7. Understanding the WNBA on and off the court

David J. Berri and Anthony C. Krautmann

7.1 INTRODUCTION

The creation and evolution of a sports league give sports economists an opportunity to examine the nature of institutions that they otherwise accept as given. One new league to enter the sports entertainment business is the Women's National Basketball Association (WNBA). Motivated by the gold medal won by the US women's basketball team in the 1996 Olympics, the league began organizing in 1996 and playing in 1997. The original league was composed of eight teams – four of which have since folded. Expansion, relocations, and bankruptcies have all followed in the subsequent 14 years. In 2011, the WNBA consisted of 12 teams located in markets all across the United States.

Not surprisingly, the league has experienced considerable growing pains. Obtaining reliable data on the profitability of any sports franchise is always difficult, but according to *USA Today* the typical WNBA club was losing about \$1.5 to \$2 million per year in 2006 (Stegg, 2007). Thus, the league was still losing millions of dollars per year as recently as 2007. While the WNBA was finally expected to turn a profit in 2009 (TVNZ, 2009), it has yet to publicly confirm that it has done so.

Many of the WNBA's claims about its finances appear overly optimistic. For example, while the league claimed that its most recent long-term broadcast contract would be worth 'millions and millions of dollars', it refused to disclose any details of its financial impact on teams (Evans, 2007). Data on attendance (and the resulting gate revenues) may be a misleading indicator of fan demand because teams frequently give away free tickets to boost the popularity of the franchise. These ongoing difficulties raise the question of whether the league is just continuing to experience growing pains or whether the league's business plan is unsustainable.

In Section 7.2, we use information from blogs, WNBA.com, and news websites to describe the basic economics of this league. In Sections 7.3 and 7.4 we describe competitive balance and the labor market in the WNBA before turning our attention to the game on the court. In Section 7.5, we model wins produced in a season by a team. In Section 7.6, we use tools

from Berri et al. (2006) and Berri and Schmidt (2010) to develop a metric of the value of players in the WNBA. We find that the underlying determinants of this metric are remarkably similar to those underlying the metric for the National Basketball Association (NBA). In Section 7.7, we also find that the decision makers in the WNBA make the same mistakes as their counterparts in the NBA in that they overvalue players who score a lot of points. Section 7.8 concludes.

7.2 PROFITS, ATTENDANCE, AND REVENUE

All WNBA teams were originally owned and subsidized by the NBA.¹ In large part due to the WNBA's reported \$12 million annual losses, the NBA sold its interest in the WNBA, mostly to the NBA teams in the same cities. Currently, nine of the 12 teams have a close partnership with the local NBA franchises.

The WNBA's questionable finances indicate that NBA owners did not expect WNBA franchises to be stand-alone profit centers. Risk diversification is also unlikely to be a motivation for owning a WNBA team; as Figure 7.1 shows, attendance per game in both the NBA and

Sources: NBA and WNBA websites.

Figure 7.1 Attendance per game, WNBA vs. NBA

WNBA has been fairly flat throughout the last decade. In addition, the lack of rival leagues suggests that the motive is not to deter entry through product proliferation. However, owning both an NBA and a WNBA team might provide cost complementarities, which result in economies of scope. Greater utilization of the basketball arena, which would otherwise sit idle during the NBA's off-season, could provide an important cost saving. Further complementarities result from joint utilization of the NBA team's departments, such as marketing, legal, and public relations.

While information about the value of WNBA franchises is sparse, one team stands out. In 2006, owner Jerry Buss sold the Los Angeles Sparks to an ownership group for \$10 million. Since the Los Angeles Sparks is one of the more successful and visible teams in the league, the \$10 million sales price may be an upper bound on the value of a WNBA franchise. Nevertheless, this sales price is far short of the \$370 million value of a typical NBA team. One reason for the low sales price is the limited revenue of the WNBA, whose primary sources are ticket sales and broadcast contracts. In contrast to the NBA, which has an average ticket price well over \$50, the average price for a WNBA game is only about \$15 (see Table 7.1).

Attendance at WNBA games has fluctuated over the league's short history. Per game attendance peaked in the league's second year of operation, and it has since declined to around 8,000 (see Figure 7.1). Assuming that about three-quarters of the gate attendance is paid admission, the typical team has gate revenue of about \$90,000 per game. For 17 home games per season, the annual gate revenue for a typical WNBA team is around \$1.5 million.² This translates to about \$18 million for the entire league, which is just over half the \$35 million revenue that a typical NBA team brings in.

Broadcast coverage of WNBA games is provided by ABC, ESPN, and NBA TV. In 2007, the league signed an eight-year contract with ESPN, guaranteeing the network a minimum of 18 broadcasts each season, as well as the rights to season-opening and All-Star games. While this contract is the first to pay rights fees to a women's professional sports league, the WNBA has never revealed what the fees are. In addition to the national broadcast contract, several WNBA teams have contracts with local television and radio stations and with Sirius Satellite Radio. Finally, the league recently initiated WNBA LiveAccess, a webcast of more than 200 live games available on-demand on WNBA.com.

Although most sports leagues in North America have avoided corporate branding on team jerseys, the WNBA has sought out this additional source of revenue. The league recently signed a long-term deal with Boost

Table 7.1 Attendance and ticket prices

Team*	Average attendance** (1997–2010)	Price range tickets (2011 season)		Metropolitan population (2003)
		Lowest	Highest	
Atlanta*	7,710	\$12	\$125	4,250
Charlotte	6,950		–	1,650
Chicago*	3,840	\$15	\$225	9,100
Cleveland	8,890		–	2,150
Connecticut*	7,150	\$16	\$200	260
Detroit	8,460		–	4,450
Houston	9,590		–	4,720
Indiana*	8,260	\$24	\$90	1,700
Los Angeles*	9,050	\$10	\$55	12,370
Miami	8,560		–	2,010
Minnesota*	7,500	\$10	\$175	2,700
New York*	11,930	\$10	\$250	18,320
Orlando	7,930		–	2,030
Phoenix*	9,440	\$10	\$195	3,250
Portland	8,320		–	2,170
Sacramento	8,290		–	2,080
San Antonio*	8,160	\$9	\$110	1,990
Seattle*	7,890	\$10	\$46	3,040
Tulsa*	4,810	\$10	\$115	900
Utah	7,330		–	1,100
Washington*	12,320	\$17	\$125	4,800
League average	8,200	\$13	\$140	

Notes:

* Current teams in 2011.

** Team-specific average attendance obtained from Womensbasketballonline.com.

Mobile that puts the cellphone company's logo on most teams' jerseys.³ Without disclosing the terms of the deal, the front office of the WNBA said that it was the richest branding contract in the league's history.

7.3 COMPETITIVE BALANCE IN THE WNBA

Within-season competitive balance is often measured by the variation in winning percent across all teams in a given season. Figure 7.2 compares the Noll–Scully ratio of the standard deviation of winning percentage to the standard deviation of a perfectly balanced league for both the NBA

Note: The Noll-Scully ratio is the ratio of a league's actual standard deviation in winning percent to the corresponding standard deviation of a perfectly balanced league. For example, a value of R equal to 1.9 means that the standard deviation of winning percent in the league that season is 1.9 times larger than that of a perfectly balanced league.

Figure 7.2 Noll-Scully ratio (R)

and the WNBA.⁴ It shows that the WNBA is significantly more balanced than the NBA, whose ratio was about 2.8 over the same time period.

Measures of competitive balance across seasons focus on the frequency of playoff appearances (Depken, 1999; Owen et al., 2007; Fort, 2011) or the distribution of playoff appearances (Leeds and von Allmen, 2011). Inter-seasonal balance for the WNBA is obscured by a number of factors (see Figure 7.3). First, the WNBA has experienced much turnover – it has had the same number of teams in successive seasons only four times. The rise in the number of playoff slots from four (from 1997 to 1998) to six (in 1999) to eight (since 2000) further complicates computations of inter-seasonal balance.

There does not appear to be a significant large-market effect on playoff appearances. The Los Angeles Sparks (in a city of 13 million) have appeared in 10 out of the 12 playoffs since 2000, but the Chicago Sky (in a similar city of 9 million) have not yet made the playoffs. At the opposite end of the spectrum, the Connecticut Sun (in Uncasville, a city of merely 20,000) has made the playoffs seven out of the nine years since the team

Source: WNBA website.

Figure 7.3 History of the WNBA

moved to the state. Table 7.2 reports the ratio of playoff appearances to the number of years each franchise has been in existence since 2000.⁵ Using all current and former teams (listed in Table 7.2), the correlation between playoff appearances per year and population is only 0.11. The distribution of team championships is highly concentrated in both the NBA and WNBA. Seven NBA teams and seven WNBA teams won the 15 championships from 1997 through 2011.

7.4 THE LABOR MARKET IN THE WNBA

Rookie talent is allocated to teams primarily through a reverse-order draft similar to that found in other North American sports leagues. The WNBA draft lasts for three rounds. Expansion teams and teams that failed to make the playoffs in the previous season have the top picks in a lottery mechanism similar to that used in the NBA.⁶ A special dispersal draft allocates players on teams that fold.

Free agency in the WNBA is defined by the collective bargaining agreement (CBA). The current CBA specifies three types of players: Reserved Players, Restricted Free Agents, and Unrestricted Free Agents. A player

Table 7.2 Playoff appearances

Team*	Team tenure	Playoff appearances (since 2000)**		Metropolitan population (2008)
		Playoffs/year	Percent	
Atlanta*	2008–	3/4	75	5,400
Charlotte	1997–06	3/4	75	1,700
Chicago*	2006–	0/6	0	9,600
Cleveland	1997–03	3/4	75	2,100
Connecticut*	2003–	7/9	78	260
Detroit	1998–09	7/10	70	4,400
Houston	1997–08	6/9	67	5,700
Indiana*	2000–	8/12	67	1,700
Los Angeles*	1997–	10/12	83	12,900
Miami	2000–02	1/3	33	5,400
Minnesota*	1999–	3/10	30	3,200
New York*	1997–	9/12	75	19,000
Orlando	1999–02	1/2	50	2,100
Phoenix*	1997–	5/12	42	4,300
Portland	2000–02	0/3	0	2,200
Sacramento	1997–09	8/10	80	2,100
San Antonio*	2003–	5/9	56	2,000
Seattle*	2000–	9/12	75	3,300
Tulsa*	2010–	0/2	0	900
Utah	1997–02	2/3	67	1,100
Washington*	1998–	6/12	50	5,400

Notes:

* Current teams in 2011.

** Playoff appearances/years in existence (2000 to 2011).

with three or fewer years of service is a Reserved Player and can sign only with her current team. Any team that drafts a rookie can exercise the Fourth Year Option, which allows the team to retain the player for a fourth year.⁷

A player with four or five years of experience is a Restricted Free Agent and may sign an offer sheet with any team. The offer sheet commits the player to the new team unless her current team matches the offer within 10 days. Unrestricted Free Agents can negotiate a new contract with any team. No compensation is required of a team that signs either type of free agent.

Teams can designate one player on their roster who would otherwise be a Restricted or Unrestricted Free Agent as a 'core player'. Teams

retain exclusive negotiating rights to core players and must offer them a one-year, guaranteed contract at the maximum salary (explained below). During the negotiations, the team and player may agree to a multi-year contract. The Core Player designation lasts for the duration of the new contract unless the player is traded.

The league has used a number of mechanisms to control costs, including limited roster sizes, a sliding salary scale, and a salary cap. While the NBA allows teams to sign and practice with up to 15 players (of which 12 are allowed to play per game), the WNBA limits each team to 11 players. The CBA sets the salary scale based primarily on experience and draft position, with small increments that reward winners of player-of-the-year awards (for example, Most Valuable Player or Rookie of the Year). The minimum and maximum salary depends on the player's years of experience. In 2013, the minimum salary for players with 0–2 years of experience was \$37,950, and for players with three or more years of experience, the minimum salary is \$55,000. Similarly, the maximum for players with up to five years of experience is \$105,000; and for players with more than six years of experience, this maximum is \$107,500. All figures have been rising at approximately 2 percent per year. As a result WNBA salaries have risen about 10 percent over the last five years, which is slightly lower than the almost 11 percent increase in the NBA.

Each team also has an overall salary cap, which sets a maximum and minimum payroll. Unlike the NBA, which has a soft cap, the WNBA has a hard cap.⁸ In 2008, the minimum team payroll was \$750,000 and the maximum was \$772,000. The minimum has been increasing at 3 percent, while the maximum has been rising slightly faster at 3.4 percent. Thus, in 2013, WNBA payrolls could range from \$869,000 to \$913,000.

7.5 MODELING WINS PRODUCED IN THE WNBA

The NBA and WNBA have market inefficiencies similar to that described by Michael Lewis in *Moneyball* (Lewis, 2004). Because most teams emphasize scoring, when evaluating players, teams that determine the true value of players can succeed relatively cheaply. We develop a method for evaluating players in the WNBA that closely follows the 'wins produced' methodology proposed by Berri (2008) for the NBA.⁹ A player's wins produced shows how many of her team's wins result from her overall performance. Our findings for the WNBA closely resemble those for the NBA, and the differences are consistent with differences in the style of play exhibited by the two leagues.

We start from the observation that a team wins when it scores more

points than its opponent. Over the course of a season, the difference between total points scored and total points allowed explains most of the variation in wins among teams. Points scored are a function of how many times a team gains possession of the ball and how efficiently it uses each possession. Because each team has roughly the same number of possessions in a game, a team's performance depends on its offensive and defensive efficiency. Offensive efficiency is the frequency with which a team converts possessions into points. Defensive efficiency consists of making the opponent's offense inefficient.

Using the above reasoning, we estimate the number of wins by team i in season t as a function of points scored (PTS) and points allowed ($opp.PTS$).

$$WINS_{it} = \alpha_0 + \alpha_1 PTS_{it} + \alpha_2 opp.PTS_{it} + \varepsilon_{lit}. \quad (7.1)$$

We estimate equation (7.1) using team data for the WNBA from 1997 (the year it began) to 2011 and for the NBA from the 1987–88 season to 2010–11. The R^2 s show that these two factors explain 81 percent of the variation in wins in the WNBA and 94 percent of the variation in wins for the NBA. The difference in the explanatory power of the two regressions stems from the fact that the WNBA season (34 games) is much shorter than the NBA season (82 games).

A player's value comes from how much she adds to her team's points and how much she limits the other team's points. A player's contribution is thus much more than the points she scores.¹⁰ To determine what factors other than scoring explain a player's value, we take a step back and ask what determines how many points a team scores.

A team's score is determined by how many shots it takes and how often those shots go in the basket. If we know a team's shooting efficiency from the field – its points-per-shot (PPS) – and how many field goals it attempts (FGA), we know how many points the team scored on shots from the field. The same is true for a team's free throw percentage ($FTper$) and the number of free throw attempts (FTA). The identities in equations (7.2) and (7.3) show how many points a team scores and how many points it surrenders:

$$PTS = PPS * FGA + FTper * FTA \quad (7.2)$$

$$opp.PTS = opp.PPS * opp.FGA + opp.FTper * opp.FTA, \quad (7.3)$$

where $PPS = [(PTS - FTM)/FGA]$ and FTM = free throws made. According to equations (7.2) and (7.3), wins are determined by eight statistics (PPS , $FTper$, FGA , FTA , $opp.PPS$, $opp.FTper$, $opp.FGA$, $opp.FTA$).

Before a team can take a shot, it must first gain possession of the ball. A team gains possession of the ball if it forces a turnover (*opp.TOV*), if it rebounds a missed shot by the opponent (defensive rebounds (*DRB*) or team rebounds (*TMRB*)), or if the other team scores.¹¹ Because not all foul shots result in a change of possession – as, for example, when the opposing team makes only the first of two foul shots and rebounds the second – we count only a fraction (b_1) of opponents' free throws made. All of the above add up to possessions acquired (*PA*):¹²

$$PA = opp.TOV + DRB + TMRB + opp.FGM + b_1 * opp.FTM. \quad (7.4)$$

When a team gains possession of the ball, it can attempt a field goal, shoot a free throw (*FTA*) because the other team has committed a foul, or commit a turnover (*TOV*).¹³ If a team misses a shot, it can take more shots by making an offensive rebound (*ORB*). Thus, the number of field goals a team attempts is given by the identity in equation (7.5):¹⁴

$$FGA = opp.TOV + DRB + TMRB + opp.FGM + b_1 * opp.FTM - TOV + ORB - c_1 * FTA. \quad (7.5)$$

As noted earlier, points scored are determined by possessions acquired and offensive efficiency. Hollinger (2002) and Oliver (2004) note that a team can 'employ' a possession in three ways: shooting a field goal, taking a foul shot, or committing a turnover. Possessions employed (*PE*) are thus given by:

$$PE = FGA + c_1 FTA + TOV - ORB. \quad (7.6)$$

We subtract offensive rebounds because an offensive rebound extends a given possession and allows additional shots, free throws, and turnovers. Because each possession acquired is a possession employed ($PE = PA$), we express points scored as:

$$PTS + PTS/PE * PA \quad (7.7)$$

$$opp.PTS = opp.PTS/opp.PE * opp.PA. \quad (7.8)$$

Because both teams have roughly the same number of possessions in a game, a team's *PA* is about equal to its opponent's possessions employed (*opp.PE*). The game's outcome is therefore determined by how many points each team scores per possession, by its offensive efficiency (PTS/PE) and by its defensive efficiency ($opp.PTS/opp.PE$). These

Table 7.3 *Determinants of winning percentage in the NBA and WNBA*

Independent variable	NBA	WNBA
Offensive efficiency	3.152 (82.11)	2.391 (18.26)
Defensive efficiency	-3.134 (73.35)	-2.450 (17.37)
Constant	0.481 (8.70)	0.556 (4.09)
R^2	0.94	0.81
Number of observations	681	196

Note: Model is estimated with team data from 1987–88 to 2010–11.

simplifications allow us to replace both $opp.PA$ and $opp.PE$ with PA in equation (7.8). Substituting equations (7.7) and (7.8) into equation (7.1) yields:

$$Wins_{it} = \delta_0 + \delta_1 * PTS_{it} / PE_{it} - \delta_2 * opp.PTS_{it} / PA_{it} + \epsilon_{9it}. \quad (7.9)$$

We compute PA and PE using the identities developed above:

$$PE = FGA + 0.44 * FTA + TOV - ORB \quad (7.9a)$$

$$PA = opp.FGM + 0.44 * opp.FTM + DRB + opp.TOV + REBTM. \quad (7.9b)$$

Estimates of equation (7.9) with data from the NBA and the WNBA appear in Table 7.3. We then calculate the marginal values of the individual components of the explanatory variables in equation (7.9). The results, which appear in Table 7.4, show that the marginal values of the statistics are very similar across the two leagues.

Three factors – personal fouls, blocked shots, and assists – are not part of the above calculations, but, as we show below, they all contribute to PE or PA . Personal fouls increase an opponent's free throws. Thus, Lindsay Whalen, a point guard for the 2011 WNBA champion Minnesota Lynx, was called for 64 (10.6 percent) of the team's 603 personal fouls. If we apply the same percentage to opponents' free throws, Whalen was responsible for 10.6 percent (50.9) of 480 free throw attempts by opponents. Blocked shots reduce scoring by an opponent. Regressing an opponent's made shots on a team's blocked shots and the opponent's field goal attempts reveals that each blocked shot reduces the opponents' field goals

Table 7.4 Value of points and possessions for the NBA and WNBA

Variable	Label	Marginal value for the NBA	Marginal value for the WNBA
Points scored	PTS	0.033	0.032
Possessions employed	PE	-0.034	-0.030
Points surrendered	opp. PTS	-0.032	-0.032
Possessions acquired	PA	0.033	0.031

by -0.618 . Since each two-point field goal by an opponent – as noted below – costs a team 0.034 wins, a blocked shot by a WNBA team is worth 0.021 (0.618×0.034) wins.¹⁵

Assists contribute to wins produced by affecting a team's shooting efficiency. To show this, we regress each player's shooting efficiency on the number of assists per minute accumulated by her teammates (*TAPM*) and a set of controls.¹⁶ (Results are available on request.) The estimated coefficient for assists reveals a key difference between the WNBA and NBA. For the WNBA, a one-unit change in *TAPM* leads to a 1.58 -unit change in a player's adjusted field goal percentage. For the NBA, a one-unit change in *TAPM* leads to a 0.72 -unit change in adjusted field goal percentage. This result suggests that assists are more important in the WNBA than in the NBA.

To see how assists affect wins produced, consider the contribution of the Lynx's assists to Lindsay Whalen's scoring in 2011. Whalen's baskets per shot are the product of *TAPM* (0.072) and its coefficient (1.58). To convert baskets to points, we multiply this product by two. We convert points per shot to overall points due to assists by multiplying this number by the number of shots Whalen took. Finally, we multiply by 0.032 because each additional point adds 0.032 to a team's wins. This calculation shows that over 1.2 wins produced by Whalen in 2011 can be traced to her teammates' assists. Doing this for every player on the Lynx and taking the sum yields the overall number of wins that are attributable to assists.

In this section, we have linked the performance of individual players to the number of games their team wins. We started by noting that the difference between total points scored and total points allowed explains most of the variation in wins among teams. Because both teams have roughly the same number of possessions in a game, the team that uses its possessions most efficiently will win. We then determine the contribution of individual performance measures to a team's offensive and defensive efficiency and hence to a team's wins.

Table 7.5 *Value of player and team statistics in the NBA and WNBA*

Variables	Marginal value in the NBA	Marginal value in the WNBA
<i>Player</i>		
Three-point field goals made (3FGM)	0.064	0.065
Two-point field goals made (2FGM)	0.032	0.033
Free throws made (FTM)	0.017	0.019
Missed field goals (FGMS)	-0.034	-0.030
Missed free throws (FTMS)	-0.015	-0.013
Offensive rebounds (ORB)	0.034	0.030
Defensive rebounds (DRB)	0.034	0.031
Turnovers (TO)	-0.034	-0.030
Steals (STL)	0.033	0.031
Opponent's free throws made (opp.FTM)	-0.017	-0.019
Blocked shots (BLK)	0.020	0.021
<i>Team</i>		
Opponent's three-point field goals made (opp.3FGM)	-0.064	-0.066
Opponent's two-point field goals made (opp.2FGM)	-0.031	-0.034
Opponent's turnovers (opp.TOV)	0.033	0.031
Team turnovers (TMTO)	-0.034	-0.030
Team rebounds (TMRB)	0.033	0.031

7.6 MEASURING WINS PRODUCED IN THE WNBA

To illustrate how we calculate wins produced, we again use the performance of Lindsay Whalen. We first calculate Whalen's baseline production of wins in 2011 (*PROD*) by multiplying values in Table 7.5 by Whalen's performance in each category:

$$\begin{aligned}
 PROD &= 17*0.065 + 162*0.033 + 89*0.019 + 171*(-0.030) \\
 &\quad + 33*(-0.013) + 30*0.030 + 89*0.031 + 75*(-0.030) \\
 &\quad + 37*0.031 + 50.9*(-0.019) + 5*0.021 \\
 &= 4.26.
 \end{aligned}$$

However, this figure requires several adjustments. First, because wins produced varies with the number of minutes played, we must normalize *PROD* and compute wins produced per 40 minutes (*P40*), the length of a standard WNBA game. For Whalen:

$$P40 = (PROD/Minutes\ played) * 40 = (4.26/956) * 40 = 0.178.$$

Second, Table 7.5 contains five factors that are not attributable to offensive or defensive efficiency. Three factors are actions by the opposing team: two-point field goals, three-point field goals, and turnovers.¹⁷ The other two refer to overall team statistics that are not attributable to a particular player: team turnovers and team blocks.

We allocate the team defensive factors to individual players in proportion to the minutes they play. This allows us to differentiate players on good and bad defensive teams but not among players on a given team. The team defense adjustment (again normalized to 40 minutes) applies team data to the marginal values from Table 7.5:

$$\begin{aligned} \text{Team defense adjustment per 40 minutes} = & \{[opp.3FGM*(-0.066) \\ & + opp.2FGM*(-0.034) + opp.TOV*0.031 + TMRB*0.031 \\ & - TMBLK*0.021]/\text{Minutes played}\}*40. \end{aligned}$$

Using the data for the Minnesota Lynx, we find their defensive adjustment is -0.003 . We then take the difference between each team's defensive adjustment and the average adjustment for the entire league. For the Lynx, this is:

$$\text{Lynx } DEFTM40 = (-0.003) - (-0.023) = 0.020.$$

We add $DEFTM40$ to each player's $P40$ to compute her adjusted wins produced per 40 minutes ($Adj.P40$).

Whalen's $Adj.P40$ is more than twice that of the average WNBA player (0.374 versus 0.172). However, such a blanket comparison might be unfair. Table 7.6 shows that the average value of $Adj.P40$ varies systematically by position, with centers contributing the most, and shooting guards contributing the least. Because basketball teams need players at all positions, players should be evaluated relative to their position averages.

Identifying most players' positions is easy, but it can be a challenge for a few players, as play in basketball can be highly fluid, so assigning

Table 7.6 Value of $Adj.P40$ across positions

Position	Average $Adj.P40$
Point guards	0.170
Shooting guards	0.117
Small forwards	0.149
Power forwards	0.193
Centers	0.230

Table 7.7 Link between actual wins and wins produced for each team in 2011

Team	Actual wins	Summation of wins produced	Difference in absolute terms
Minnesota Lynx	27	27.3	0.3
Connecticut Sun	21	22.1	1.1
Phoenix Mercury	19	21.9	2.9
Indiana Fever	21	20.6	0.4
San Antonio Silver Stars	18	19.9	1.9
Atlanta Dream	20	19.5	0.5
Seattle Storm	21	19.0	2.0
Chicago Sky	14	17.1	3.1
New York Liberty	19	16.8	2.2
Los Angeles Sparks	15	12.3	2.7
Washington Mystics	6	6.4	0.4
Tulsa Shock	3	1.2	1.8
Average error			1.6

a position can sometimes be arbitrary. We based a player's position on the designation found at WNBA.com and her height and weight (when reported). Because the website did not separate point guards from shooting guards, we also considered each guard's assists per minute and assumed that the guards on a team with the most assists are point guards.

We next calculate a player's performance relative to the league-wide average at her position. Whalen's relative performance is 0.204 above the average for point guards, which means that she produced 0.204 more wins per 40 minutes than the average point guard. Given that Whalen played 956 minutes, she produced 4.9 more wins than the average point guard.¹⁸

Finally, we calculate a player's wins produced per 40 minutes (*WP40*) and her wins produced. As noted in Berri et al. (2006), to move from relative wins to absolute wins we need to know the average number of wins produced by a player per 40 minutes. The average team wins 0.500 times per game. Since a team employs five players per 40 minutes, the average player produces 0.100 wins per 40 minutes. Because teams occasionally play overtime games, the actual figure is 0.099 wins per 40 minutes. Thus, Whalen produced 0.303 wins per 40 minutes ($0.204 + 0.099$) in 2011. Multiplying this figure by Whalen's total minutes played and dividing by 40 yields 7.2, Whalen's total wins produced for 2011.

The sum of wins produced by all players on a team should roughly equal the team's win total. Table 7.7 reports the wins produced for all WNBA teams in 2011. The average difference between wins produced and actual

wins – in absolute terms – is very small (1.6), which supports the validity of our metric.

This section adjusts the wins produced statistic that we developed in the preceding section. We account for playing time by normalizing the statistic to a per 40-minute basis. We then adjust the statistic for defensive contributions. Because some defensive statistics are team based rather than individually based, we cannot distinguish the defensive contributions by individual players on a given team. We also account for position-specific effects by comparing players to the average player at their position.

7.7 PERCEPTIONS OF PERFORMANCE IN THE WNBA

Continuing our example using the Minnesota Lynx, we find that 19 of the Lynx's 27 wins are attributable to Lindsay Whalen, Rebekkah Brunson, and Maya Moore, while only 3.7 are attributable to the team's leading scorer, Seimone Augustus. This leads to two important insights: a small number of players on each team account for most of its wins, and players who score a lot of points might not be particularly valuable. However, the perceptions of both the media and decision makers in the WNBA are often at odds with our findings.

Berri and Schmidt (2010) reveal that the Pareto principle – 80 percent of outcomes can be linked to 20 percent of people – applies to the NBA. The majority of wins in the WNBA are connected to relatively few players. Of the 142 players who played in the WNBA in 2011, only 40 – 28.2 percent of the league – produced 163.2 (80 percent) of the league's 204 wins.

In addition to showing that only a few players account for most a team's wins, our measure also shows the undue weight given to scoring. Table 7.8 shows the 40 best players in the WNBA in 2011 according to our wins produced metric. It shows that the WNBA's 2011 Most Valuable Player (MVP), Tamika Catchings, produced 8.0 wins in 2011, the most in the WNBA and more than three times those produced by the WNBA's leading scorer, Angel McCoughtry. Using our metric of wins produced, McCoughtry was only the sixth most productive player *on her own team*, the Atlanta Dream. However, the sports media covering the WNBA saw little difference between the two players, as McCoughtry was second to Catchings in the voting for the All-WNBA team.

While the All-WNBA teams and the league MVP awards are granted by the media, one might expect more nuanced evaluations from the league's decision makers. Unfortunately, we do not have access to salary data

Table 7.8 Top 40 players in the WNBA in 2011 (ranked by wins produced)

Rank	Player	Team	Position	Minutes	Voting points for All-WNBA teams	Votes WNBA MVP	WP40	Wins produced
1	Tamika Catchings*	Indiana Fever	SF-PF	1,040	187	292	0.308	8.0
2	Sylvia Fowles**	Chicago Sky	C	1,175	150	148	0.254	7.5
3	Lindsay Whalen*	Minnesota Lynx	PG	956	164	104	0.303	7.2
4	Penny Taylor**	Phoenix Mercury	PF-SF	864	82	10	0.311	6.7
5	Rebekkah Brunson	Minnesota Lynx	PF	938		1	0.268	6.3
6	DeWanna Bonner	Phoenix Mercury	SF	857			0.263	5.6
7	Becky Hammon	San Antonio Silver Stars	PG	1,050		18	0.198	5.2
8	Sue Bird**	Seattle Storm	PG	1,123	123	106	0.177	5.0
9	Candice Dupree	Phoenix Mercury	C-PF	1,075			0.183	4.9
10	Armintie Price	Atlanta Dream	SG	797			0.244	4.9
11	Tina Charles*	Connecticut Sun	C	1,136	166	209	0.167	4.8
12	Maya Moore	Minnesota Lynx	SF-PF	951		1	0.194	4.6
13	Kara Lawson	Connecticut Sun	SG-PG	832			0.221	4.6
14	Ticha Penicheiro	Los Angeles Sparks	PG	807			0.216	4.4
15	Renee Montgomery	Connecticut Sun	PG	991			0.168	4.2
16	Katie Douglas	Indiana Fever	SF-SG	940			0.173	4.1
17	Cappie Pondexter**	New York Liberty	SG-PG	1,151	94	9	0.138	4.0
18	Tiffany Jackson	Tulsa Shock	PF-SF	1,152			0.133	3.8
19	Kalana Greene	Connecticut Sun	SG-SF	781			0.188	3.7
20	Seimone Augustus**	Minnesota Lynx	SG-SF	997	69	33	0.147	3.7

21	Michelle Snow	Chicago Sky	PF	821			0.178	3.7
22	Alison Bales	Atlanta Dream	C	687			0.212	3.6
23	Danielle Robinson	San Antonio Silver Stars	SG-PG	786			0.185	3.6
24	Lindsey Harding	Atlanta Dream	PG	1,037			0.134	3.5
25	Diana Taurasi*	Phoenix Mercury	SG-SF	965	168	65	0.143	3.5
26	Candace Parker	Los Angeles Sparks	C	555			0.246	3.4
27	Tanisha Wright	Seattle Storm	SG-PG	953			0.143	3.4
28	Nicole Powell	New York Liberty	SF-PF	935			0.135	3.1
29	Swin Cash	Seattle Storm	PF-SF	1,128			0.110	3.1
30	Sheryl Swoopes	Tulsa Shock	SG	879			0.140	3.1
31	Taj McWilliams-Franklin	Minnesota Lynx	C	966			0.120	2.9
32	Sancho Lyttle	Atlanta Dream	PF	577			0.191	2.8
33	Crystal Langhorne	Washington Mystics	PF-C	1,063			0.102	2.7
34	Le'coe Willingham	Seattle Storm	SF	649			0.167	2.7
35	Sophia Young	San Antonio Silver Stars	PF-SF	1,043			0.101	2.6
36	Erin Phillips	Indiana Fever	PG-SG	689			0.153	2.6
37	Kia Vaughn	New York Liberty	C-PF	955			0.108	2.6
38	Erika de Souza	Atlanta Dream	PF-C	877			0.111	2.4
39	Tully Bevilacqua	San Antonio Silver Stars	SG	494			0.196	2.4
40	Angela McCoughtry*	Atlanta Dream	SF-PF	921	172	70	0.104	2.4

Note:

* Selected by members of the media to first team of the All-WNBA team.

** Selected by members of the media to the second team of the All-WNBA team.

for the WNBA. We do know, though, how the coaches allocate minutes on each team. To examine this decision, we estimate the determinants of minutes played per game (MGM_{it}):

$$\begin{aligned}
 MGM_{it} = & \alpha_0 + \alpha_1 relPTS_{it} + \alpha_2 relTRB_{it} + \alpha_3 relSTL_{it} + \alpha_4 relAST_{it} \\
 & + \alpha_5 relBLK_{it} + \alpha_6 relPF_{it} + \alpha_7 AdjFG_{it} + \alpha_8 FTper_{it} \\
 & + \alpha_9 TOper_{it} + \alpha_{10} dTRADE_{it} + \alpha_{11} AGE_{it} + \alpha_{12} SQAGE_{it} \\
 & + \alpha_{13} DftPos_{it} * XP1_{it} + \alpha_{14} DftPos_{it} * XP2_{it} \\
 & + \alpha_{15} DftPos_{it} * XP3_{it} + \alpha_{16} DftPos_{it} * XP4_{it} \\
 & + \alpha_{17} DftPos_{it} * XP5_{it} + \varepsilon_{10it},
 \end{aligned} \tag{7.10}$$

where:

<i>relPTS</i>	=	points per minute, relative to the position average; ¹⁹
<i>relTRB</i>	=	rebounds per minute, adjusted for position played;
<i>relSTL</i>	=	steals per minute, adjusted for position played;
<i>relAST</i>	=	assists per minute, adjusted for position played;
<i>relBLK</i>	=	blocks per minute, adjusted for position played;
<i>relPF</i>	=	personal fouls per minute, adjusted for position played;
<i>AdjFG</i>	=	adjusted field goal percentage;
<i>FTper</i>	=	free throw percentage;
<i>TOper</i>	=	turnover percentage;
<i>dTRADE</i>	=	equal to 1 if player was traded during the season;
<i>AGE</i>	=	player's age;
<i>SQAGE</i>	=	age squared; and
<i>DftPos* XPi</i>	=	the player's draft position multiplied by a dummy variable equal to one if she is in her <i>i</i> th year in the WNBA.

The results in Table 7.9 show that a player's minutes increase when her relative scoring, steals, assists, and blocked shots increase. They fall when her personal fouls and turnovers increase or when she has been traded. While our model of win production highlighted the importance of shooting efficiency and gaining possession of the ball, Table 7.9 shows that rebounds and shooting efficiency do not affect playing time.

To further highlight the similarity between the WNBA and NBA, we estimate the determinants of minutes played for a sample from the NBA. The results in Table 7.10 tell the same story. As in the WNBA, decision makers in the NBA give more minutes to players who score more points. While shooting efficiency affects playing time in the NBA, its impact is relatively small. In both the WNBA and NBA, assists

Table 7.9 Determinants of minutes per game in the WNBA: 1997–2011

Variable	Coefficient	Standard error	t-stat	p-value
<i>relPTS*</i>	22.866	2.431	9.408	0.000
<i>relTRB</i>	– 2.012	4.618	–0.436	0.663
<i>relSTL*</i>	34.879	12.676	2.752	0.006
<i>relAST*</i>	53.111	6.461	8.220	0.000
<i>relBLK*</i>	38.414	12.040	3.190	0.001
<i>relPF*</i>	–81.303	6.980	–11.648	0.000
<i>AdjFG</i>	5.340	3.782	1.412	0.158
<i>FTper</i>	–1.236	2.026	–0.610	0.542
<i>TOper**</i>	–0.102	0.051	–1.979	0.048
<i>dTrade*</i>	–2.777	0.894	–3.106	0.002
<i>AGE*</i>	1.559	0.549	2.839	0.005
<i>SQAGE*</i>	–0.026	0.010	–2.689	0.007
<i>DftPos*XP1*</i>	–0.174	0.036	–4.764	0.000
<i>DftPos*XP2*</i>	–0.101	0.033	–3.065	0.002
<i>DftPos*XP3</i>	–0.054	0.038	–1.415	0.157
<i>DftPos*XP4</i>	–0.062	0.038	–1.643	0.101
<i>DftPos*XP5</i>	0.021	0.032	0.653	0.514
Constant term	–4.404	7.894	–0.558	0.577
R-squared	0.490			
F-statistic*	53.9			
Observations	938			

Note: * Significant at the 1% level; ** Significant at the 5% level.

per minute have a smaller impact on minutes than personal fouls and scoring do. The impact of assists in the WNBA, though, appears to be larger. Thus, assists matter more in the WNBA than in the NBA, both according to our metric of wins produced and according to coaches' decisions.

Tables 7.9 and 7.10 also show the impact of draft position on minutes played. Consistent with studies of the NBA by Camerer and Weber (1999) and Staw and Hoang (1995), we find that a player's draft position affects minutes played in the WNBA, even after controlling for performance. The effect appears to last for only two years in the WNBA, about half the time it lasts in the NBA. We conclude that WNBA decision makers let go of their preconceived notions much faster.

This section has shown that decision makers in the WNBA make some – but not all – of the mistakes that their counterparts in the NBA make. As in the NBA, coaches place too much weight on points scored per game when allocating playing time. The lack of comprehensive salary data

Table 7.10 *Modeling minutes per game for the NBA: 1999–00 to 2007–08*

Variable	Coefficient	Standard error	<i>t</i> -stat	<i>p</i> -value
<i>relPTS*</i>	22.788	1.234	18.469	0.000
<i>relTRB*</i>	20.610	2.710	7.606	0.000
<i>relSTL*</i>	34.186	11.016	3.103	0.002
<i>relAST*</i>	36.941	4.362	8.469	0.000
<i>relBLK*</i>	26.164	6.642	3.939	0.000
<i>relPF*</i>	-136.380	4.958	-27.505	0.000
<i>AdjFG*</i>	7.744	2.572	3.010	0.003
<i>FTper*</i>	11.823	1.236	9.562	0.000
<i>TOper*</i>	0.106	0.039	2.722	0.007
<i>dTrade*</i>	-1.228	0.383	-3.211	0.001
<i>AGE*</i>	2.431	0.331	7.334	0.000
<i>SQAGE*</i>	-0.049	0.006	-8.058	0.000
<i>DftPos*XP1*</i>	-0.142	0.015	-9.578	0.000
<i>DftPos*XP2*</i>	-0.127	0.015	-8.336	0.000
<i>DftPos*XP3*</i>	-0.105	0.015	-6.851	0.000
<i>DftPos*XP4*</i>	-0.074	0.014	-5.136	0.000
<i>DftPos*XP5**</i>	-0.030	0.016	-1.931	0.054
Constant term	-20.488	4.634	-4.421	0.000
Adjusted <i>R</i> -squared	0.646			
<i>F</i> -statistic*	248.8			
Observations	2,339			

Note: * Significant at the 1% level; ** Significant at the 5% level.

for the WNBA keeps us from determining the monetary value of scoring in terms of player salaries. We find, however, that WNBA teams are not as wedded to their top draft picks and are willing to disregard sunk costs much more quickly than NBA teams are.

7.8 CONCLUSION

A new league provides sports economists a wealth of information about the economic viability of the sport as well as new insights into the factors that make it viable. At this time, the jury is still out as to whether the WNBA will attain self-sustaining profitability. While the Los Angeles Sparks recently sold for \$10 million, this price tag falls far short of the sales prices of its NBA brothers. In fact, it is unclear whether any WNBA franchise makes positive economic profits.

The WNBA's profits are limited by the dearth of non-ticket revenues,

particularly broadcast revenues, as well as attendance, which peaked in the league's sophomore season and has not recovered since. This has, in turn, limited the league's ability to compensate its players. The WNBA has held down salaries by imposing a hard cap that, unlike the NBA's soft cap, does not allow exceptions.

The WNBA shows much more intra-seasonal balance than the NBA. In contrast, the NBA and WNBA have similar levels of inter-seasonal balance. Furthermore, whatever inter-season imbalance exists in the WNBA cannot be traced to any advantage held by franchises in larger cities.

In terms of individual play, we find that basketball – whether in the NBA or the WNBA – is essentially the same game. As a result, the marginal values of almost all offensive performance measures are roughly the same for each position. Assists are the one major exception. Our estimates indicate that they are much more important in the WNBA than in the NBA.

Finally, we find that coaches and other team officials in the WNBA make the same mistakes as their NBA counterparts when evaluating player performance. Coaches in both leagues place too much weight on points scored per minute when they allocate minutes to their players despite the fact that shooting efficiency and gaining and keeping possession of the ball (that is, rebounds, turnovers, and steals) primarily determine the outcomes of games in both leagues. The disconnect between perception and reality – which has been documented in a number of studies of the NBA – also appears in our study of the WNBA.

NOTES

1. The WNBA was approved by the NBA Board of Governors on April 24, 1996.
2. Under the current collective bargaining agreement (CBA), WNBA teams share 10 percent of their gate when league revenues hit an agreed-upon benchmarks. In 2008, this benchmark was \$2.5 million.
3. The Phoenix Mercury and San Antonio Silver Stars already have separate deals with cell-phone companies and were excluded from the deal.
4. In a perfectly balanced league, games are decided by chance, and the variance in winning percentages is $(0.5/\sqrt{G})$, where G is the number of games in a season.
5. We focus on the past decade as that was when the WNBA expanded to eight playoff slots.
6. The WNBA adopted a version of the NBA's draft lottery, which was a response to claims that bad teams intentionally lost at the end of the season. For a review of the literature, see Price et al. (2010).
7. To exercise the Fourth Year Option, the team must declare its intention during the rookie's second year of service. A player bound by this option receives an automatic 15 percent increase in her base salary for her second and subsequent years.
8. The NBA's soft cap contains significant exceptions that allow teams to exceed the

maximum. Under very limited conditions, teams in the WNBA can exceed the limit by 4 percent without penalty.

9. See Berri et al. (2006) and Berri and Schmidt (2010) for a less technical version of this model.
10. Berri (2008) built a wins model for basketball, and Gerrard (2007) did the same for soccer.
11. Team rebounds are an accounting device. The number of missed shots should equal the number of rebounds. However, if a missed shot goes out of bounds or if a player misses the first of two free throws, a rebound cannot be credited to anyone. These events are called team rebounds. We include only team rebounds that result in a change of possession and treat all team rebounds as defensive rebounds (see Berri, 2008).
12. The percentage of free throws that result in a possession (b_1) is about 0.44. See Berri (2008).
13. We find that $0.44*FTA = FGA$ in both the NBA and WNBA.
14. The value of c_1 is about 0.44 in both the NBA and WNBA. This value is determined by calculating free throws that change possessions. For details see Berri (2008). Berri and Schmidt (2010) report that, even ignoring team rebounds that change possession, these statistics explain 98 percent of a team's field goal attempts in the NBA. Furthermore, the estimated impact of *opp.TOV*, *DRB*, *opp.FGM*, *TOV*, and *ORB* on a team's field goal attempts is approximately 1.0. This means that each time a team gains (loses) possession of the ball, it has gained (lost) the ability to take one field goal attempt.
15. Similar results hold for the NBA. Each blocked shot in the NBA reduces the opponent's made shots by 0.637. Hence, a blocked shot is worth 0.020 wins in the NBA.
16. The controls were the player's adjusted field goal percentage in the previous season, her age and age-squared, the percentage of games in which she played in the previous two seasons, her teammates' adjusted field goal percentage, and a dummy variable for each year). For the NBA, the equation also included measures of roster stability, dummy variables for playing under a new coach and a new team, and dummies for position played.
17. Only turnovers not attributable to steals by individual players are included in this calculation.
18. For players who played multiple positions, we calculate a weighted average of *Adj.P40* using the minutes our analysis suggests the player played at each position as weights.
19. The calculation of a player's relative per-minute performance begins by determining the per-minute average performance of players at each of the five positions. These position averages are then subtracted from each player's per-minute performance. We then add the overall per-minute league average for that statistic. For example, Tina Charles had 0.329 rebounds per minute in 2011. The league average for a center in the WNBA was 0.240, while the average for all players was 0.166. So Charles's *RELTRB* was: $(0.329 - 0.240) + 0.166 = 0.256$. These steps were followed for all variables statistics except those expressed as percentages.

REFERENCES

- Berri, David J. (2008), 'A Simple Measure of Worker Productivity in the National Basketball Association', in *The Business of Sport*, edited by Brad Humphreys and Dennis Howard, vol. 3, Westport, CT: Praeger, pp. 1–40.
- Berri, David J. and Martin B. Schmidt (2010), *Stumbling on Wins: Two Economists Explore the Pitfalls on the Road to Victory in Professional Sports*, Princeton, NJ: Financial Times Press.
- Berri, David J., Martin B. Schmidt and Stacey L. Brook (2006), *The Wages of Wins: Taking Measure of the Many Myths in Modern Sport*, Stanford, CA: Stanford University Press.
- Camerer, Colin and Roberto A. Weber (1999), 'The econometrics and behavioral economics of escalation of commitment in NBA draft choices', *Journal of Economic Behavior and Organization*, 39(1), May: 59–82.

- Depken, Craig II (1999), 'Free Agency and the Competitiveness of Major League Baseball', *Review of Industrial Organization*, **14**(3), May: 67–75.
- Evans, Jayda (2007), 'WNBA Gets Its First TV Rights Fee', *Seattle Times*, July 16.
- Fort, Rodney (2011), *Sports Economics*, 3rd edn, Boston, MA: Prentice-Hall.
- Gerrard, Bill (2007), 'Is the Moneyball Approach Transferable to Complex Invasion Team Sports?', *International Journal of Sports Finance*, **2**(4), November: 214–28.
- Hollinger, John (2002), *Pro Basketball Prospectus 2002*, Washington, DC: Brassey's Sports.
- Leeds, Michael and Peter von Allmen (2011), *The Economics of Sports*, Boston, MA: Addison-Wesley.
- Lewis, Michael (2004), *Moneyball: The Art of Winning an Unfair Game*, New York: W.W. Norton.
- Oliver, Dean (2004), *Basketball on Paper: Rules and Tools for Performance Analysis*, Dulles, VA: Potomac Books.
- Owen, P. Dorian, Michael Ryan and Clayton Weatherston (2007), 'Measuring Competitive Balance in Professional Team Sports Using the Herfindahl–Hirschman Index', *Review of Industrial Organization*, **31**(4), December: 289–301.
- Price, Joseph, Brian Soebbing, David Berri and Brad Humphreys (2010), 'Tournament Incentives, League Policy, and NBA Team Performance Revisited', *Journal of Sports Economics*, **11**(2), April: 117–35.
- Staw, B.M. and Ha Hoang (1995), 'Sunk Costs in the NBA: Why Draft Order Affects Playing Time and Survival in Professional Basketball', *Administrative Costs Quarterly*, **40**(3), September: 474–94.
- Steeg, Jill (2007), 'New Owners Stake Claim in Overhauling WNBA', *USA Today*, June 7.
- TVNZ (Television New Zealand Limited) (2009), 'NBA Getting Through Tough Times', online at: tvnz.co.nz/basketball-news (accessed January 16, 2012).
- Womensbasketonline.com (2011), 'Attendance', online at: <http://womensbasketballonline.com/wnba> (accessed January 11, 2012).