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Pregnancy in the Paint and the Pitch: Does Giving Birth Impact Performance?

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Abstract: We examine the impact of giving birth on athletic performance of players in the Women's National Basketball Association. Using data from media reports and National Womens Basketball Players Association records we specify a productivity model and use a differences-in-means approach to investigate. We do not find any impact of giving birth on player performance in the sample. In the wake of the Gunnarsdottir maternity leave decision against Club Lyon, this research could help inform league policies concerning maternity leave and also contribute to the broader conversation about gender discrimination in the workplace based on perceptions of productivity before and after giving birth.

Keywords: worker productivity; pregnancy; elite athlete performance; motherhood penalty

JEL Classification: I13; J23; J24; Z1

1 Introduction

"They cut through my abs!" she explained to a reporter. In 2006, forward DeMya Walker endured the cesarean birth of her daughter. Walker believed her physical recovery from a cesarean birth would be more difficult than a vaginal birth. Regardless of the method, giving birth is physical with well-documented impacts on

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the mother's body. Bo and Backe-Hansen (2007) study three chronic conditions of pregnancy and provide some analysis of their prevalence among athletes. For elite basketball players in the Womens National Basketball Association (WNBA), giving birth may also impact their wages and career trajectory. WNBA salaries are modest in comparison to NBA salaries. Only recently has the Collective Bargaining Agreement (CBA) for the players required WNBA teams to offer fully paid maternity leave. Prior to 2020, the CBA provided 50 % of a player's salary during the pregnancy leave or until the end of the player contract. The new CBA opens the doors for players to potentially earn a 50-50 split of their own contingent on the league hitting its revenue goals (this translates into a tripling of top player salaries). This may result in fewer players looking for income overseas. As recently as 2019, the league saw over 80 % of its athletes play for international teams to increase their earnings. Clearly, the new CBA improves the working conditions for WNBA players.

However, being side-lined longer due to a difficult birth can still impact a player's physical, emotional and financial quality of life. It is not just the time off; what if physical effects of the birth change the way an athlete can run, jump or shoot the ball? These questions are not limited to professional basketball players. In her memoir, *Saving Grace: What the Quarter Mile Has Taught Me* (Richards-Ross 2017), track star Sanya Richards-Ross recounts her heartbreaking decision to terminate a pregnancy weeks before the 2008 Beijing Olympics. She revealed that most of her peers had terminated pregnancies in order to maintain performance. Media reports before and after the birth of Serena Williams' daughter addressed the issue this way: will Serena be the same tennis player after motherhood? Harris (2018) reports in *Fast Company* that Williams' position as a high profile elite athlete sparked a nationwide maternity leave debate. More recently, in May of 2022, footballer Sara Gunnarsdottir won 82,000 Euro plus 5 % interest on back pay stemming from her maternity pay suit against Club Lyon. The FIFA Dispute Resolution Chamber reiterated that Gunnarsdottir had the right to continue providing sporting services while pregnant. She also had the right to be otherwise employed by Club Lyon during her pregnancy. The resolution dispute goes into very granular detail about the communications between Gunnarsdottir and the Club; it reveals the tenuous nature of pregnancy, birth, and player performance from the viewpoints of players and employers.

It seems that much of what society knows about the impacts of pregnancy and birth on elite athlete performance is anecdotal in nature. Indeed, there is mixed evidence on return to work for women and their mental health according to a meta-analysis by McCardel Loedding and Padilla (2022). Martínez-Galiano et al. (2019) find that long term quality of life varies for mothers conditioned on a variety of factors related to the birth (i.e. vaginal or caesarean delivery, degree of damage to the perineal area, health of the newborn after birth, and health of the mother after birth). But, as far as we can tell, there is very little empirical investigation of this

issue. This study tackles a foundational question: Does giving birth impact player performance on the basketball court? To be clear, our research question focuses on the performance of players who give birth to a child. We recognize that becoming a parent by adopting, by marriage or by your partner giving birth may also impact performance. However, we save analysis of the impact of parenting on performance for a future paper.

2 Background on Sports Labor Productivity

There are three literatures foundational to our study: sports labor productivity research, sports performance research related to pregnancy and birth, and the broader literature examining gender discrimination against pregnant workers. We know quite a bit about how to measure athlete productivity in basketball. Berri (1999) introduced a robust estimator of wins produced. Berri uses OLS to determine the marginal effect of every action a player takes resulting in possession of the basketball and actions resulting in turnovers. He controls for offense and defense, player fixed effects and other game specific effects. The result is a performance metric (originally called win score, but eventually labeled wins produced) that explains 90 % or more historical variation in wins in repeated trials. Berri, Schmidt and Brook (2006) apply this tool to answer the age-old question: who is the greatest of all time? Their book "The Wages of Wins" contains dozens of cases where the wins produced metric helps explain athlete performance reliably through a player's career and consistently across players. Since we are comparing a single athlete's performance before and after treatment, we adopt a slightly modified version of this metric – one that is not adjusted for player position. Although marginal revenue product is not a focus of this study, we do note that several papers by Brown (1994) and Brown and Jewell (2004, 2006) leverage measures of athlete productivity to estimate the rents generated by highly skilled college athletes.

We know less about the impact of giving birth on athlete performance. Frankovitch and Lebrun (2000) study the impact of the menstrual cycle and oral contraceptives on athlete performance. They find that female sex steroids do influence cardiovascular, respiratory and metabolic systems but the relationships have minimal impact on sports performance. Appleby and Fisher (2009) write about elite distance runners' experiences in competition after pregnancy. The authors focus on the athletes' shifting identity from "athlete" to "mother and athlete." However, they do not study performance empirically. Bø and Backe-Hansen (2007) investigate the prevalence of low back pain and pelvic floor disorders in female athletes during and after pregnancy using survey data. The authors report no significant differences in the athlete group compared to the control group in their study. This result

hints at our preliminary findings: these common female complications of pregnancy do not appear to impact player performance in the WNBA (for the mothers we know about).

An interesting paper by Krapf, Ursprung, and Zimmerman (2017) examines parenthood and productivity of highly skilled labor. This work is related to earlier contributions from Kaufman and Uhlenberg (2000), Goodwin and Sauer (1995) and Sauer (1988). The authors use survey data from academe to measure difference-in-differences in publication rates three years prior to and three years after the birth of children. Our study is most closely patterned after Krapf, et al. They find no evidence that motherhood is associated with lower productivity. They do find that becoming a mother before age 30 can possibly reduce productivity relative to peers. Our results mirror some of those documented by Krapf, et al. Player performance, in general, improves with age and does not appear to be adversely affected by giving birth.

Kalist (2008) studies the impact of giving birth on the pay and performance of professional golfers on the Ladies Professional Golf Association (LPGA) tour from 1980 to 2004. Of the 376 women in the panel, 52 had become mothers by the last year observed in the sample. Using rankings, golf score, and income as measures of productivity, Kalist (2008) reports that all three measures decrease after the players have their first child. While our approach is similar to Kalist (2008), our fixed effects estimation reveals no impacts on player performance after the birth of the first child. Golf is, obviously, an individual sport with travel demands and playing demands that differ markedly from the team sport of basketball. Kalist (2008) warns that their results may not be generalizable to other sports or industries precisely because of golf's unique demands.

Scholars from diverse backgrounds have studied the treatment of pregnant workers. Cunningham and Macan (2007) examine the effects of pregnancy on hiring decisions during interviews. Over 200 business school students participated in a study where they watched videotaped interviews and rated applicants. Pregnant applicants with identical credentials and experience were rated lower and also rated more likely to miss work or need time off. Huhta, Westfall, and Williams (2003) argue that the Pregnancy Discrimination Act of 1978 should provide legal remedy to new mothers if their employers' subject them to adverse employment actions. The authors cite multiple cases and draw on social psychology literature to make the causal link between gender and pregnancy discrimination. More than 30 years after the act was passed, legal scholars are still generating articles in order to help attorneys plead these types of claims. This signals to us that more work needs to be done in this area to combat misperceptions about the effect of pregnancy on productivity. We view our study as a potential contribution to all three threads of literature we previewed.

3 Background on the WNBA and Legal Context of Research Question

The WNBA began in 1997 with eight teams and expanded to 16 teams by 2000 before contracting to 12 teams in 2010. The league is often compared to the NBA in terms of revenues and attendance to illustrate its relative lack of success. However, these comparisons are usually between the WNBA now – a league that is 27 years old – and the NBA which is 77 years old. This is not an apt comparison. The WNBA does have a new contract with the Ion Television network in 2023 that is valued at $39 million. However, its players only earn about 10 % of WNBA revenue. Even in 1972 (the 27th season of the NBA), players were earning more than 50 % of NBA revenue.

The latest CBA has improved the earnings potential for WNBA players. The league minimum is $62,285 and the maximum is $234,936. Prior to this new agreement, the average salary in the WNBA was about $74,000. This fairly meager salary sent 80 % of the WNBA players overseas to play international basketball. The CBA also included paid season-long housing with extra bedrooms for children. Perhaps most important, the CBA mandates that if a player has to take a leave due to pregnancy, the player still gets paid.

Women earned protection from pregnancy related employer discrimination after the Pregnancy Discrimination Act of 1978 was passed. Dozens of papers in the labor economics literature and countless law review articles have examined the impacts of this single piece of legislation. Pedriana (2009) provides a succinct overview of the history and path to the legislation. But, one does not need to read the history of the Act to appreciate that pregnant female athletes have been treated differently than non-pregnant female athletes. Cater (2020) discusses the court's dismissal of the United States Womens National Soccer team's equal pay claim and provides a summary of the disparity between the women's pay and the men's pay. The Gunnarsdottir decision against Club Lyon illustrates the point that the motherhood penalty exists. If athletes or their employers perceive that their productivity is negatively impacted by pregnancy, they may be treated differently. Thus, investigating the relationship between giving birth and player productivity may help provide evidence for players and employers alike to make more informed decisions about pregnancy and maternity policy.

4 Data

We use an author-generated panel data set which includes player performance metrics and player fixed effects from 1997 to 2022 and reported birth years for the

first-time mothers during the same time period. We observe player offensive and defensive performance metrics, player personal characteristics like height and team affiliation, as well as other team characteristics including team coach. We observe these variables before and after the player gives birth. This gives us 4,194 player-year observations for the sample period. The performance metrics are estimated using statistics from basketball-reference.com and the WNBA website. The reported birth years were gathered from publicly available media reports, roster notes, social media posts and from the Womens National Basketball Players Association (WNBPA). Descriptive statistics of key variables are listed in Table 1.

The average age of players in the WNBA over this period is 26. The youngest player in the entire sample is 19 years old. The oldest is 49 years old. Although not broken out in Table 1, the youngest mother is 23 and the oldest in the sample is 34 years old. Roughly 84 % of the entire sample is less than 30 years old. Figure 1 shows a distribution of Player Ages. The WNBA is full of young athletes; however, in the sample period the average length of a player's career is just under four years. By comparison, the average National Basketball Association (NBA) career length is just under five years.

UNADJP40 is the player performance metric. Berri (2008) and Berri and Schmidt (2010) developed this measure to capture the impact of player performance on wins. This measure is often referred to as "Wins Produced." Due to the fact that players often participate in contests for differing amounts of time, each player's productivity is reported per 40 min played. Thus, UNADJP40 considers the wins produced per 40 min played for each player in the sample. Wins Produced is generated from a regression of team wins on team offensive and defensive efficiency, where efficiency is defined by how many points a team scored and surrendered per possession. Berri (2008) describes offensive efficiency as points per possession employed, where possession employed is calculated as: Field Goals Attempted +0.44*Free Throws

Table 1: Descriptive statistics of key variables. *n*(control) = 4,194 *n*(treated) = 24 where control group are players who have not given birth and treated is the group who have given birth during the sample period.

Variable	Mean	S.D.	Min	Max
AGE	26.38	3.96	19	49
AGEsquared	711.63	222.78	361	2,401
Player productivity (UNADJP40)	0.119	0.164	−2.502	1.124
One year post birth (Mom 1)	0.012	0.370	0	21
All years post birth (Mom 2)	0.075	2.196	0	127
Second year post birth (Mom Next)	0.011	0.319	0	18
Player is power center or forward (Dbig)	0.416	0.483	0	1
Player is point guard or shooting guard (Dguard)	0.390	0.488	0	1
Player had new coach (Newcoach)	0.423	0.494	0	1
Player moved to new team (NewTm)	0.236	0.424	0	1

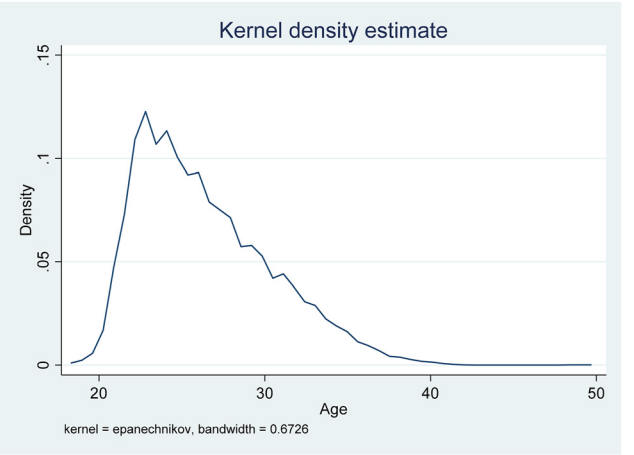


Figure 1: WNBA player age distribution 1997–2022.

Attempted + Turnovers – Offensive Rebounds. Defensive efficiency is points per possession acquired, where possession acquired is calculated as: Opponent's Field Goals Made +0.44*Opponent's Free Throws Made + Defensive Rebounds + Opponent's Turnovers + Team Rebounds. The estimated parameters and additional details are found in Berri and Schmidt (2010).

An average player should have an UNADJP40 of 0.100. Figure 2 is a kernel density plot of player performance over the entire sample with two of the extreme outliers omitted and player performance for the players who have given birth. Our player performance metric is sensitive to minutes played. Thus, if a player performs poorly and played fewer than 10 min, the UNADJP40 can exceed –1.0. As Table 1 indicates, the average player performance is 0.164 with just over half the players in the sample performing at or above the average during the span of their careers. The density plots reveal that on average the players we observe who have given birth tend to be more productive players. We can make educated guesses about why this is true, but that is not the focus of our study. Instead, we investigate whether or not the performance of players is meaningfully different before and after the birth event.

5 Empirical Strategy

Our player observations create a large longitudinal database with one level of fixed effects. The basic model we employ to estimate player performance is represented by Equation (1):

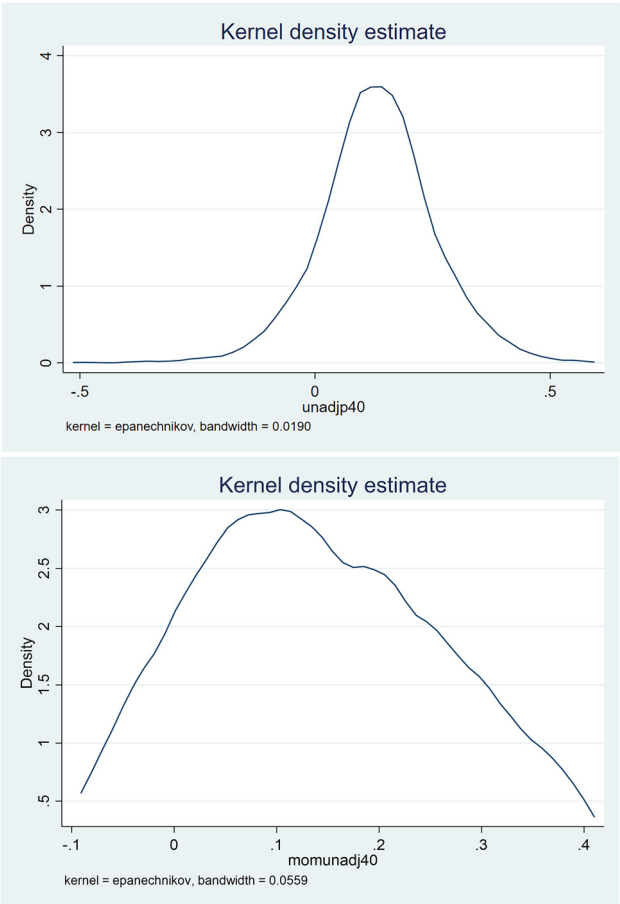


Figure 2: Distribution of WNBA performance 1997–2022 full sample & treated.

$$Y_{it} = \beta_0 + \delta_0 d_t + \beta_1 X_{it} + \alpha_i + e_{it} \quad (1)$$

Where Y_{it} is the performance of player i in time period t and the right hand side variables consist of player characteristics (X_i), time constant unobserved heterogeneity (α_i), a panel constant and time varying time dummy (d_t), and a mean zero error term. We use a linear fixed effects estimator. McCaffrey et al. (2012) explain that when a data set has a large number of fixed effects at one level and it is assumed the fixed effects are "nuisance" parameters to control for differences among observations, it is more computationally efficient to absorb the player fixed effects using the "within" transformation. That is, the player-level means are subtracted from each element of the dependent variable vector, Y, and each element of every column in the

vector X. These revised outcomes are then regressed on the covariates indicators. The use of panel data corrects for the endogeneity caused by the unobserved time constant effect (i.e. $\text{cov}(x_{it}, a_i) \neq 0$). We note that given the potential dynamic nature of our data (player performance in time period t may be a function of lagged player performance), we could estimate our model using a generalized method of moments estimator like the Arellano–Bond model. We are not convinced that the assumptions of the Arellano–Bond approach are strictly satisfied by our data. Thus, we report on the results from the linear fixed effects model described above.

6 Empirical Results

Table 2 contains the estimated coefficients, t-statistics and probability values from the linear regression with absorbing indicators model. As expected and confirmed by Harris and Berri (2015), performance is positively impacted by age. Both signs on AGE and AGESquared support the notion that players develop skills and improve the longer they are in the WNBA. For every year older a player is, her performance (as captured by UNADJP40) increases by a little over two percent. By virtue of their size and position, centers and power forwards are almost two percent more productive than other players on the court. These three estimated coefficients are statistically significant at the 5 % level. The signs on NewTeam and NewCoach are negative, but not significant. Over the time period we are studying, these results show no evidence of a relationship between coaching changes and player performance or team changes and player performance, holding other variables constant. The estimated coefficient on Mom1 is negative but insignificant. This number is very close to zero,

Table 2: Linear regression with absorbing indicators: effect of giving birth on performance. Dep. variable = UNADJP40 *n* = 4,194.

Variable	Coefficient	t-statistic	p-value
AGE	0.023**	2.86	0.004
AGESquared	−0.000**	−3.04	0.002
Dbig	0.019**	1.94	0.053
Dguard	−0.016	−1.49	0.137
NewTeam	−0.004	−0.69	0.488
NewCoach	−0.005	−1.24	0.216
Mom 1	−0.006	−0.34	0.734
Mom Next	0.008	0.71	0.481
R-squared 0.71			
Adjusted R-squared 0.62			

*** = significant at the 1 % level ** = 5 %, * = 10 % estimated with clustered standard errors.

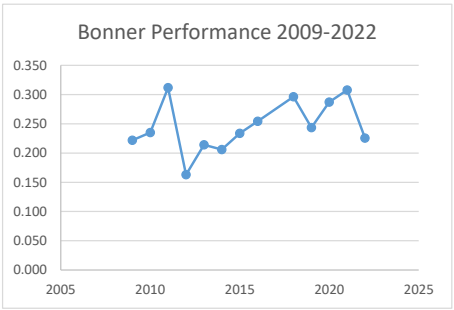
but not quite zero. Thus, we cannot reject the null hypothesis of no effect one year after the birth event. Likewise, the estimated coefficient on MomNext is positive, but not significant. We fail to reject the null hypothesis of no effect on performance in all subsequent years to the birth event. Taken together, the results from the model suggest that giving birth does not have any observable impact on player performance – either positive or negative – when we control for all the other player characteristics and time effects.

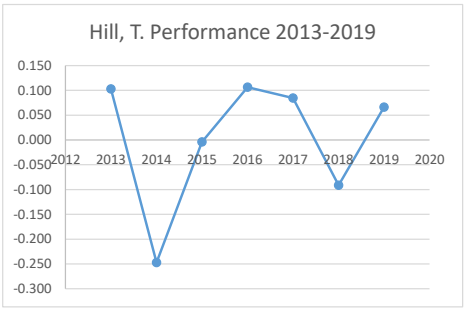
The overall explanatory power of the model is reasonable: 62 % of the variation in player performance is explained by variation of the covariates. One third of the variation in player performance is not captured by our current covariates. This means there could be some omitted variable bias in our estimates. We conduct difference in means tests on player performance for the treated group and report those below as a robustness check on the empirical model results. We discuss possible extensions and alternate specifications in the next section.

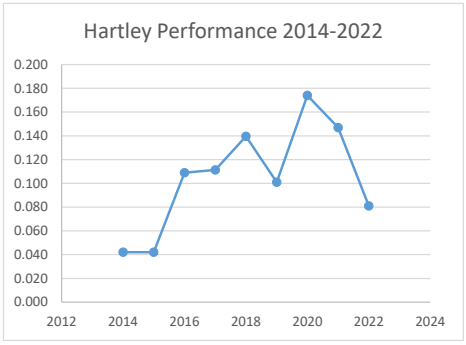
7 Difference in Means Tests for Players Who Gave Birth

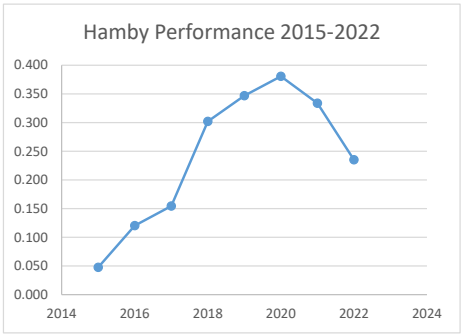
We are not asking whether pregnancy is causal to changes in performance. Rather, we are simply observing whether performance changes after giving birth. One way to check the robustness of our findings above is to conduct difference in means tests on the observed mothers in our sample. First, we show graphs of the athlete's performance over the span of the careers in Figure 3 below. DeWanna Bonner began her career in 2009 and gave birth in 2018. She played for four more years. Table 3 summarizes the difference in means test results. The p-values indicate whether or not we can reject the null hypothesis of no difference between the mean performance before giving birth and after. In Bonner's case, we cannot reject the null and therefore accept the alternate hypothesis of no difference in mean performance after the birth of a first child. As Table 3 indicates, there are only three cases where we cannot reject the null hypothesis. In these three cases (Hamby, Harley, and Perkins), the means are different. However, we draw attention to the fact that the player's mean performance actually increased after the birth of their first child – it did not decrease. We include visualizations and results in Table 3 for the players who had the greatest number of years post birth to analyze. Full results for all players in the sample are available upon request.

In Figures 7–12 below, we plot the player's unadjusted performance metric per 40 min of game play on the vertical axis over the years of her career on the horizontal axis. For most of these players, the performance metric is positive; one exception is









Figures 3–6: Performance of select WNBA players across time.

Table 3: Difference in performance means pre-birth and post-birth.

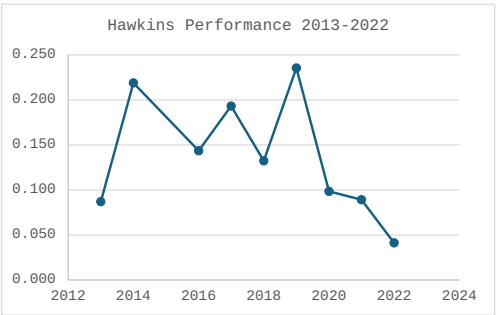
Player & Birth Year	Mean pre	Mean post	p-value
Bonner 2018	0.237	0.272	0.169
Hamby 2017	0.107	0.292**	0.011
Hartley 2017	0.076	0.126*	0.066
Hawkins 2017	0.160	0.119	0.387
Hill 2015	−0.049	0.032	0.396
Holmes 2019	0.111	0.046	0.225
Johnson 2016	0.286	0.265	0.586
Parker 2009	0.419	0.426	0.888
Perkins 2005	0.046	0.122*	0.052
Swoopes 1997	0.222	0.236	0.789

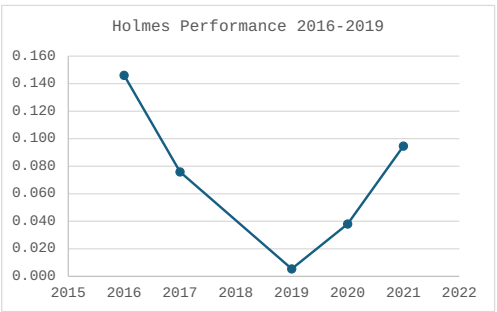
Hill in 2014. As we discussed in the data section, when a player does not perform well and plays a small amount of minutes, the performance metric can dip below zero. Tayler Hill only played 39 min in 2014 compared to her average of 408 min a season during her career. Candace Parker's performance is perhaps most impressive over the arc of her career with an unadjusted wins produced per 40 min averaging 0.419 (Figures 7–12).

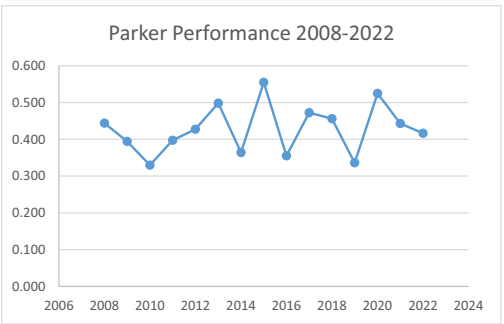
8 Discussion

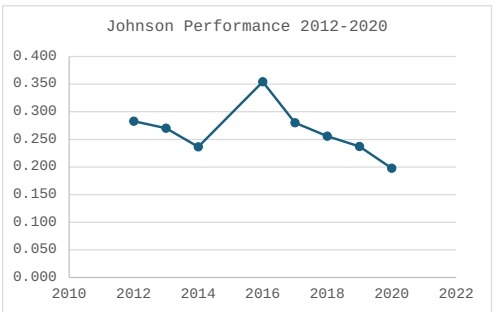
We view these results as evidence that many policies on pregnancy and performance that lead to a motherhood penalty may be based on flawed assumptions or discrimination. Indeed, the Gunnarsdottir case may have been avoided altogether if Club Lyons had communicated more clearly with their player to determine her capacity for work while she was pregnant and after she gave birth. In team sports where the outcome of player efforts is combined to produce wins or losses, the direct link between giving birth, performing well on the pitch or the court, and generating wins may be harder to identify. However, the wins produced metric has been used in hundreds of empirical studies on NBA and WNBA players alike with consistent and statistically robust results. We can measure performance in basketball with precision.

Certainly, our results differ from Kalist (2008) where individual performances in professional golfers who are first time mothers decreased. As Kalist (2008) explains, many of the first time mothers reduced the number tournaments they entered once they became mothers. A reduction in performance could be strictly due to less time competing. Our results are minutes per game adjusted. We do not find reduced

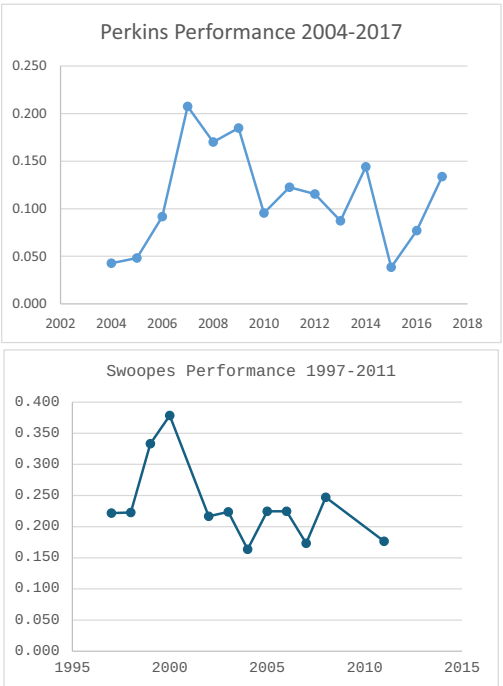








Figures 7–12: Performance of select WNBA players across time.



Figures 7–12: Continued.

playing time in our sample on average. The literature tends to suggest that mothers will not be as productive after having a child. Our results do not support this view. Our results weakly support the notion that some elite basketball players who become mothers come back after giving birth and perform better for the remainder of their careers.

While the structure of this study does not permit us to generalize these results to a wider population, the results partially fill a gap in the literature. Performance in basketball can be measured precisely. As the WNBA continues to grow, more and more players will make the decision to have a child during their career instead of retiring and then starting a family. This study and future studies can be reproduced with more and better data to confirm the results we find here.

9 Conclusions

What does this model of player performance show us? There appears to be no statistically significant effect on player performance from giving birth when we

control for other known performance characteristics and unobservable characteristics in our sample of WNBA athletes. Relative to their peers, elite basketball players are just as productive one year, two years and multiple years beyond the birthing event. This provides us with cautious optimism. To be certain, our research does not indicate that player performance is increased by motherhood, but it definitely does not show a negative impact. Yet, historically in the WNBA and other sports, there is a presumption that athlete performance will be negatively impacted.

Our approach is currently handicapped by omitted observations and the somewhat anecdotal nature of our observations of pregnancy. No exhaustive list of players and birth certificates cross-reference exists. Neither the Players' Association nor the WNBA keep such records. Anecdotally, we suspect the number of players who have given birth may be twice the amount identified in our current data set. There likely could be players in our data who were in the early stages of pregnancy and might not have even known it. Likewise, some players' may have given birth and avoided the media limelight in the off-season. Even with these limitations, however, we expect our results to hold up as more players are identified for two reasons. First, elite athletes in the WNBA have trained for a minimum of four years (probably closer to eight years) to perform the tasks necessary for success in their sport. Therefore, with a planned or unplanned pregnancy, there is sufficient time for each athlete to develop a program for returning to the game in a reasonable time frame. DeMya Walker is the perfect example. As soon as she was medically cleared to begin workouts after her caesarian birth, she got back to training. The birth itself is probably not impacting performance; it is the break in training that could potentially affect player effort. Second, we recognize this design may suffer from survivor bias since poorer performing players may not stay in the game after giving birth. Clearly, to investigate the effect of giving birth, we must have observations on players both pre and post the birth event. If mothers choose not to return to the game, our sample will be biased upwards. In this case our research may only be identifying the upper bound of players who experience pregnancy and birth.

We intend to pursue our research question more fully. If the stigma of starting a family while playing professional sports is somewhat unfounded (i.e. players are not negatively impacted by the act of giving birth), then player labor-leisure trade-offs could be changed in the future. Endorsement contracts, recruiting decisions and the opportunities to continue play overseas are all potentially influenced by a player's productivity. If that productivity is not negatively impacted and could potentially be positively impacted by having a family, this is good news for players and team management alike. Additionally, in the last few years many players have started families by other means than giving birth. We plan to identify those players and repeat our study to determine if becoming a parent – by any method – has an impact on player performance.

Finally, other employers like the military have maternity leave policies with unintended consequences. Female officers leave the service at a rate higher than male counterparts. Studies indicate this is often because promotion requirements penalize mothers who give birth during critical junctures in the career cycle. If productivity is not negatively impacted by the birth event and it can be shown that the only difference between an officer or enlisted member before and after the birth event is the time off, then retention could improve if the policy is amended based on empirical evidence. A presidential order made effective in October of 2019 provides all Department of Defense members 12 weeks of parental leave. This change could provide a natural experiment where separation decisions can be studied before and after this change order became effective. For these reasons, our results hold promise in the literature examining pregnancy and its effect on worker productivity. Decision makers on the basketball court, in the back office and in the courts of law will benefit from our empirical approach.

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Code availability: The authors completed the empirical analysis using Excel and Stata.

Appendix Variable Names and Descriptions

AGE: Number indicating age of each player in the sample

AGEsquared: Number indicating age squared of each player in the sample

Dbig: Number equal to 1 if the player is a center or power forward, 0 otherwise

Dguard: Number equal to 1 if the player is a shooting or point guard, 0 otherwise

NewCoach: Number equal to 1 if the player had a new coach that year, 0 otherwise

NewTeam: Number equal to 1 if the player moved to a new team that year, 0 otherwise

Mom1: Number equal to 1 the first year after giving birth, 0 otherwise
Mom2: Number equal to 1 the second year after giving birth, 0 otherwise
MomNext: Number equal to 1 all subsequent years after the second year of giving birth, 0 otherwise

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