MP is the change in medals earned each year.

We compare the estimated MRPs for all athletes in the sample to their actual earnings. For many athletes in the sample, the earnings or "wage" they receive is just the stipend from USA Gymnastics. For others, earnings will be the sum of the stipend and their payments from winning a medal at the Olympics or the World Championships. This difference between the athlete MRP and the athlete wage is the exploitation gap. If this difference is positive, we reject the null hypothesis in Equation 1 and conclude the gymnast is exploited. If this difference is negative, we reject the null hypothesis and determine the athlete is not exploited by our definition. If the gap is equal to zero, we do not reject the null hypothesis and the athlete is not exploited by our definition. Figure 1 illustrates the gap between the MRP and wage for every athlete in the sample. Figure 2 orders these gaps from the smallest (the athletes who are earning far above their generated MRP) to the largest (those most exploited).

Figure 1. Dollar Value of Exploitation Gap

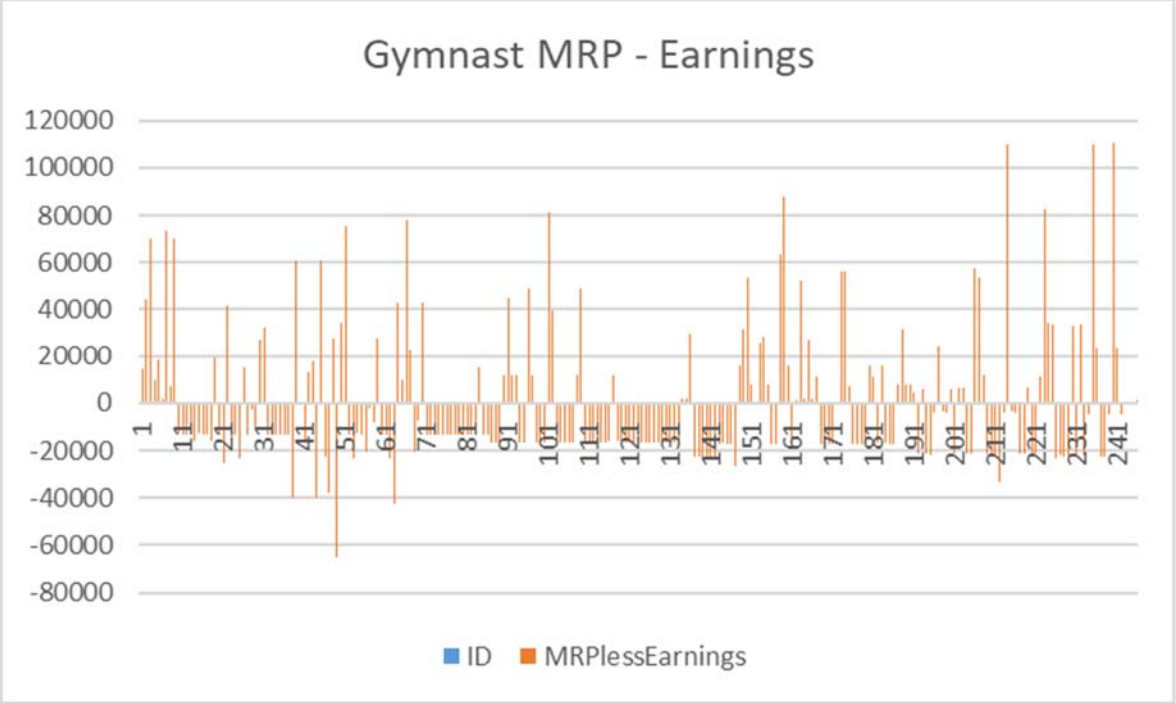


Figure 2. Dollar Value of Exploitation Gap Order Smallest to Largest

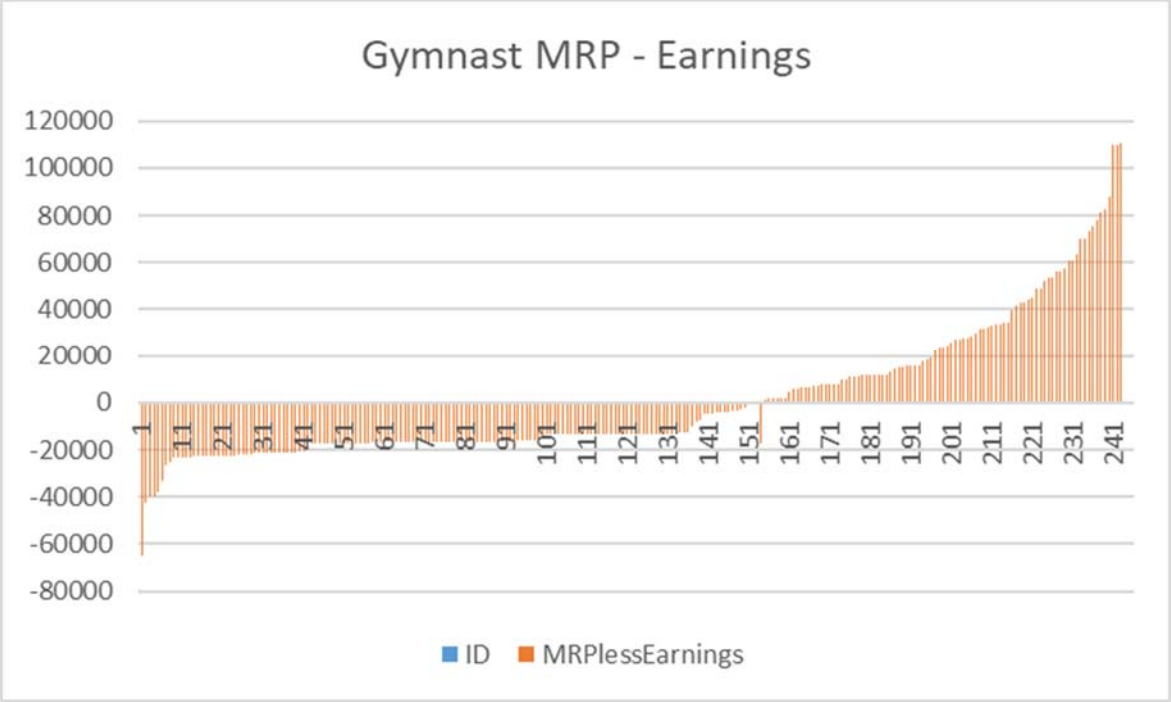


Figure 3. Distribution of Exploitation Gap in Descending Frequency

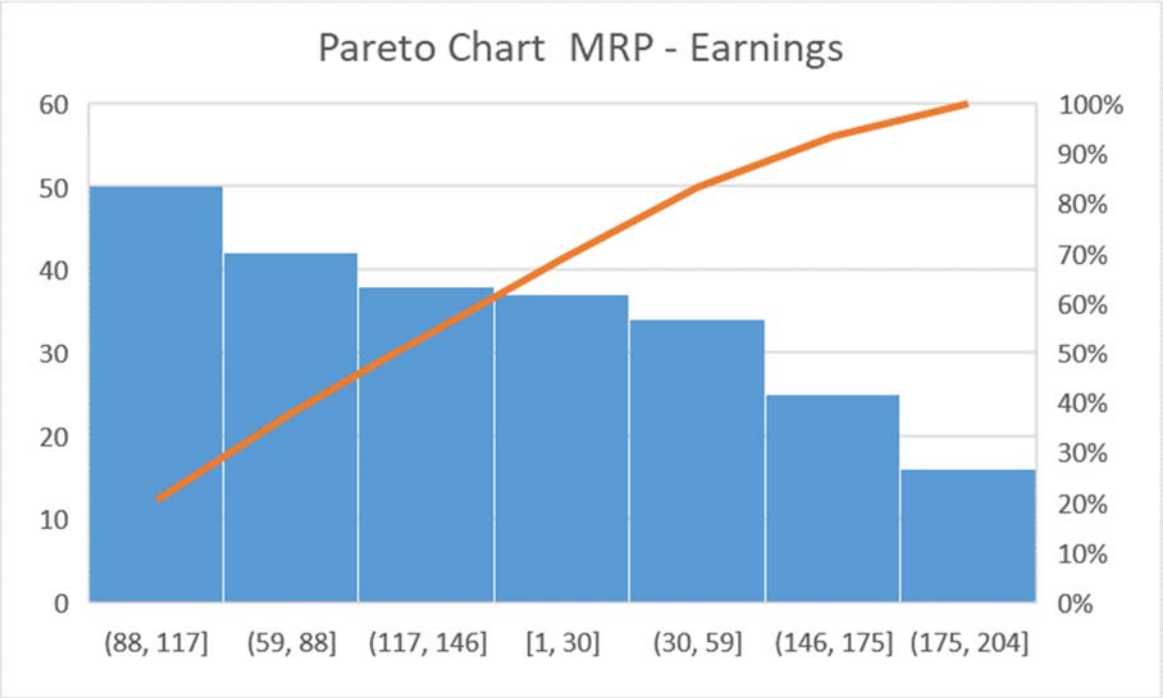
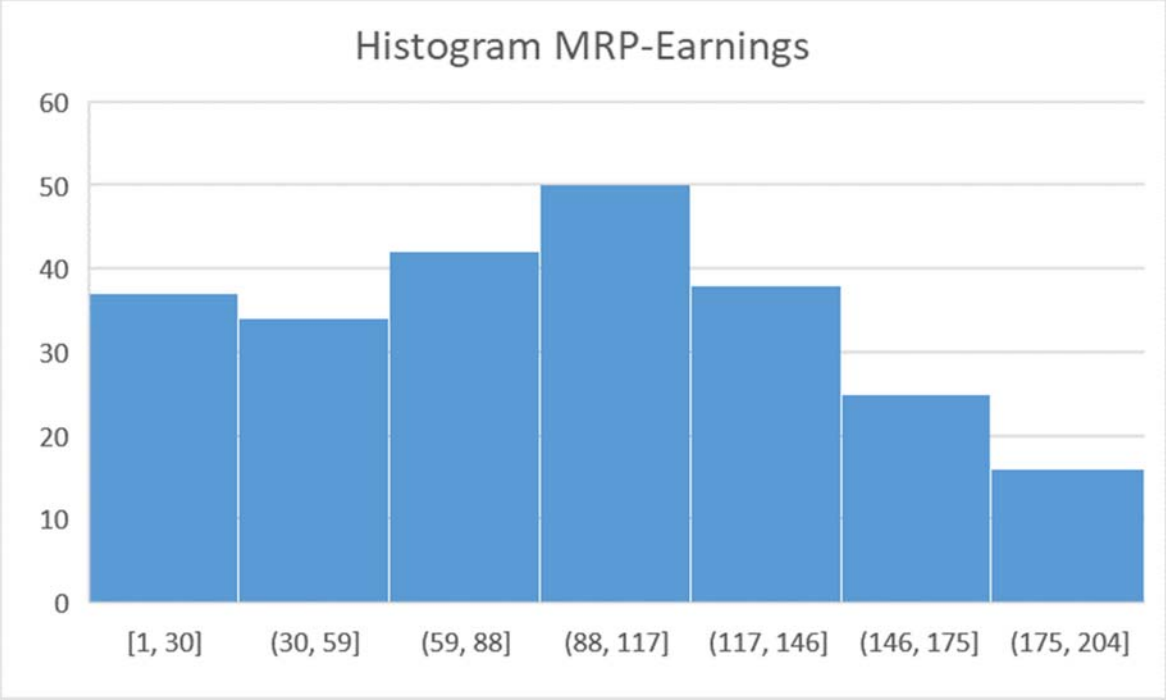


Figure 4. Histogram of Exploitation Gap



The y-axis is the dollar value of the difference between the estimated MRP for each athlete and the wage (medal winnings plus stipend) paid in the performance year. Clearly, not all athletes (based on our estimated MRPs) are exploited. But 88 of 243 earn less than the value they generate for USA Gymnastics. And, for some of these, the exploitation is remarkable. Sunisa Lee's Gold medal performance at the World Championships in Stuttgart, Germany generated in excess of $160,000 in MRP for USA Gymnastics yet she earned $50,000. Or consider Nastia Liukin's performance in the Beijing Olympics where she earned the All Around Gold and her team earned Silver generated close to $100,000 in MRP; yet, her stipend that year from was less than $20,000. The average exploitation gap is just $939. However, the bar chart reveals that this average is quite misleading.

Figure 3 shows the distribution of the gaps in descending order of frequency with a cumulative line showing the percentage of the total. Figure 4 displays a histogram of the MRP-Earnings gap. The mean gap may be $939, but the standard deviation is $28,077. For 40 athletes in the sample period, earning another $28,000 would more than double their income from gymnastics.

The last step in our research design is to compare labor income shares from other professional leagues with the labor share observed in swim. Zimbalist (2010) and Greer, Berri, and Harris (forthcoming) note that professional sports leagues pay labor between 40% and 60% of revenues earned; based on our estimates, gymnasts from the 2016 Rio Games received about 3% of USA Gymnastics revenue. The positive exploitation gap is positively correlated with gold medals. However, 67 silver medal performance and 14 bronze medal performances resulted in positive exploitation. If USA Gymnastics paid their gymnasts just 14.5% of revenues instead of 3%, exploitation—as we define it—would be eliminated. This is not to say that we are recommending this lower bound income share.

V. Discussion and Conclusion

Prior findings by Harris (forthcoming) indicate there is a substantial gender wage gap for female swimmers when endorsement earnings are part of the human capital wage model. However, this is not what we observe in this study of elite female gymnasts. Females earn about $4,700 more per year than male gymnasts, other things the same. There are two main contributions of this study. First, we have identified some of the key variables in a human capital wage model of gymnastic performance. Age, gender, Olympic appearances and gold medal performances significantly increase athlete earnings. Second, we have shown that gymnasts who perform exceptionally are exploited (in our sample, this constitutes 36% of athletes). If you are a glass-half-full type of analyst, then this is good news in since 64% of elite gymnasts are likely not exploited.

In the tradition of Krautmann, et al., we can discuss these results in terms of who pays for human capital development or training. Viewed this way, 64% of elite gymnasts are benefiting from USA Gymnastics paying for their development and training. But, this is true only if we assume zero past training costs—which is very unlikely. It is equally unlikely that the 36% of gymnasts who are exploited have not benefited on some level from the subsidized support from USA Gymnastics. Tackling this issue properly requires a different paper.

We have at least two paths forward with this research. First, we can improve upon our human capital wage model by incorporating observations on race and the interaction of race and gender. Though difficult, other studies make use of photographic technology to categorize athletes on the basis of skin color (Robst, et al., 2011). Since Simone Biles is now the most decorated World Champion gymnast with 23 medals, it is incumbent on us to examine whether or the earnings of non-white gymnasts are impacted by discrimination. Second, we can incorporate observations on the influence of coaching or club membership on earnings. Gymnastics is a sport of coaching dynasties (i.e., Bela Karolyi). Club participation could also be correlated with college training. Both of these might improve our model.

The bottom line in this elite gymnastics industry is this: USA Gymnastics reported $20.4 million in revenues in 2018. The National Team members earned 3% of this revenue. More than three times less than elite swimmers earn from USA Swimming, and more than 10 times less than professional basketball players. This might be one of the reasons the plaintiffs in the pending lawsuit against USA Gymnastics were underwhelmed with the recent settlement offer. As in swim, novice member athletes pay fees in excess of $7.8 million--this more than covers the costs of supporting the National Team. The novices keep the elite athletes tumbling. Organizing bodies, like USA Gymnastics, do provide necessary functions to promote the sport, collecting fees and earning income from amateur participants. However, the administrators and executives are paid generous six-figure salaries while many of the top athletes in the sport live just above the poverty level, if they are lucky.[3] While it is true that no one forces a young, star gymnast to pursue a career in the sport, it is also true that the institutions responsible for organizing and administering the sport retain the largest share of income generated.

[3] Anecdotal evidence suggests that elite gymnasts spend between $20,000 to $50,000 on coaching, equipment, supplies, and travel to remain competitive. Without endorsement income, the stipend may not cover all these expenses and leave them with less than poverty level income.

Appendix 1. List of Variables and Definitions

Variable	***Definition***
Year	The time variable in our panel, ranging from 1984 to 2019
Meet Finals	A qualitative variable describing the competition (e.g. Olympic Games)
Gymnast ID	A number from 1 to 445 identifying the swimmer in our panel
D_Femal	A dummy variable with a value of 1 when the gymnast is female, 0 otherwise
TotalEarnings	The dollar value of total earnings based on medals
MeetEvents	A count variable of the number of events the swimmer entered at that meet
Gold	A count variable of the number of gold medals won at that meet
Silver	A count variable of the number of silver medals won at that meet
Bronze	A count variable of the number of bronze medals won at that meet
MR	The dollar value of a gold medal to the organizing body, USA Gymnastics, from increased donations and membership revenues after Olympic performances
MRP	The value of a swimmer's earned gold medals multiplied by the MR
Gap	The difference between the USA Gymnastics stipend for the year and a gymnast's MRP for the event

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IRB statement:

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