LEAGUE POLICY, INVARIANCE, AND PLAYER MOBILITY AND PAY: THE CASE OF THE NATIONAL BASKETBALL ASSOCIATION

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ABSTRACT

The focus of this dissertation is imperfectly competitive sports labor markets and the effects of league labor policy on player mobility, compensation, and job location choice. The analyses conducted herein contributes primarily to a broad area of research within sports economics that generally uses changes in league labor rules to examine employer monopsony power and the validity of the Invariance Principle, which states that the distribution of playing talent in a sports league is invariant to the ownership of the rights to players' services. After a critical review of the literature and some background on the National Basketball Association (NBA), a broad-to-narrow approach is used to present evidence from three empirical essays. Essay one examines the effects of 40 years' worth of institutional change on competitive balance in the NBA. Essay two investigates the effects of more recent free agency rules on player mobility and pay. Finally, essay three narrows the focus a bit further to the effects of nonwage job characteristics on player wages and the implications of such nonwage attributes for player movement.

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1. INTRODUCTION

As Fort (2011) states, "the problem addressed by sports league competition policy is market power" (p. 420). The major North American leagues are widely viewed by economists as joint ventures or sanctioned cartels that seek to maximize profits (e.g., Krautmann, 2008). Indeed, these collusive combinations of teams, as Rottenberg (1956) describes them, have agreed to be bound by rules that inhibit competition, resulting in considerable market power. There is one dominant league in each sport, and leagues limit the number of teams within each league, so that franchises are scarce. Furthermore, teams are granted exclusive territorial rights, which allows them to act as local monopolies. Thus, leagues and teams operate in an environment without the threat of rivals, and significant barriers to entry create market power and a scarcity of top-tier teams (Ross, 2003).

Traditionally, these agreements among teams have also allowed them to exercise considerable monopsony power in the market for inputs, that is, the professional players' labor market. Prior to 1976, Major League Baseball (MLB) had a reserve system that ensured teams did not have to bid against one another for players. Nearly all player contracts were one-year contracts that contained a renewal clause (known as the *reserve clause*) that allowed a team to renew a player's contract at a price set by the team. Thus, the reserve clause gave teams exclusive (i.e., monopsony) rights to their players for as long as the players were in the league. Club owners claimed that the reserve clause was necessary in order to preserve competitive balance (CB) and thus the financial viability of the league. The other major North American leagues had similar reservation rules, but after MLB players won the right to become free agents (after six years of service) in

1976, the relaxation of strict labor constraints quickly spread to other sports (Szymanski, 2003a).

Although the infamous reserve clause is a thing of the past, other anticompetitive policies have survived (e.g., rookie drafts) or been implemented. Ancillary institutional arrangements that restrict player mobility, negotiating rights, and pay have arisen in response to greater contractual freedom and escalating player salaries. As a result, the major North American leagues continue to exert a considerable degree of control over their respective markets for players.

The primary justifications for these institutional arrangements are to maintain CB, ensure the financial stability of both the league and its teams, and to recoup player investment costs. The key assertion, which has provided the foundation for numerous antitrust defenses in U.S. courts, is that revenue imbalance will result in competitive imbalance, which reduces fan interest because outcomes become more certain (Szymanski, 2003a). In the absence of such restrictions, it is argued, the best players would migrate to large-market teams with high drawing potential, small-market teams would not be able to compete, and CB would be compromised.

2. ROTTENBERG'S INVARIANCE PRINCIPLE

In his seminal paper on the economics of professional baseball, Rottenberg (1956) famously argued that the reserve clause did not result in a more equal distribution of players among teams than a free market would. In short, Rottenberg's reasoning was that, because players could be sold to other teams under the reserve clause, and players are more valuable to some teams than others, the reserve clause and a free market would result in the same distribution of talent. In either case each player would end up playing for the team that is able to get the highest return from his services (i.e., where the player's marginal revenue product [MRP] was highest).

Rottenberg's argument that the distribution of talent would be the same under both systems has become known as the Invariance Principal (IP), and it is a foundational element of sports economics. While interpretations of the IP and its implications vary, the theorem is generally understood to mean that the distribution of playing talent in a sports league is invariant to property rights (i.e., contract ownership rights).[1] Over the years, researchers have extended the IP to a wide array of league policies that restrain the professional players' labor market. Indeed, the idea that the distribution of talent in a league, and thus CB, is invariant to league labor policy has taken a dominant place in the sports economics literature.

As will be discussed further, there is not widespread agreement about whether changes in the rights to players' services affect the distribution of talent in a sports league. There is little debate, however, about the effect of changes in property rights on

[1] As Sanderson and Siegfried (2006) note, the IP "is, for all practical purposes, consistent with and predates the Coase Theorem" (p. 599). The Coase Theorem states that if the price mechanism is working smoothly (i.e., costlessly), changes in property rights will have no long-run effect on the optimal allocation of resources, that is, the allocation of resources that maximizes the value of production (Coase, 1960).

the distribution of salary wealth, whether players were worse off under reserve clause, and so forth. Indeed, an undisputed effect of the reserve clause was the suppression of player salaries and the transfer of rents associated with player skills from players to team owners (Eckard, 2001). According to the IP, then, contract ownership rights have no effect on distribution of talent but they do affect the distribution of wealth, and restrictive labor policies only result in a redistribution of income. As Rosen and Sanderson (2001) note, "to a first approximation contract property rights have to do with who gets the rent on talent, not with who plays for whom" (p. F54).

The Empirical IP Literature

Given the importance of the IP, it not surprising that there have been numerous empirical tests of the theorem. Broadly speaking, this large literature has studied the effect of changes in contract ownership rights on (i) player mobility and (ii) player wages. Research relating to the former has examined the degree of player movement and/or the distribution of playing talent before and after league policy changes. In the latter case, researchers have primarily sought to measure the extent to which players were exploited under policies that granted owners monopsony rights to players' services. For both mobility and pay, the vast majority of these studies considered the effects of the advent of free agency in MLB. This being the case, only MLB free agency studies are surveyed in this section. Section III reviews the advent of free agency in the other North American leagues and a number of other prominent league policy changes.

Invariance and Mobility

While the data and methodology employed have varied, the majority of empirical IP studies related to player mobility and the abolition of the MLB reserve clause have compared the pre- and post-free agency periods using one of two approaches (or both). The first approach taken was to consider aggregate measures of player mobility in an effort to determine whether the players moved differently under free agency than the owners had moved them under the reserve clause. While the hypotheses tested vary, these studies generally sought to detect any systematic differences in the movement of players. Those who took the second approach followed Rottenberg's (1956) lead and focused on CB as a proxy for how evenly talent was distributed across the teams in the league. A variety of CB measures have been employed, with the most common being the dispersion of team win percentages (a within-season measure) and the year-to-year correlation between league rankings (between-season).

Consistent with the IP, Spitzer and Hoffman (1980) and Besanko and Simon (1985) found that the advent of free agency did not have a significant effect on the rate of player transfers. Besanko and Simon (1985) also showed that teams in large markets and teams with poor won-lost records were net sellers of player contracts, which in their view supports the IP. Looking only at the post-free agency period, Drahozal (1996) rejected the hypothesis that high-quality free agents moved from small cities to large cities and concludes that the evidence is consistent with invariance. Daly and Moore (1981), however, found that players were more likely to move toward large markets as free agents, which suggests that the abolition of the reserve clause decreased equality. Similarly, Hylan, Lage, and Treglia (1996) concluded that mobility of veteran pitchers increased with free agency and rejected the IP on that basis.

A number of authors who took the second approach and considered changes in CB concluded that the evidence did not warrant a rejection of the theorem (Besanko &

Simon, 1985; Dolan & Schmidt, 1985; Drahozal, 1986; Fort & Quirk, 1995). However, by indicating that the introduction free agency enhanced league-wide CB, others reported results that do not support the IP (Balfour & Porter, 1991; Eckard, 2001; Vrooman, 1995, 1996). It was not uncommon for researchers who used multiple measures of CB to find significant differences in parity between the pre- and post-free agency periods for some measures but not others (e.g., Dolan & Schmidt, 1985). In addition, several of those who treated the league's two conferences separately found support for IP in one case but not the other (Depken, 1999; Horowitz, 1997; Scully 1989).

As this brief survey indicates, there has been some disagreement about the implications of Rottenberg's (1956) analysis, particularly when it comes to aggregate flows of playing talent. Rottenberg (1956) did not address player movement directly; he stated only that the same, unequal distribution of talent was to be expected under both the reserve clause and a free market because the revenue generating potential of teams varies and in either case "players will be distributed among teams so that they are put to their most 'productive' use" (p. 256). Thus, as Surdam (2006) notes, the IP "does not imply that the pattern and volume of players' movements should remain the same, just that the overall distribution of talent should be similar" (p. 202).

According to some economists, however, the essence of Rottenberg's (1956) argument was that invariance was expected because the reserve clause (with unrestricted cash sale) did not prevent the migration of talent from smaller-market, lower-revenue teams to larger-market, higher-revenue teams. In other words, players will move to wealthier teams in larger markets regardless of who owns the property rights and, if the IP holds, free agency should not result in more players moving from small to large markets (e.g., Daly & Moore, 1981). The reason that the distribution of playing talent would not become more unequal in a free market, according to Rottenberg (1956), was that diminishing marginal returns to high-quality talent would effectively prevent the large-market teams from contracting all of the best players. As a result, the key point of inquiry for other researchers was whether more players moved from small-market to large-market teams under free agency (e.g., Hylan et al., 1996).

Invariance and Pay

As noted previously, the IP does not assert that the distribution of rents is invariant to property rights. As Rottenberg (1956) pointed out with regard to the reserve clause, "by confronting each contracted player with an exclusive bidder, the rule can have the effect of depressing salaries, at least for some players" (p. 248). Consistent with the IP, subsequent research has shown that the reserve clause established monopsony rights, kept wages down by reducing the competition for players' services, and made team owners better off. Indeed, "all evidence points to remarkably large effects of contract ownership rights on player salaries" (Rosen & Sanderson, 2001, p. F54).

Evidence of the effect of property rights on player wages has primarily come in the form of quantitative estimates of individual player salaries before and after exogenous changes in league labor policies. More precisely, the degree of monopsony exploitation (salaries less than MRP) is calculated by comparing players' actual salaries with their estimated MRPs before and after the change. In the seminal study of this type, Scully (1974) found that players were, on the whole, exploited under the reserve clause and that the economic loss to players was considerable. Subsequent research on the early years of free agency in MLB agreed with Scully and reported that salaries increased substantially with the advent of free agency and that many free agents received salaries that were at or above their marginal values (Fort, 1992; Hill & Spellman, 1983; Raimondo, 1983; Sommers & Quinton, 1982; Zimbalist, 1992).

3. COMPETITIVE BALANCE REMEDIES AND THE IP

Since Rottenberg's (1956) original insights into the IP, the theorem has been extended to nearly all league-imposed labor market restraints, direct and indirect, across a variety of league contexts. The arguments for the restraints are the same as those traditionally made for the strict player reserve system, mainly that such policies are needed to promote the balanced competition that fans desire. What follows is a survey of both the modern theory of sports leagues as it pertains to the IP and the relevant empirical assessments. After some introductory remarks about both the theoretical and empirical research, the survey proceeds according to the main CB remedies considered in the literature to date: reserve clauses and entry (rookie) drafts; payroll (salary) caps and luxury taxes; individual salary caps; and revenue sharing arrangements.[2]

According to differences in the modeling assumptions made, the theoretical contributions make different predictions about the effects of the primary CB remedies. Chief among these assumptions is whether team owners seek to maximize profit or wins. This distinction matters because owners' incentives dictate how they behave under a given league policy. The standard model assumes that the league's objective is to maximize the joint profits of the owners (e.g., Fort & Quirk, 2005). Many other distinctions can be made between the theoretical models, but a thorough discussion of the implications of these modeling differences is beyond the scope of this paper. Hence, the emphasis here is on profit maximization versus win maximization.

[2] Other institutional changes such as league expansion, franchise relocation, and so forth are not covered here. While such changes are relevant to the IP discussion they are generally treated as controls in the context of CB analysis.

Although league policies have received a considerable amount of theoretical attention, there is not widespread agreement about their implications for the IP. It would appear, then, that empirical studies have an important role to play in the discussion. However, with the exception of free agency, there is a general lack of empirical evidence of the effects of the CB remedies. This is likely because opportunities are limited for well-defined natural experiments, such as imposing a draft or payroll cap where no such policy existed before. Indeed, empirical testing of league policy change is complicated by the fact that drastic changes are rare and multiple policies are sometimes implemented concurrently. When this happens it is very difficult, if not impossible, to measure their individual effects. Furthermore, comparison of a specific policy such as revenue sharing across leagues is clouded by the interference of many other league-specific factors (Szymanski, 2003a).

Reserve Clauses and Entry Drafts

For players in the major North American leagues, free agency was generally achieved via litigation. As noted previously, after a 1975 labor arbitration ruling opened the door to free agency for baseball players in 1976, the relaxing of strict labor constraints soon followed in the National Basketball Association (NBA), the National Football League (NFL), and the National Hockey League (NHL).

Pioneered by the NFL in 1936, reverse-order drafts are used by all major North American leagues to assign eligible players (typically amateurs) who are entering the league (or its affiliated minor leagues) to a single team for contract negotiations. Rather than competing with other league members for the services of incoming players, each team receives exclusive contracting rights to the players that it selects. The draft order is inversely related to the previous year's on-field success, with the worst performing teams in the prior season receiving the earliest picks. Commenting on the other labor rules that characterized professional baseball at the time, Rottenberg (1956) noted that the draft rule used to ostensibly place the best minor league players on the worst major league teams was not having its intended effect. As with the reserve rule, the cash sale of players was to blame—to avoid losing the players most likely to be drafted, minor league teams would simply sell the players to the highest major league bidders prior to the draft date.

Rottenberg's (1956) groundbreaking insights about the effects of league labor policy on the "disposition of players" were first formalized mathematically by El Hodiri and Quirk (1971) and Quirk and El Hodiri (1974). Consistent with the IP, their seminal model shows that, in the long run, a balanced league is consistent with profit maximization only if all franchises have similar drawing potential and league rules prohibit the cash sale of player contracts. As long as "weak" franchises can sell players (including draft picks) to "big-city" franchises, a reserve clause and a reverse-order-of-finish draft will not improve competitive balance; the policies simply limit the competition for players, which reduces player costs (i.e., salaries) and raises profits. Using a simplified version of the Quirk and El Hodiri model, Fort and Quirk (1995) similarly show that, with unrestricted cash sale of players, a reserve clause and a rookie draft have no effect on CB.

There is a large empirical literature pertaining to free agency and the IP. Most of the papers consider the advent of free agency in MLB, which is covered in Section II. By comparison, few have examined the other major North American leagues. Larsen, Fenn, and Spenner (2006) and Lee (2010) consider the NFL, where free agency was enacted in conjunction with a payroll cap (and other provisions) in 1993. They find that CB improved under the policies, but, due to the simultaneous implementation of the cap, the effect of free agency alone is indeterminate. Turning to hockey, Richardson's (2000) analysis of CB in the NHL suggests improvement over time, but the author is reluctant to reject the IP because the rules regarding (restricted) free agency had changed little over the sample period. Fenn, von Allmen, Brook, and Preissing (2005) also consider structural change and CB in the NHL and find that, supporting the IP, neither free agency nor the amateur draft had a significant effect. Contrary to the IP, however, Maxcy and Mondello (2006) found that there was a noticeable improvement in balance when the NHL moved from a strict reserve system to restricted free agency. Finally, the NBA has received very little treatment and the evidence provided is inconclusive (Maxcy & Mondello, 2006).

The number of draft-related empirical studies is limited because drafts have generally been implemented early in the leagues' histories, which makes the opportunities for before-and-after experiments rare. MLB has undoubtedly received the most attention, which is not surprising given that, despite being the oldest North American league, it was the last to institute an amateur draft (in 1965). Contrary to the IP, Daly and Moore (1981) and Butler (1995) found that CB improved in the post-draft period for both the National League (NL) and the American League (AL). Fort and Quirk's (1995) empirical work supports invariance for the NL (the draft had no effect), but rejects for the AL (balance improved). Considering MLB as a whole, Maxcy (2002) argues that the amateur draft generates an income (wealth) effect that alters the distribution of talent in favor of the poorest on-field performers and, hence, improves CB.

As for drafts in the other major leagues, the tests conducted by Fort and Quirk (1995) failed to reject the hypothesis that the NFL's rookie draft had no effect on CB. Conversely, Grier and Tollison (1994) examined the factors affecting team performance in the NFL and found that higher draft choices significantly improved winning percentages over time, indicating the reverse-order draft enhanced balance. Using the same basic approach, Richardson (2000) showed similar findings for the NHL. Lastly, analysis of the NBA again lags behind the other leagues, probably because its draft coincides with the league's inception in 1946. However, there is some evidence from Fort and Lee's (2007) time-series study that CB in the NBA was not impacted by the advent of the draft.

In conclusion, theoretical work supports the validity of the IP—the distribution of talent should be invariant to the advent of free agency and the imposition of a draft. The empirical results are generally mixed, although in the case of the rookie draft the bulk of the papers surveyed here appears to reject invariance. Altogether the evidence suggests that reserve clauses and drafts hinder player mobility. The effects of both IP remedies likely hinge on the prevalence of transaction costs and other market frictions, an issue that was not stressed in Rottenberg's (1956) original analysis.

Payroll Caps and Luxury Taxes

In 1984, the NBA became the first modern league to implement a payroll cap, that is, to limit the amount that teams could spend on player salaries. The 1983 collective bargaining agreement (CBA) designated a maximum team payroll equal to a set percentage of league revenues divided by the number of teams in the league. From its inception, however, the NBA's soft cap has allowed teams to exceed the limit under certain circumstances, for example when re-signing their own free agents (the so-called "Bird" exception). All North American leagues now have payroll caps except MLB, which has only a luxury tax (called the Competitive Balance Tax), to curb spending. Under a luxury tax, teams with payrolls that exceed a set threshold are subject to a tax that is paid to the league. The tax is determined as a set percentage (the rate) of the amount by which the team's payroll exceeds the threshold, and the rates are higher for repeat offenders. The NBA also has a luxury tax that has become increasingly punitive since it was added to the league's economic system in 1999.

Theoretically, when it is assumed that the league is comprised of profit maximizing owners, Fort and Quirk (1995) show that a league becomes balanced with a reverse-order draft and a payroll cap that equalizes spending. However, the cost of talent goes down (salaries are lower) and strict cap enforcement is needed because incentive remains for strong-drawing teams to spend more than the cap and weak-drawing teams to spend less. Similarly, Hausman and Leonard (1997) show that a cap can affect the distribution of talent if it restrains the large-market teams and, furthermore, that team quality is equalized if the cap is binding for all teams. Their analysis also indicates that salaries are lower under the cap (i.e., there is a shift in rents from players to owners). Conversely, Vrooman (1995, 2000) concludes that a payroll cap worsens CB and enables the teams of the league to collusively suppress player salaries.

When teams maximize win percentage, Késenne (2000a) shows that a payroll cap can improve CB because large clubs hire fewer high-productivity players. The model also suggests that, as a result of the cap, average player salary will decrease, the profits of all clubs (small and large) will rise, and the distribution of salaries will become more equal (dispersion will decrease).

With regard to a luxury tax, Gustafson and Hadley's (1996) model features a tax imposed on all teams whose payroll exceeds the league average by a set percentage. They find that it reduces tax-paying teams' demand for "stars" (highly productive players) and thus stars' equilibrium salary. However, teams below the tax threshold hire more stars and, assuming tax-paying teams tend to be in large markets, CB improves. Marburger (1997) considers several luxury tax variations and concludes that, while the effect on league balance (and profits) depends on how the taxes are calculated and how the tax revenues are shared, luxury taxes will, in general, depress player salaries. He further argues that, as with salary caps, strict enforcement is necessary because teams and players both have an incentive to circumvent the tax.

Several studies have empirically examined the effects of the NFL's hard (i.e., strictly enforced) payroll cap, which was implemented alongside free agency in 1993. The evidence presented by Larsen et al. (2006) and Lee (2010) indicates that the combination of a salary cap and free agency increased competitive balance in the NFL. Again, however, the effect of the cap alone cannot be determined. One of the two CB measures employed by Maxcy and Mondello (2006) also indicates that CB has improved significantly in the post-1993 period but the authors note that, on the whole, the NFL results are ambiguous and "the separate impacts on competitive balance of unrestricted free agency and the salary cap remain inconclusive" (p. 362). Empirical analyses of the NBA's cap have typically found that it had no effect on balance (Endo, Florio, Gerber, &

Sommers, 2003; Fort & Quirk, 1995; Vrooman, 1995). The lone exception is Maxcy and Mondello (2006), who found that the cap worsened CB.

The scant empirical work on luxury taxes indicates that MLB's luxury tax, first implemented as part of the 1997 Basic Agreement (i.e., CBA), enhanced league balance. Maxcy (2011) concluded that the tax altered player movement because transfers to high-revenue teams were reduced. Ajilore and Hendrickson (2011) examined the determinants of team competitiveness and found that teams have become more competitive since the implementation of the tax.

Summing up, the IP is theorized not to hold for an enforced payroll cap—balance is expected to be altered with an increase in CB the most likely result. The theoretical impact of a luxury tax is rather ambiguous, though it is probably safe to say that CB is expected to increase with strict enforcement. The details surrounding the mechanism that is implemented are important to the efficacy of both CB remedies, especially how strictly the spending limit is enforced. The mobility-related empirical studies largely support the theory, and thus reject the IP, though more research is needed. Theoretically, wages are unambiguously lower under both a cap and a tax, which explains why players unions have fiercely opposed them (with varying degrees of success). To date, however, there are no known empirical studies on this particular issue.

Individual Salary Caps

The NBA was also the first to institute a true *salary cap* on individual salaries, with limits that vary according to years of service. More recently, the NHL implemented an individual salary cap, along with a payroll cap and other restrictions, after a labor dispute that canceled the entire 2004–05 season. Theoretical treatments of individual caps are scarce, and to date the policy has not been examined empirically.

Rottenberg (1956) argued that a cap on individual salaries was unlikely to affect the distribution of talent. His reasoning was that players who were worth more than the maximum would distribute themselves based on criteria other than annual salary and the "teams which, in the absence of a maximum salary rule, would have outbid other would-be buyers of a player's services with cash will outbid them with non-money offers" (p. 257). According to Késenne (2000a), a profit-maximization league is more imbalanced under an individual salary cap than under a payroll cap. Consistent with Rottenberg's intuition, Késenne's analysis shows that large-market teams will hire more high-productivity players because the expectation is that the top players "will prefer to play for the bigger club and the better team," and "the richer club can offer the star players more non-wage or fringe benefits on top of their salary" (p. 429). The individual cap does, however, narrow the salary differential between high- and low-productivity players.

Revenue Sharing

All North American leagues centrally collect the revenues from national media broadcast rights, licensing, and other sources. Generally, this league-level revenue is then split evenly among the teams. Locally-produced revenues are also shared, although the current methods of doing so vary considerably across leagues. Leagues' revenue sharing arrangements have generally changed little over time. A possible exception is MLB, which instituted a complex system for sharing local revenues in 1997 (the system was modified in 2002). MLB's system is progressive in that it disproportionately distributes revenue in favor of the low-revenue teams. The NBA began sharing local revenue in 2011, but the system was to be implemented over time and detailed information about the plan has not been made public (it is not part of the league's CBA).

The theoretical literature indicates that the impacts of revenue sharing on league balance are not straightforward. Indeed, among all of the CB remedies surveyed, the predictions for revenue sharing display the greatest variation. Unsurprisingly, this is because the models vary with respect to the sharing mechanism considered, the specification of the team revenue function, the type of revenue that is shared, and the sensitivity of those revenues to winning. The emphasis here is on the traditional sharing scheme considered most frequently in the literature, sharing a fixed proportion of home gate receipts.[3] There are also theoretical treatments of pooled sharing, whereby a set percentage of team revenue (usually gate) is centrally collected and placed in a pool that is then split among the teams (usually equally).

In the more conventional, profit maximization scenario, Fort and Quirk (2005) suggest that, consistent with the IP, gate sharing has no effect on CB; the policy simply lowers player salaries by lowering the demand for talent. National TV revenue sharing is also expected to have no effect on league balance if it is equally divided, that is, if allocation is independent of team performance. Vrooman (1995, 2000) similarly argues that the sharing of gate (and other "winning-elastic") revenues among teams will only depress player costs; league profit is enhanced but CB is unchanged. In contrast, Marburger (1997) and Késenne (2000b) show that revenue sharing can improve CB under the assumption of profit maximization. In essence, they argue that while the net

[3] The typical treatment assumes that all teams share the same proportion of their home gate receipts, that is, a certain percentage α is retained by the home team and the remainder $(1 - \alpha)$ goes to the visiting team.

effect is a decrease in the demand for labor (and thus player salaries), large teams are affected more negatively than small teams, altering the distribution of talent that obtains in equilibrium. Atkinson, Stanley, and Tschirhart (1988) consider a pool sharing arrangement and conclude that revenue sharing can improve balance. Their model also predicts that revenue sharing depresses player salaries.

More recent additions to the theoretical literature on the IP and revenue sharing also make the profit maximization assumption but take a slightly different approach. These studies employ a model based on contest (tournament) theory, which differs from the standard model, primarily with respect to the way Nash equilibrium concepts are applied.[4] Using the contest model, Szymanski (2003b; 2004) and Szymanski and Késenne (2004) show that, contrary to the IP, gate sharing worsens CB; talent investment is reduced in general, and the effect is greater for the weaker-drawing team, resulting in greater imbalance. However, if league-level revenue, such as broadcasting, is distributed to teams based on performance (i.e., winning percentage), CB can improve; in this case, investment in playing talent increases and league profit is reduced (Szymanski, 2003b). Using the same contest-Nash strategy, Késenne (2005) also considers a pool sharing arrangement and shows that it, too, worsens CB.

Starting from the win maximization hypothesis, Késenne's (1996; 2000b) model shows that gate sharing results in a more equal distribution of playing talent. As revenues are shared more equally, CB improves because large clubs hire less talent and small clubs hire more. In addition, revenue sharing in a win maximization league does not necessarily lower the cost of playing talent and can increase the player salary level. In

[4] The tournament model is probably most appropriate when similar leagues compete against one another for players (e.g., European soccer).

his analysis of the balance and salary impacts of different revenue sharing systems, Késenne (2001) shows that, for similar reasons, a pooling system also improves CB and increases the average salary level.

Of the CB remedies, revenue sharing has received the least empirical attention. The effect of the policy on CB, and thus the validity of the IP, has been implied, not tested directly. In the context of MLB, Lewis (2008) employed a dynamic decision-making model and concluded that the adoption of progressive revenue sharing reduced small-market teams' incentives to invest in talent and increase local revenues by winning. Maxcy (2009) looked at the effect of MLB revenue sharing on player transfers. His results indicate that revenue sharing significantly altered the flow of talent away from low-revenue teams. Given that league-wide transfer rates increased in the post-implementation period, the implication is that the policy has had an adverse effect on CB. Similarly, Schmidt (2014) finds that revenue sharing increased player movement (roster turnover). In the NFL, Atkinson et al. (1988) found that revenue sharing has moved the league toward greater balance. The empirical analysis also confirms their theoretical prediction that revenue sharing depresses player salaries—the equilibrium wage rate is below the rate that prevails in the absence of revenue sharing. Finally, some conflicting evidence comes from the time series work, which supports the IP for both of the leagues (Fort & Lee, 2007; Lee & Fort 2005).

In sum, the varied and often contradictory predictions of the theoretical literature suggest that the IP, which states that revenue sharing leaves league balance unchanged, does not hold. However, as Késenne (2001) comments, for the case of gate sharing in a profit maximizing league the IP is probably not far off the mark. It appears that a number of questions remain to be answered empirically, and thus further empirical work is needed.

4. THE NATIONAL BASKETBALL ASSOCIATION

The NBA was founded at the Commodore Hotel in New York on June 6, 1946 as the Basketball Association of America (BAA). The league was initially comprised of 11 teams competing in two divisions (East and West). Three seasons later, in 1949, the BAA absorbed six surviving teams from the Midwest-based National Basketball League and became the NBA. The NBA generally continued to expand between 1949 and 1975 and in June of 1976 the modern era of the league began when the NBA merged with North America's other principal league, the American Basketball Association (ABA). With the NBA-ABA merger, four teams from the disbanded ABA were absorbed by the NBA starting with the 1976–77 season, resulting in a total of 22 teams. Today, the NBA consists of 30 teams, 29 in the U.S. and one in Canada, with each assigned to one of six divisions within two conferences (Eastern and Western).

In 2014–15, the NBA's total annual revenue was an estimated $5.2 billion (Badenhausen, 2016). This figure will soon grow substantially as media rights revenue will increase nearly threefold, from $930 million to $2.67 billion annually, starting with the 2016–17 season (Lombardo & Ourand, 2014). Team revenue estimates range from $307 million (New York Knicks) to $127 million (Philadelphia 76ers) with an average of about $173 million (Badenhausen, 2016). On the cost side, team payrolls for the 2015–16 season ranged from $108.3 million (Cleveland Cavaliers) to $61.7 million (Portland Trailblazers) with an average of about $79 million (USA Today Sports, 2016). The average salary was about $5 million in 2014–15, but that number is expected to exceed $6 million in 2015–16 (Badenhausen, 2016). The league's highest paid player (base salary), Kobe Bryant, received $25 million in 2015–16.

The NBA has, over the years, implemented a variety of collectively-bargained policies intended to control costs and enhance CB, including several that were the first of their kind (e.g., a payroll cap). Despite a history of innovative CB remedies, empirical evidence suggests that the NBA has persistently been the most imbalanced North American league (Fort & Quirk, 1995; Vrooman, 1995, 2009; Zimbalist, 2002; Berri et al., 2005, Rockerbie, 2016). Indeed, it appears that "the NBA has achieved much less parity over the last three or four decades than its North American competitors", an observation that Rockerbie (2016) refers to as "the NBA anomaly" (p. 287).

The NBA also has an inter-conference balance problem.[5] Since 1999–2000, the first full season after an owner-imposed lockout in 1998–99, inter-conference play has been decidedly one-sided. Over that 16-year span, teams the Western Conference hold a winning percentage of 57.4% against their Eastern Conference rivals. The imbalance is persistent with the Eastern Conference winning more games against Western opponents only once (2008–09). Moreover, Western teams captured 11 of the 16 NBA championships in this period. Although this East versus West disparity has caught the attention of team owners and sportswriters, the issue has not been addressed by academic researchers.

A Concise History of Collective Bargaining in the NBA

Prior to 1976, the NBA had what amounted to a reserve clause; all standard player contracts contained a one-year option clause that bound players to their current team for the year following the expiration of their contracts. If a player and his team could not agree on terms when the player's contract expired, the team had the right to renew the

[5] Each team plays every member of the other conference twice (one home and one away), which results in a total of 30 interconference games per 82-game season.

contract for an additional year on the same terms (Goldberg, 2008). The clause therefore appeared to be a one-time option, but player mobility was stifled by a complex compensation (or arbitration) system that discouraged teams from signing free agents (Goldberg, 2008). This system featured an "equalization" rule similar to the NFL's "Rozelle Rule," which stipulated that if a free agent signed with a new team, the acquiring team had to compensate the former team via cash, current players, draft choices, or some combination of the three (Berry, Gould, & Staudohar, 1986). If the two teams could not agree on the amount or type of compensation, the matter went to arbitration and the league commissioner, as the arbitrator, determined the compensation.

The 1976 and 1980 CBAs and the Advent of Free Agency

In *Robertson v. NBA*, which was originally filed in 1970, the players challenged, under U.S. antitrust laws, the legality of several league restraints that limited player movement. These included the reserve clause, uniform player contract, and college draft. The case was also aimed at blocking the NBA-ABA merger, which the players argued would result in a professional basketball monopoly (Berry et al., 1986). In 1976 the NBA and the NBPA entered into a court-approved settlement agreement which expired at the end of the 1986–87 season (Hertz, 1995). Concurrent with the *Robertson* settlement, the NBA and NBPA signed a multiyear CBA that included the substantive terms of the settlement agreement and expired on June 1, 1979 (Hertz, 1995).

The settlement and 1976 CBA eliminated the option clause from all non-rookie contracts, instituted a right-of-first-refusal system, and phased out the system of compensation and arbitration that was used when a team signed another team's free agent (Goldberg, 2008). Indeed, the 1976 CBA created a new system of free agency that was enacted via a two-stage process. First, for an initial five-year period (i.e., until the end of the 1980–81 season), the direct compensation system continued for free agents. Then, until the end of the 1986–87 season, a second system was utilized whereby a free agent's current team had the right of first refusal, that is, the right to match any offer the player received. Prior to the second stage, in 1980, the two parties signed a two-year CBA that revamped some of the 1976 CBA provisions but did not alter the free agency compensation procedures due to the prior agreement (Berry et al., 1986).

The 1983 CBA and the Payroll Cap

The 1980 CBA expired in June of 1982, but play continued and the 1982–83 season began without a new agreement.[6] After the two sides clashed in a series of heated negotiations, a four-year agreement was eventually reached in March of 1983 (Berry et al., 1986). The 1983 CBA was groundbreaking in professional sport because it included a payroll cap. The cap, effective starting with the 1984–85 season, limited the amount each team could spend on player salaries and benefits to 53% of league revenues divided by the number of teams in the league (Foraker, 1985).[7] Thus, in exchange for a cap, players received a guaranteed percentage of the NBA's defined gross revenue, which is referred to as Basketball Related Income (BRI). The new agreement also included a salary floor (i.e., a minimum team payroll) and, importantly, several exceptions that meant the NBA's cap was "soft". The most egregious exception was the Bird exception,

[6] According to old agreement, if new agreement was not reached by expiration date, the old agreement remained in effect until a new agreement could be reached.

[7] Technically, team payroll was limited to "the greater of either a fixed sum of $3.6 million in 1984-85, $3.8 million in 1985–86, and $4 million in 1986–87, or fifty-three percent of the league's gross revenues divided by the number of teams in the league" (Foraker, 1985).

which permitted a team to exceed the salary cap in order to re-sign its own free agents (NBA-NBPA, 1995).

The 1988 CBA and Unrestricted Free Agency

After the 1983 CBA expired following the 1986–87 season, the players "re-challenged the college draft, the right of first refusal, and the salary cap on antitrust grounds without success" (Hertz, 1995, p. 253). Therefore, the 1988 CBA preserved the draft, the right of first refusal, and the salary cap guaranteeing the players 53% of the league's revenues. Notably, however, the right of first refusal was eliminated for players with seven or more years of service who had completed two NBA contracts (Levine, 1995). This meant that veteran players became unrestricted free agents when their second contract expired.

The 1995 CBA

After the 1988 CBA expired in June of 1994, both sides avoided a work stoppage by reaching a no-strike, no-lockout agreement that effectively extended the 1988 CBA through the 1994–95 season (Hertz, 1995). Accordingly, play continued in 1994–95 under the previous agreement with the hope that a new deal could be reached during the season. A tentative agreement between the league and the players' association was reached in June of 1995, shortly after the season had ended. However, a number of players who objected to the proposed agreement attempted to decertify the union and a decertification election was scheduled for September 1995 (Staudohar, 1999).[8] The league responded by locking out the players and making a revised proposal that was "more attractive to the dissident players" (Staudohar, 1999, p. 4). The league's tactics

[8] The intent of decertifying was to end the collective bargaining relationship and make the league vulnerable to antitrust litigation.

proved successful, as the players voted against decertification and the two sides ratified the CBA. The lockout was lifted and the 1995–96 season proceeded without any games being lost.

The final agreement again contained elements for both sides. The owners received a strict rookie wage scale that specified the salaries of all first-round draft picks for each of their first three seasons. The players retained the all-important Bird exception, and, importantly, the agreement eliminated restricted free agency and the right of first refusal for all but the least-experienced players. Indeed, players would become unrestricted free agents upon completion of their first NBA contract (Levine, 1995; NBA-NBPA, 1995).

The 1998–99 Lockout and the 1999 CBA

The agreement reached in 1995 contained a provision that allowed the owners to reopen negotiations after the third year if player salaries exceeded 51.8% of BRI (NBA-NBPA, 1995). Because the players had received about 57% of league revenue during the 1997–98 season, well above the required 51.8%, the league exercised its option to reopen the 1995 CBA following the 1997–98 season (Staudohar, 1999).[9] Salaries had indeed grown considerably, and the owners were determined to obtain a hard salary cap, that is, to eliminate the exceptions that prevented the cap from containing player salaries (Staudohar, 1999). Because the league had recently signed a new four-year TV contract that would boost teams' revenues considerably, the players refused to accept a hard cap and the league initiated a lockout on July 1, 1998 (Staudohar, 1999).

[9] The league also claimed that nearly half of its 29 teams were losing money (Staudohar, 1999).

The lockout dragged into early 1999, resulting in the loss of 32 games. An agreement was eventually reached and a new six-year CBA went into effect prior to the start of the shortened (50-game) 1998–99 season, which officially began on Feb. 5, 1999. Concessions were made on both sides. The owners dropped their insistence on a hard cap in exchange for other cost-control mechanisms, most notably a cap on individual player salaries, a first for professional sport.[10] The league also achieved its goal of implementing a luxury tax.[11] If the penalty threshold was in effect after a given year and a team's payroll exceeded the threshold, the team would be assessed a tax equal to 100% of the overage (NBA-NBPA, 1999). The players were guaranteed 55% of league revenues, the Bird exception was maintained, and additional exceptions to the cap were added.

The 2005 CBA

Under the terms of the 1999 CBA, the NBA had the option to extend the agreement for one additional year, which it exercised. Accordingly, the extended 1999 CBA expired in June of 2005. Negotiations caused some delays to the start of the free agent signing period, but the two sides avoided a work stoppage and a new 6-year deal was signed on July 30, 2005. The principal points favored by the owners included a controversial increase in the player age minimum (from 18 to 19 years) and reductions in maximum contract lengths and annual salary increases. The players were guaranteed a higher percentage of BRI (57%) than they had received under the previous agreement.

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[10] The maximum salary limits varied according to years of league service and players who already made more than the new maximums had their salaries protected by a grandfather clause (Staudohar, 1999).

[11] The luxury tax was part of a complicated system that featured escrow, tax, and distribution components (see, for example, Kaplan, 2004).

The 2011 Lockout and the 2011 CBA

The league again had the option to extend the 2005 CBA for one additional year, through the 2011–12 season, but chose not to exercise it. Negotiations, which had begun in the summer 2009 when the league notified the players' union of its decision not to extend, intensified during the 2010–11 season. The focal point of the discussions was how to divide the league's BRI and, claiming that it had lost money every year under the recently expired CBA, the league was intent on obtaining a greater share of league revenues (Staudohar, 2012). With no agreement in sight when the extended 2005 CBA expired on June 30, 2011, the owners immediately initiated a lockout on July 1.

In November of 2011, the players dissolved the union and filed a federal antitrust lawsuit challenging the legality of the lockout (Staudohar, 2012). With the entire 2011–12 season in jeopardy due to the lengthy nature of court proceedings, the two sides made a last-ditch negotiation effort and about two weeks later reached an agreement that settled the players' lawsuit. The players' union was re-formed and a new, 10-year CBA was signed on December 8, 2011. The 161-day lockout resulted in a shortened (66-game) 2011–12 season that officially began on Christmas Day.

The 2011 agreement called for a 50-50 split of BRI, a clear victory for the owners given that players had received 57% under previous deal.[12] The owners also secured a more punitive and progressive luxury tax system and additional reductions in maximum contract lengths and annual salary increases. While the 2011 agreement heavily favored the owners, the players' negotiators won concessions that relaxed the trade rules and the regulations on restricted free agents (Coon, 2011). It is also important to note that,

[12] More specifically, players receive between 49 and 51 percent of BRI depending on whether the league exceeds or falls short of projections (NBA-NBPA, 2011).

concurrent with the 2011 CBA, the owners agreed to institute a revenue sharing system that would be fully implemented by the 2013–14 season.

5. ESSAY ONE: INSTITUTIONAL CHANGE AND COMPETITIVE BALANCE IN THE NBA

The IP suggests that the distribution of talent in a sports league is invariant to changes in property rights. Most of the empirical IP treatments are related to the advent of free agency in MLB, that is, whether player mobility or CB was altered by the abolition of the reserve clause for veteran players in 1976. Much less attention has been paid to the effects of other league policies and the other North American leagues. Furthermore, those who have examined other institutional changes and league contexts also focused on prominent all-or-nothing cases, such as the introduction of the rookie draft in MLB and the advent of free agency and a payroll cap in the NFL. Further empirical work is needed regarding the effects of more recent policy changes that are less representative of natural experiments.

The NBA is an ideal candidate for further investigation. Despite a history of innovative institutional changes ostensibly enacted to enhance CB, the NBA has persistently been the most imbalanced North American league (Fort & Quirk, 1995; Vrooman, 1995, 2009; Zimbalist, 2002; Berri et al., 2005, Rockerbie, 2016). Balance at the conference level may also be a concern; for example, only five different teams have won the last 17 Western Conference championships, and two of those teams account for 12 of the 17. It is surprising, then, that the empirical research related to league labor restrictions and invariance in the NBA is limited. Furthermore, few of the studies that have been conducted tested policy efficacy directly; the evidence is largely limited to plausible explanations for an observed lack of change, or reduction, in long-term balance.

A notable exception is Maxcy and Mondello's (2006) attempt to isolate and directly assess the impacts of multiple policies on NBA CB over time.

The motivation for this paper is to contribute an up-to-date, comprehensive examination of the effects of prominent league labor policies on CB in the NBA. The primary goal is to assess the validity of the IP by determining whether these policies have had a causal, statistically significant impact over time. This paper is also the first to analyze CB at the conference level as well as the league level. The idea here, of course, is that the policy changes may have affected the two conferences differently.

Background and Literature Review

As discussed in Section IV, since the modern era of the NBA began in 1976, the league has enacted a number of collectively-bargained policies including (unrestricted) free agency, a team payroll cap, an individual salary cap, a luxury tax, and revenue sharing. In addition to these changes, the league's reverse-order rookie draft system was also substantively altered twice during the sample period. In 1985, a lottery system was introduced whereby all non-playoff teams had an equal chance of drawing one of the first 11 picks (this was changed to the first three picks in 1987). A weighted lottery was introduced in 1990, which gave the team with the worst record the highest probability of receiving the first pick. As with the previous system, only the first three picks were determined by the lottery. In both cases, after the lottery picks were assigned, the remainder of the selections were determined in reverse order of finish.

Summary of Theory

The IP and predictions of the recent theoretical models are discussed in Section III. It is worthwhile, however, to reemphasize a few of the main points here. Consistent with the IP, the advent of free agency is expected to have no effect on CB assuming a well-functioning transfer market. The IP is not expected not to hold for payroll caps, which, if strictly enforced, are likely to improve balance. The same can be said for luxury taxes—if strictly enforced and if the threshold is sufficiently binding for large-market teams, CB is expected to improve. In both cases, however, loopholes and exceptions will lessen the effectiveness of the policies. Theoretical treatments of individual salary caps, while few in number, suggest that an individual cap has no impact on or decreases league balance. Lastly, CB is generally expected to be invariant to local revenue sharing in a profit-maximizing league but in a win-maximizing league revenue sharing improves balance.

Empirical Evidence

The NBA IP literature has primarily examined the imposition of the salary cap, which started with the 1984–85 season. Fort and Quirk (1995) used two different CB measures and found that, depending on the measure, league-wide CB either did not change or declined after the salary cap was implemented. Their reasoning was that equal spending had not materialized because of exceptions to, and loopholes in, the cap agreement. Similarly, Endo, Florio, Gerber, and Sommers (2003) found that there was no statistical change in CB in the post-1984 era. Vrooman (1995) considered league balance between 1970 and 1992 and concluded that “there is no tendency for this balance to be increased by the imposition of the salary cap in 1984” (p. 984). A later study by Vrooman (2009) suggests that the NBA became less balanced after the cap was implemented (i.e., during the 1984–95 period). He also notes a shift toward greater balance starting in 2002–03, which he attributes to the effects of the luxury tax. Finally, Maxcy and Mondello (2006) considered the effects of several changes in league policy from 1951 to 2004. Although the emphasis is on the advent of free agency (specified as the 1978–1982 period), there is some evidence that the imposition of a payroll and individual salary cap resulted in greater imbalance. Specifically, they reported a significant decrease in year-to-year CB for both a cap on team payrolls and the combination of a payroll cap and an individual salary cap.

The so-called "break point" literature, which seeks to determine whether structural breaks in time series CB measures correspond to changes in league policy, has also considered the NBA. Fort and Lee (2007) employed two different measures and found that both indicated a worsening underlying trend in CB over the 1946–2003 period. The authors also found that there were improvements in CB after the two break points detected at 1972 (with a 90% confidence interval of 1970–76) and 1997 (confidence interval of 1995–99). They surmise that the improvement in CB that followed the first break point was the net result of several factors that both improved (e.g., relocations, the 1976 NBA-ABA merger) and reduced (e.g., expansion, the 1976 TV rights "explosion") balance. Similarly, the net improvement in CB after the second break point was likely due to expansion (negative effect), the 1999 CBA and its harder salary cap (positive effect), and an influx of international players (positive effect). Consequently, there was no evidence that CB was impacted by the advent of the draft, free agency, or the salary cap.

Methodology

With the exception of the time series work, the majority of studies have compared CB, statistically or observationally, before and after a specific policy change (e.g., the advent of the payroll cap). Because the goal here is to examine the balance effects of a number of league policy changes over time, I employ a time series econometric model that regresses both within- and across-season measures of CB on variables capturing the policies and other controls. This essay therefore builds on the work of Maxcy and Mondello (2006), who used a similar methodology in their study of several North American leagues. I focus on the modern era of the NBA and examine balance at the conference level as well as the league level.

Competitive Balance Measures

Researchers analyzing CB have employed a variety of metrics including the standard deviation of win percentages, Gini coefficients, and the Herfindahl-Hirschman Index (HHI) of, for example, the concentration of league championships. There is no single, correct measure, and the different measures have allowed researchers to evaluate different research questions (Fort & Maxcy, 2003). In this study, I employ two widely-accepted measures to analyze CB, the Ratio of Standard Deviations (RSD) and Spearman's rank correlation coefficient (SRCC). These two measures, it should be noted, are also the ones used by Maxcy and Mondello (2006).

The first measure, RSD, is the ratio of the actual to the ideal standard deviation of win percentages (also called the Noll-Scully Ratio); it is an intraseasonal-measure of the dispersion of the teams' win percentages in a given year. A ratio equal to 1 indicates perfect parity. The larger the ratio, the greater the competitive imbalance. Because RSD does not capture changes in the relative standing of the teams over time, a second measure, SRCC, is also employed. SRCC is an interseasonal measure of the year-to-year changes in team standings. The possible values of the coefficient range from −1 to 1 with a value of 1 indicating no change in the standings from the previous season and a value of −1 indicating a complete reversal of standing.

Figures 1.1 and 1.2 present CB over time, as measured by RSD, for the league and the two conferences, respectively. In similar fashion, Figures 1.3 and 1.4 show the second balance measure, SRCC, over time for the league and the two conferences. It is clear from the league charts (Figures 1.1 and 1.3) that there is considerable year-over-year variation in both CB measures and that NBA is an imbalanced league (mean League RSD = 2.758, mean League SRCC = 0.637). The conference charts (Figures 1.2 and 1.4) show considerable variation overall and the conference balances rarely move in the same direction at the same time. The conference CB correlations are rather low, 0.241 and 0.069 for RSD and SRCC, respectively. This conference-level variation in CB is consistent with the notion that league policy has affected the two conferences differently.

Figure 1.1. League RSD

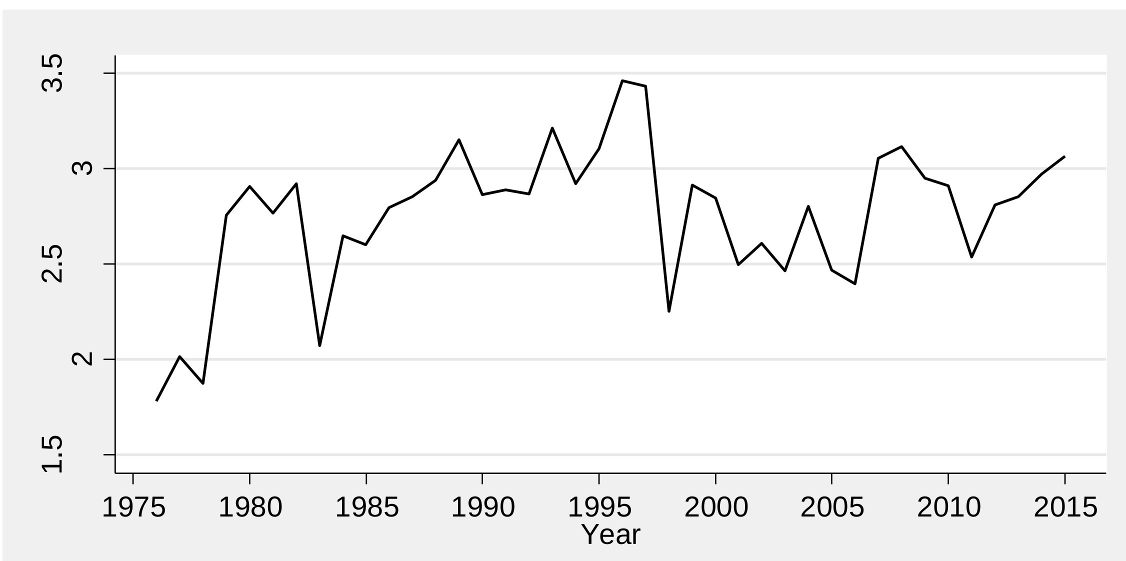


Figure 1.2. Conference RSD

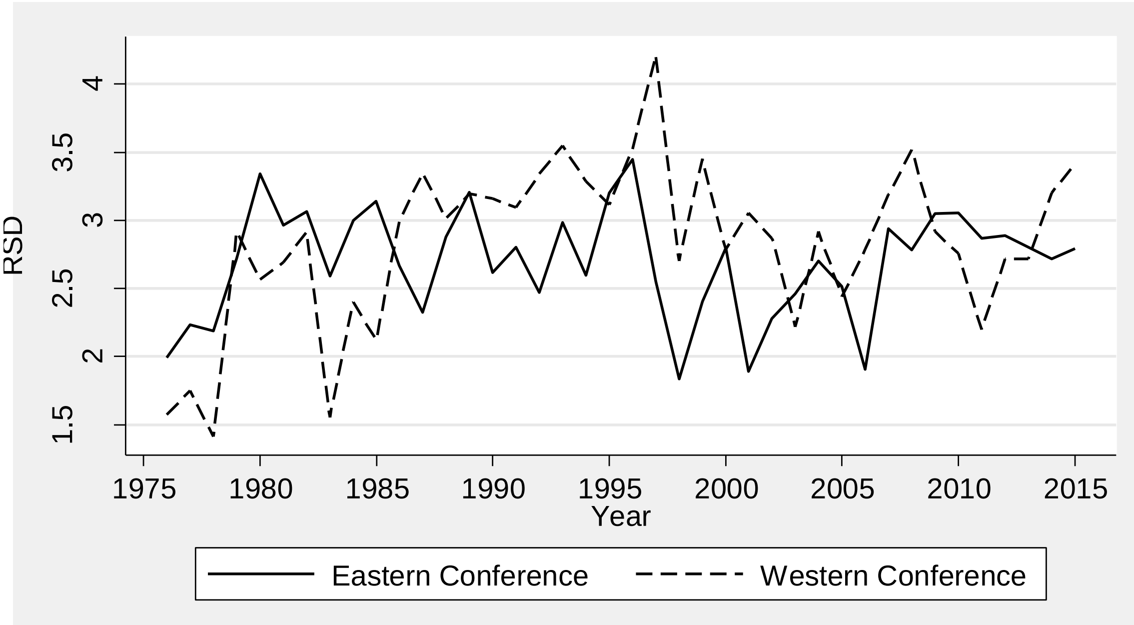


Figure 1.3. League SRCC

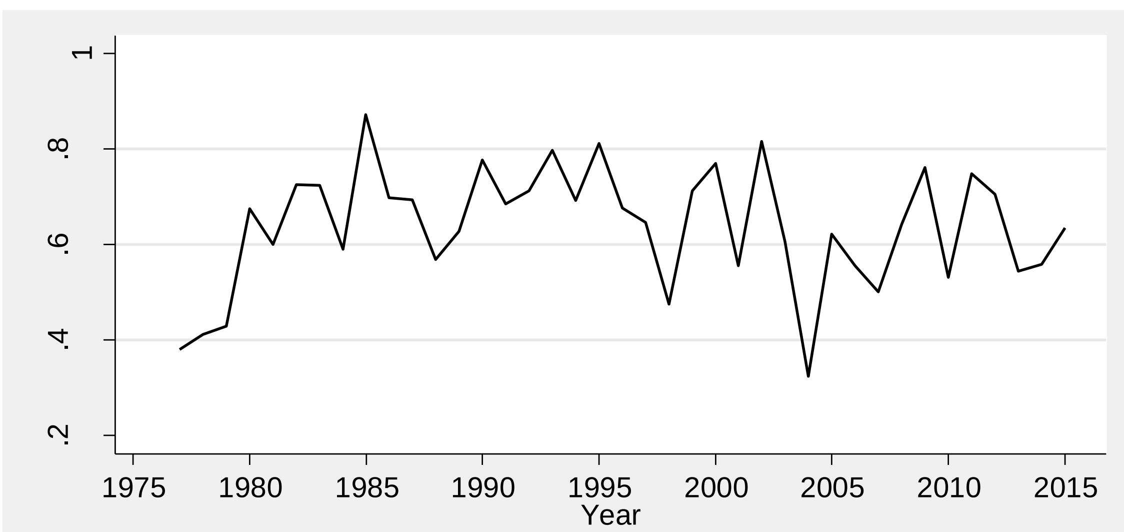
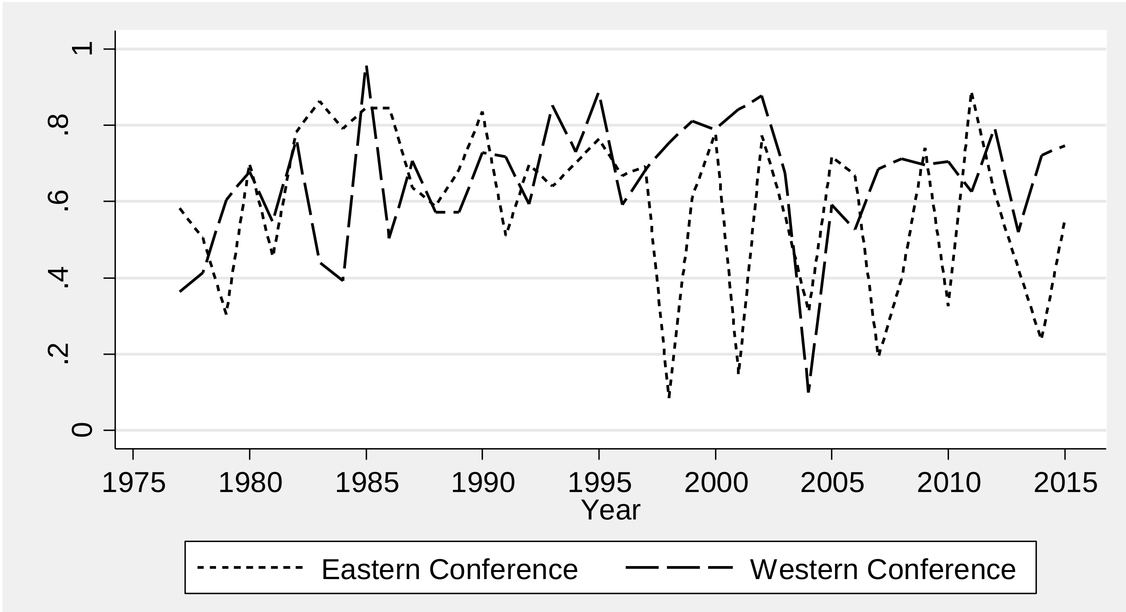


Figure 1.4. Conference SRCC



Empirical Models and Estimation

The primary model, Model 1, is a linear model of the determination of CB:

$$CB_{it} = \boldsymbol{X}_{it}\,\boldsymbol{\beta} + \gamma t + u_{it} \qquad (1)$$

where CB_{it} is the balance measure, *i* indexes "league" (*i* = NBA, Western Conference, Eastern Conference), *t* indexes season, $\boldsymbol{X}_{it}$ is a vector of policy-related variables that affect league balance, γt is a time trend, u_{it} is a random error term, and the vector $\boldsymbol{\beta}$ is comprised of the unknown parameters of interest.

First, Equation 1 was separately estimated via OLS for each of the six dependent variables, which correspond to the different balance measure-league pairings:

i) League RSD (LRSD),

ii) Western Conference RSD (WRSD),

iii) Eastern Conference RSD (ERSD),

iv) League SRCC (LSRCC),

v) Western Conference SRCC (WSRCC), and

vi) Eastern Conference SRCC (ESRCC).

Although the figures do not provide visual evidence of a trend in CB, a trend variable is included in the model because Fort and Lee (2007) reported a worsening trend in NBA league balance over time (1946–2003) and because estimates of the equation $CB_t = a + bt + u_t$ showed that the coefficient on time (b) was significant at the 5% level for two of the variables (*LRSD*, *WRSD*) and at the 10% level for one of the variables (*ESRCC*).

Second, because the current distribution of talent may depend on the previous years' distribution, I also considered a dynamic specification of the primary model. Model 2 is a first-order autoregressive model that includes a lagged value of the dependent variable:

$$CB_{it} = \delta CB_{it-1} + \boldsymbol{X}_{it}\boldsymbol{\beta} + \gamma t + u_{it} \qquad (2)$$

As with Model 1, Equation 2 was separately estimated for every balance measure-league pairing. Tests confirmed stationarity for all six of the dependent variables used in the two models; augmented Dickey-Fuller and Phillips-Perron tests both rejected the null hypothesis of a unit-root process. Both models were also tested for the presence of first-order serial correlation. In the case of Model 1, Durbin-Watson and Breusch-Godfrey tests both failed to reject the null hypothesis of no serial correlation for all six dependent variables. Similarly for Model 2, which contains the lagged dependent variable, Breusch-Godfrey tests failed to reject the null of no serial correlation. Thus, OLS provides consistent estimates in both cases.[13] Finally, evidence of heteroskedasticity was found for both models, so the Huber-White estimator was used.

Data and Independent Variables

The data covers the period 1976–77 through 2015–16. The start date corresponds to the start of the current era of relative stability for the NBA, which had undergone a number of significant changes since it was officially formed (as the BAA) in 1946. Indeed, the league took its current shape, albeit with fewer teams, and eliminated competition from rival leagues when it merged with the ABA following the 1975–76 season. While my goal was to include all notable policy and institutional changes that occurred over this 40-year period, parsimony was also important given the small sample size.

The independent variables are dummy variables indicating the seasons marked by:

- Expansion (with accompanying expansion drafts, 1980, 1988, 1989, 1995, 2004)
- Payroll cap (1984–present)
- Individual salary cap and the luxury tax (1998–present)
- More punitive luxury tax system and revenue sharing (2011–present)
- Lottery draft (1985–present)
- Free agency 1 (veterans unrestricted, 1988–1994)
- Free agency 2 (in its modern in form, 1995–present)

Concurrent with the 2004 expansion, the NBA underwent a realignment that went into effect starting with the 2004–05 season. The Charlotte Bobcats were added to the

[13] For the sake of comparison, Model 2 was also estimated using the Newey-West variance estimator (which is consistent in the presence of autocorrelation) but the results are not included here because there were no meaningful differences.

Eastern Conference and the New Orleans Hornets moved from the Eastern Conference to the Western Conference. Also, the advent of free agency in 1988 coincided, approximately, with an April 1989 ruling by the Fédération Internationale de Basketball (FIBA) that prompted an influx of international players into the NBA. FIBA voted to allow professionals to compete in FIBA competitions including the Olympics, which meant that international players could play in the NBA without being disqualified from representing their countries in international events (Eschker, Perez, & Siegler, 2004).

The list does not include relocations (there were no contractions) and seasons shortened by work stoppages. Although there were some relocations during the period, they do not affect the number of teams in the league and all changes in conference affiliation are captured in the dataset. Similarly, shortened seasons should not have an impact as the idealized standard deviation accounts for the number of games played.

Results and Discussion

The results of Model 1 are presented in Table 1.1. For both CB measures, a positive coefficient estimate indicates the policy decreased balance. Overall, there is no evidence that the payroll cap improved CB, a finding that agrees with several of the prior empirical studies (Endo, et al., 2003; Fort & Lee, 2007; Fort and Quirk, 1995; Vrooman, 1995). This no-effect result suggests that either the IP holds (contrary to expectation) or the numerous exceptions allowed by the NBA’s soft cap hinder its efficacy. There is also no evidence that free agency affected CB, a finding that supports the IP.

Looking first at *RSD*, expansion decreased CB in the Eastern Conference but not in the Western Conference. The estimates also indicate that the combination of a cap on individual salaries and a luxury tax has improved balance for the league as a whole as well as for both conferences. This is not surprising given that the Bird-type exceptions allow teams to exceed the cap in order to re-sign a free agent, but the player's new salary is still counted toward the team salary and can thus cause the team's payroll to exceed the tax level. Some further, albeit weaker, support for the effectiveness of the luxury tax at the league level comes from the coefficient estimate for the more punitive luxury tax system (and revenue sharing), which indicates an improvement in balance but is only significant at the 10% level. Lastly, consistent with previous studies, the time trend (coefficient on Year) suggests worsening CB during the period for both the league and the Eastern Conference.

Table 1.1

Results of Regression Analysis for Model 1, Effects of League Policy on Competitive Balance

	RSD						SRCC					
	LRSD		ERSD		WRSD		LSRCC		ESRCC		WSRCC	
Variable	*B*	*SE B*	*B*	*SE B*	*B*	*SE B*	*B*	*SE B*	*B*	*SE B*	*B*	*SE B*
Expansion	0.208	(0.125)	0.488***	(0.140)	-0.022	(0.167)	-0.063	(0.087)	-0.014	(0.075)	-0.138	(0.154)
Payroll cap	0.048	(0.180)	0.119	(0.137)	0.012	(0.284)	0.006	(0.068)	0.176	(0.107)	-0.144*	(0.073)
Individual cap and luxury tax	-0.990***	(0.226)	-0.975***	(0.341)	-1.106***	(0.386)	-0.147	(0.106)	-0.255	(0.173)	-0.025	(0.137)
Punitive tax and revenue sharing	-0.330*	(0.174)	-0.269	(0.205)	-0.467	(0.331)	-0.000	(0.094)	0.025	(0.197)	0.059	(0.098)
Lottery draft	-0.006	(0.058)	-0.425	(0.259)	0.332	(0.322)	0.158**	(0.060)	-0.022	(0.075)	0.345***	(0.123)
Free agency 1	-0.098	(0.126)	-0.397	(0.289)	0.184	(0.355)	-0.058	(0.083)	-0.125	(0.131)	0.032	(0.139)
Free agency 2	-0.021	(0.250)	-0.487	(0.441)	0.334	(0.509)	-0.054	(0.130)	-0.098	(0.205)	0.113	(0.193)
Year	0.053***	(0.019)	0.068***	(0.020)	0.047	(0.030)	0.003	(0.009)	0.004	(0.018)	-0.007	(0.008)
Constant	-103.104***	(37.371)	-131.839***	(40.131)	-90.449	(59.304)	-5.588	(17.414)	-6.377	(34.905)	14.379	(14.881)
N	40		40		40		39		39		39	
R^2	0.597		0.477		0.529		0.254		0.225		0.255	

$^{***}p < .01$. $^{**}p < .05$. $^{*}p < 0.1$.

Turning to the results for *SRCC*, the season-over-season balance measure, the policy variables have less explanatory power than they did for *RSD*—the R^2 values are considerably lower. Even so, the findings suggest that the imposition of the lottery draft worsened CB for the league as a whole and for the Western Conference. Thus, by this measure at least, it appears the lottery draft, which, like all rookie drafts, was primarily designed to place the best entering players onto the prior season's worst-performing teams, has actually resulted in greater seasonal imbalance.

The results for Model 2, which included a lagged value of the dependent variable, are displayed in Table 1.2. None of the lagged dependent variable values are significant at the 5% level (the $ESRCC_{t-1}$ coefficient is significant at 10%). By and large, the estimates are very similar to those of Model 1. The only notable difference between the two models is that, unlike Model 1, Model 2 provides some evidence that the payroll cap affected conference-level CB, as measured by *SRCC*, and that the policy had a different effect on the two conferences. Indeed, the payroll cap decreased balance in the Eastern Conference and increased balance in the Western Conference. This result is the strongest evidence that league policies have affected the two conferences differently.

Table 1.2

Results of Regression Analysis for Model 2, Effects of League Policy on Competitive Balance

	RSD						SRCC					
	LRSD		ERSD		WRSD		LSRCC		ESRCC		WSRCC	
Variable	B	SE B	B	SE B	B	SE B	B	SE B	B	SE B	B	SE B
Lagged dependent variable	0.061	(0.195)	0.063	(0.158)	0.104	(0.184)	-0.006	(0.160)	-0.349*	(0.192)	-0.055	(0.168)
Expansion	0.185	(0.117)	0.472***	(0.135)	-0.046	(0.165)	-0.076	(0.088)	-0.042	(0.063)	-0.154	(0.153)
Payroll cap	0.046	(0.200)	0.109	(0.152)	0.057	(0.317)	-0.015	(0.065)	0.278**	(0.130)	-0.177**	(0.079)
Individual cap and luxury tax	-0.900***	(0.241)	-0.863**	(0.394)	-1.005***	(0.361)	-0.127	(0.110)	-0.331*	(0.176)	-0.002	(0.138)
Punitive tax and revenue sharing	-0.256	(0.177)	-0.208	(0.223)	-0.354	(0.322)	0.025	(0.093)	0.018	(0.194)	0.093	(0.103)
Lottery draft	-0.025	(0.132)	-0.427	(0.258)	0.252	(0.375)	0.164***	(0.059)	-0.035	(0.073)	0.362***	(0.118)
Free agency 1	-0.065	(0.139)	-0.333	(0.310)	0.160	(0.412)	-0.040	(0.083)	-0.176	(0.133)	0.059	(0.137)
Free agency 2	0.046	(0.263)	-0.394	(0.476)	0.352	(0.565)	-0.020	(0.133)	-0.129	(0.200)	0.164	(0.195)
Year	0.044**	(0.019)	0.058**	(0.026)	0.037	(0.029)	0.000	(0.009)	0.004	(0.017)	-0.011	(0.008)
Constant	-85.630**	(36.738)	-112.812**	(51.863)	-72.119	(57.966)	0.344	(17.673)	-6.149	(32.934)	22.106	(15.307)
N	39		39		39		38		38		38	
R^2	0.554		0.459		0.491		0.237		0.313		0.254	

***$p < .01$. **$p < .05$. *$p < 0.1$.

In conclusion, this examination, although limited in scope due to the small sample size, nonetheless provides new and updated information regarding league labor policy and invariance in the NBA. The most robust finding is the improvement in CB associated with the combination of the individual salary cap and the luxury tax. The two effects cannot be separated, unfortunately, but the theoretical prediction—luxury taxes improve balance—receives some support. Collectively, there is no reason to believe that the policies have resulted in greater balance over time, and in fact the analysis suggests an underlying trend of greater imbalance. Importantly, the analysis also shows that the effects of league policies can differ across the two conferences. Understanding why league policies have the potential to affect the conferences differently is a promising avenue for further research.

6. ESSAY TWO: MONOPSONY POWER, WAGES, AND MOBILITY: EVIDENCE FROM THE NBA

In a perfectly competitive labor market, workers are theoretically free to work for any employer and earn a salary commensurate with their MRP (the competitive wage rate). Sports labor markets, however, are not perfectly competitive; all North American leagues employ labor market controls that restrict players' abilities to negotiate with potential employers and receive a wage that approximates their market value. The owners argue that such interventions are necessary, ultimately, to ensure the financial health of the league, which depends on maintaining CB and thus fan interest. The IP, however, suggests that these rules are unlikely to improve CB and instead result in monopsony power and monopsony rents (Rottenberg, 1956).

Since the advent of free agency in MLB in 1976, the empirical research on this issue has largely considered only the all-or-nothing case, e.g., a strict reserve system vs. unrestricted free agency. Indeed, researchers have mainly examined player pay and/or mobility before and after pronounced, abrupt changes to free agency eligibility rules that occurred relatively early in leagues' histories (Maxcy, 2002). Most changes in league labor policy over the past several decades have been incremental, however, and the assignment of property rights is a matter of degree. While a number researchers have studied the effects of MLB's reservation system in more recent periods, such examinations of the other major North American leagues are limited. Furthermore, for all league contexts, the vast majority of the treatments are concerned with players' salaries, not their mobility.

The motivation for this essay is the lack of current empirical evidence of the effects of contracting restrictions on the compensation and mobility of NBA free agents. Accordingly, the goal is to measure the effects of free agent rights on player salaries and, to a lesser extent, player mobility. While the analysis does not constitute a direct test of the IP, the results should shed light on the theorem's validity. This paper is also unique in its methodological approach, which accounts for both the mobility "decision" and wage determination and leverages a panel dataset that spans multiple league policy periods.

Background and Literature Review

Although each North American league has developed its own system of free agency, all maintain what is referred to as a "modified reservation system" that grants free agent rights according to league tenure. As a result, entry-level players are subject to the strictest reservation rules. Theoretically, the IP suggests that policies that reduce the competition for players' services, even by a small degree, suppress player salaries and transfer rents from players to owners. This has generally been borne out by the empirical literature, which has predominantly considered MLB. While a number of early studies showed that monopsony exploitation (i.e., MRP minus salary) largely ended with the advent of unrestricted free agency for veterans in 1976, analyses of later periods suggest that monopsony power persists due to the ongoing contractual arrangements that bind many players, particularly those with little experience. The focus of these more recent studies of free agent rights, however, has been on the wage effects—player mobility has received much less attention. Thus, the more interesting question of whether the IP holds in the case of player movement remains largely unanswered.

Empirical Evidence

The majority of the research pertaining to the IP-related effects of reservation systems has examined salary suppression in professional baseball. These studies showed that, consistent with the IP, players with the least bargaining power are exploited relative to unrestricted free agents (UFAs) and those with some recourse when it comes to salary disputes. The evidence from the other major leagues is less conclusive but generally consistent with that of MLB. Indeed, findings from both the NHL and the NBA indicate that restricted free agents (RFAs) and other reserved players are underpaid and that exploitation falls as players' negotiating freedom increases. The empirical work related to player mobility, while scant, suggests that less restricted players are more likely to transfer.

Several studies of wage determination in MLB have considered the exploitative effects of the league's player reservation system, which defines several player categories and features a salary arbitration process. Generally speaking, free agent rights are conditioned on years of major league service with distinctions drawn between (i) three years or less, (ii) more than three but less than six years, and (iii) six or more years. For the first three years, players are under strict reserve, they cannot negotiate with other teams, and they have no recourse regarding their salaries (they are not eligible for salary arbitration). Players with three to six years of experience are still restricted to their teams but are eligible to submit salary disputes to binding final-offer arbitration.[14] Players with at least six years are eligible for free agency and can market their services to any team.

[14] The player and his team both submit a salary figure and the independent arbitrator must select one figure or the other.

Marburger (1996) compared the salaries of arbitration-eligible players with those of free agents in MLB during the 1991 and 1992 seasons. He found that, controlling for performance and experience, there was no statistical difference between the two groups. He further concluded that, while experience matters, arbitrators attempt to replicate salary determination in the free agent market. Conversely, Krautmann (1999) also considered the early 1990s but took a different empirical approach and found that both types of reserve-clause players were paid less than their market values, with “apprentices” (less than three years of experience) more underpaid than “journeymen” (three to six years). Similarly, Krautmann, Gustafson, and Hadley (2000) found that apprentices (not eligible for arbitration) were underpaid (by about $475,000 on average) when compared to free agents who had similar performance characteristics. The average journeyman (arbitration-eligible player) received a salary that slightly exceeded his value. Finally, Hakes and Turner (2011) analyzed player performance and pay over time and found some evidence that players of all ability levels are underpaid during the years of limited negotiating power (i.e., the first five years) but starting with the advent of free agent eligibility they are paid proportionately to their production.

Two studies of professional hockey present similar findings. Noting that the NHL has a “strong” player reservation system, Richardson (2000) compared players’ salaries to their estimated MRPs to measure the extent of monopsony power in the market. The author considered both free agents and non-free agents and found limited support for the hypothesis that that free agency reduces monopsonistic exploitation. He concluded, however, that in the aggregate there was very little exploitation under the reservation system. Cyrenne (2013) examined players’ mobility as well as their salaries under the

2005 NHL CBA, which defined several player categories of mobility rights. He found that RFAs and UFAs were underpaid (by about 4% and 13%, respectively) relative to "established" players who had signed long-term contracts after time spent as an entry-level player, a RFA, or an UFA. (Interestingly, contrary to the IP, players on entry-level contracts enjoyed a 23% wage premium.) There is also some evidence that mobility was affected by free agent status, namely, UFAs were significantly more likely to change teams.

Consistent with those who have studied the other major North Americans leagues, NBA researchers have most often considered the compensation of restricted players. Scott, Long, and Somppi (1985) applied the Scully (1974) approach to the advent of free agency in the NBA in 1976, which eliminated the option clause on all non-rookie contracts but maintained the direct compensation system for free agents until 1980. Their evidence from a small sample suggests that NBA free agents were exploited prior to advent of (restricted) free agency in 1980, but after 1980 free agents were paid a salary that was in line with their MRP. Using a different approach, Krautmann, von Allmen, and Berri (2009) investigated the underpayment of restricted players in several leagues including the NBA. For the 2005-06 and 2006-07 seasons, they found that restricted NBA players, defined as those with less than four years of league service, were substantially underpaid (the median MRP-wage difference was $732,000), with the typical restricted player receiving about two-thirds of his MRP.

Finally, regarding free agent rights and mobility in the NBA, Eschker et al.'s (2004) study of salary determinants included an explanatory variable indicating whether the player had changed teams between seasons. Changing teams had a significant, negative impact on salary, a finding that the authors state is "consistent with the view that between season player movement may represent a 'market for lemons'" (p. 1016). However, it appears that no distinction was made between free agents and non-free agents. Lin and Chang (2011) considered a sample period encapsulated by a single CBA (2001-02 through 2004-05) and used a probit model to examine the determinants of transfer probability. They found that RFAs and UFAs both had higher transfer probabilities (with UFA > RFA > non-free agents) and rejected the IP on that basis. Here again, however, it is not clear what constitutes a transfer and indeed their analysis shows that the transfer frequency for non-free agents, who by definition were still under contract in the following year and bound to their current team, was about 16%.

Free Agency in the NBA

There are two types of free agents in the NBA, restricted free agents (RFAs), and unrestricted free agents (UFAs). The determining factor is years of service, the number of NBA seasons that a player has played. Generally speaking, a player becomes a RFA at the conclusion of any contract that expires after any of the first three seasons that the player plays in the league.[15] Because most players enter the league via the rookie draft, this usually means that they become RFAs upon completion of their Rookie Scale Contracts, which have a maximum length of four years (including any team option years). Once the designated free agency period begins (typically on July 1) RFAs can negotiate and sign an Offer Sheet with any team, but his current team has the right of first refusal (ROFR); if a RFA signs an Offer Sheet with a new team, the current team (called

[15] Technically, when a player's contract expires, he becomes a RFA if his current team makes a Qualifying Offer; if the team does not make a Qualifying Offer by the start of the free agency period, the player becomes an UFA.

the “ROFR Team”) has a certain number of days to exercise its ROFR by matching the terms of the Offer Sheet. If the current team does not match the Offer Sheet, the player enters into the contract outlined in the Offer Sheet with the new team. UFAs, on the other hand, are free agents who are not subject to a team’s ROFR and are therefore at liberty to negotiate and sign a contract with any team.

The NBA also features a collectively-bargained sign-and-trade rule that allows a team to re-sign its own UFA and immediately trade him to another team. This is accomplished by including a clause stating that the contract becomes null and void if the trade to the specified team is not completed within 48 hours. A number of conditions apply to sign-and-trade agreements including: the contract must be for at least three seasons, the player cannot be (re-)signed pursuant to several of the payroll cap exceptions, the acquiring team must have room for the player’s salary, and the trade must be completed prior to the first game of the season.

Methodology

A detailed panel dataset is used to conduct a thorough analysis of the effects of free agent status on player pay and mobility. Unlike much of the prior research, this study’s empirical work emphasizes the proper treatment of player mobility (i.e., whether the player changed teams) a wage determination setting. The use of panel data to analyze multiple periods of league labor policy is also rare—typically such studies have considered only a single period, that is, they have looked within rather than across regimes. This essay, then, builds on several of the studies surveyed above and particularly Cyrenne’s (2013) paper, which applied a similar methodological approach to the NHL but focused on a single CBA period.

Empirical Models and Estimation

Analysis was conducted in two phases. The first was player wage determination:

$$ln(w_{ijt}) = \boldsymbol{X}_{ijt}\boldsymbol{\beta} + \delta_t + u_{ijt} \qquad (1)$$

where w_{ijt} is the annualized, guaranteed salary of player *i* (adjusted for inflation) as specified by the contract he signed with team *j* (the acquiring team) in year *t*, $\boldsymbol{X}_{ijt}$ is a vector of regressors, and δ_t is a full set of $(T - 1)$ year dummies. The explanatory variables in $\boldsymbol{X}_{ijt}$ can separated into several distinct groups given by the vector ($\boldsymbol{P}_{it}$, $\boldsymbol{T}_{jt}$, RFA_i) where $\boldsymbol{P}_{it}$ is a sub-vector of player characteristics and productivity measures, $\boldsymbol{T}_{jt}$ is a sub-vector of team characteristics and performance measures, and RFA_i is an indicator of free agent status (1 = RFA, 0 = UFA).

I also employ a second model specification, Model 1B, which is identical to Equation 1 and Model 1A except that that it includes two additional regressors, a dummy variable $change_{ijt}$ indicating that player *i* changed teams via free agency between $(t - 1)$ and *t* (i.e., that *j* is a different team) and the interaction variable $RFA_i \times Change_{ijt}$. This step integrates the mobility decision into the wage determination analysis and captures the effects of changing teams for both RFAs and UFAs. The results of this second specification are compared to those of the first, which did not include the changed-teams variables, as well to the findings of prior studies that included a similar variable in their wage determination equation (e.g., Eschker et al., 2004).

The first phase of analysis, then, involves the estimation of both specifications of wage Equation 1 using pooled OLS. Standard errors are robust to heteroskedasticity and clustered on team (*j*).

In the second phase, I extend the empirical work to account for the likely endogeneity of *change*. To this end, I add a second equation, the determination of player mobility:

$$change_{ijt} = \boldsymbol{X}_{ijt}\boldsymbol{\beta} + \delta_t + u_{ijt} \qquad (2)$$

where $change_{ijt}$ is the previously-described binary variable equal to unity if the contract signed by player *i* in year *t* was with a different team and zero if the player re-signed with the same team. Throughout the analysis a sign-and-trade transfer was considered a change of teams.

Together, Equations 1 and 2 were estimated using the two-step treatment-effects (TE) model with Equation 2, a probit model, representing the first stage of the estimator (Maddala, 1983). This TE model, which corresponds to the second phase of analysis, is referred to as Model 2. Because the exogenous explanatory variables are the same for both equations, an instrument is needed for identification. A proper instrument must be endogenous to the mobility equation but largely exogenous to the salary equation. I use a measure of team roster stability that is based on the roster stability variable employed by Simmons and Berri (2011). It is calculated as the average of the percentage of team minutes accounted for by the group of players who appeared for the team in both of the prior two seasons. The argument for roster stability is that it likely affects player movement but is unrelated to player salary.[16]

[16] The literature suggests that roster turnover tends to be higher for teams with a lower win percentage, all else constant, but it is also possible that successful teams, who are more likely to have higher payrolls, may experience roster changes due to payroll cap restrictions.

Data and Variables

The panel dataset starts with the 2000–01 season and goes through the 2010–11 season. Thus, it covers contracts signed under both the 1999 and 2005 CBAs. There are a total of N = 628 observations, 521 UFA transactions and 107 RFA transactions. I included all UFAs and RFAs that met two conditions. The first condition was that the player spent the prior two years in the NBA (i.e., he did not play internationally, in the NBA's development league, and so forth). This ensures that all player performance statistics, important predictors of salary, are based on NBA performance. The second condition is that the player averaged at least 20 games played and 12 minutes per game in each of the prior two seasons. This requirement, adopted by numerous NBA researchers, "eliminates fringe players who contribute little to team wins" (Simmons & Berri, 2011, p. 383).

Descriptive statistics are shown in Table 2.1. The independent variables are player and team characteristics and performance measures that are supported by the previous NBA literature. The player characteristics and productivity measures ($\boldsymbol{P}_{it}$) are:

- Minutes played, points, total rebounds, steals, assists, blocks, turnovers, personal fouls, field goal percentage, and free throw percentage (on a per-game basis, average of the prior two seasons)
- Start ratio (the number of games started divided by the number games played, average of the prior two seasons)

- Experience and experience^2 (NBA years of service and its square)[17]
- Position (1 = Point Guard, 2 = Shooting Guard, 3 = Small Forward, 4 = Power Forward, 5 = Center)

Eschker et al. (2004) showed that there was a considerable premium paid to international players in 1996–97 and 1997–98, but that the premium disappeared starting with the 1998–99 season. Hence, I chose not to include a foreign-born player indicator (e.g., equal to one if the player was born outside the U.S.). Similarly, I considered adding a control for race (e.g., a binary variable equal to one if the player was Black) but, as Eschker et al. (2004) note, several studies of NBA wage determination have shown that the salary gap between African-American and Caucasian players that existed in the 1980s had disappeared by the 1990s.

[17] *Age* and *age*^{2} were initially included in the models (along with *experience* and *experience*^{2}) but they were quickly removed due to collinearity.

Table 2.1

Descriptive Statistics for Variables Used in Regressions

Variable	*M*	*SD*	*MIN*	*MAX*
Annual wage (millions)	5.113	4.499	0.706	22.499
ln(wage)	15.091	0.858	13.467	16.929
Minutes	24.980	7.038	10.898	42.116
Points	9.672	4.839	1.692	29.057
Total rebounds	4.188	2.197	0.796	13.834
Steals	0.808	0.390	0.067	2.598
Assists	2.270	1.751	0.122	9.377
Blocks	0.479	0.521	0	3.006
Turnovers	1.394	0.636	0.323	3.875
Personal fouls	2.238	0.578	0.823	3.873
Field goal percentage	0.449	0.045	0.341	0.625
Free throw percentage	0.749	0.095	0.411	0.932
Start ratio	0.493	0.379	0	1
Experience	7.178	3.697	2	18
Experience^2	65.172	63.349	4	324
Position	2.922	1.444	1	5
Sign-and-trade	0.054	0.226	0	1
RFA	0.170	0.376	0	1
Change	0.596	0.491	0	1
Canadian team	0.027	0.162	0	1
Population (millions)	5.259	4.700	0.943	19.601
Per-capita income (thousands)	42.850	6.859	29.789	65.215
Team win percentage (prior season)	0.529	0.147	0.146	0.817
Postseason (prior season)	0.632	0.483	0	1
League champion (prior season)	0.041	0.199	0	1
Expansion team	0.003	0.056	0	1
New Orleans in Oklahoma City	0.003	0.056	0	1

Note. N = 628.

The acquiring team's characteristics and performance measures ($\boldsymbol{T}_{jt}$) are:

- Canadian franchise indicator
- Population of the metropolitan area (in millions)
- Per-capita income of the metropolitan area (in thousands of inflation-adjusted U.S. dollars)

- Regular season win percentage in the prior season
- Qualified for postseason play indicator (prior season)
- League champion indicator (prior season)
- Expansion team indicator
- New Orleans in Oklahoma City indicator (due to Hurricane Katrina, the New Orleans Hornets were temporary relocated to Oklahoma City for the 2005–06 and 2006–07 seasons)

Population and income data were obtained from the Bureau of Economic Analysis. I considered a variable related to the prior success of the team's head coach (e.g., the number of playoff games or league championships won), but coaching measures have not had a significant effect on wages in similar studies (e.g., Michaelides, 2012). Team willingness to pay (for free agents) was also considered. While there is some precedent for the use of team revenue in the prior year, such variables are only meaningful to the extent that past revenues are indicative of future revenues; what likely matters to teams in this regard is not past revenues but expectations about future revenues.

Results

The results of the first phase of analysis, free agent wage determination without and with *change*, are displayed in Table 2.2. The sign-and-trade and expansion team indicator variables were omitted from Model 1B because of (perfect) collinearity; by definition, a sign-and-trade is a change of teams, and a player must change teams when he joins an expansion team. Similarly, the New Orleans Hornets in Oklahoma City indicator was omitted from Model 1B because it was also equal to one when change was equal to one (i.e., there are no New Orleans/Oklahoma City re-signs in the sample).

All of the player productivity measures have the expected signs—the lone negative coefficient is the one on turnovers, an undesirable statistic. Steals, turnovers, personal fouls, and start ratio do not appear to explain player salaries. It also appears that, taken together, the team-related variables do not explain player compensation; metro area population, per-capita income, win percentage in the prior season, having made the playoffs in the prior season, and being the reigning league champion were generally insignificant.

Table 2.2

Regression Results for Phase 1, Model 1 Specifications

	Model 1A		Model 1B	
Variable	*B*	*SE B*	*B*	*SE B*
Minutes	0.022**	(0.008)	0.022***	(0.008)
Points	0.062***	(0.016)	0.062***	(0.014)
Total rebounds	0.048**	(0.018)	0.057***	(0.018)
Steals	0.130	(0.080)	0.125*	(0.074)
Assists	0.089***	(0.026)	0.080***	(0.025)
Blocks	0.259***	(0.058)	0.198***	(0.068)
Turnovers	-0.147*	(0.084)	-0.139*	(0.082)
Personal fouls	0.057	(0.049)	0.053	(0.047)
Field goal percentage	2.233***	(0.583)	1.938***	(0.543)
Free throw percentage	0.741**	(0.353)	0.737**	(0.338)
Start ratio	0.068	(0.113)	0.062	(0.115)
Experience	0.009	(0.030)	0.016	(0.030)
Experience^2	-0.003	(0.002)	-0.003*	(0.002)
1.Position (PG)	0.093	(0.075)	0.103	(0.071)
3.Position (SF)	0.145	(0.086)	0.113	(0.084)
4.Position (SF)	0.196**	(0.089)	0.199**	(0.092)
5.Position (C)	0.301***	(0.107)	0.323***	(0.103)
Sign-and-trade	0.171**	(0.071)		
RFA	0.167*	(0.086)	-0.092	(0.096)
Change			-0.294***	(0.058)
RFA x change			0.509***	(0.099)
Canadian team	0.256***	(0.059)	0.264***	(0.057)
Population (millions)	0.003	(0.005)	0.005	(0.005)
Per-capita income (thousands)	0.001	(0.003)	0.000	(0.003)
Team win percentage (prior season)	0.219	(0.192)	0.262	(0.205)
Postseason (prior season)	-0.026	(0.067)	-0.050	(0.066)
League champion (prior season)	-0.173	(0.103)	-0.216**	(0.103)
Expansion team	-0.273***	(0.086)		
New Orleans in Oklahoma City	0.489***	(0.127)		
2.Year (2001)	-0.165	(0.130)	-0.208*	(0.115)
3.Year (2002)	-0.407**	(0.168)	-0.382**	(0.149)
4.Year (2003)	-0.360***	(0.123)	-0.343***	(0.114)
5.Year (2004)	0.040	(0.130)	0.028	(0.110)
6.Year (2005)	-0.101	(0.135)	-0.141	(0.123)
7.Year (2006)	-0.112	(0.137)	-0.115	(0.126)
8.Year (2007)	-0.088	(0.139)	-0.098	(0.128)
9.Year (2008)	-0.099	(0.137)	-0.092	(0.120)
10.Year (2009)	-0.443***	(0.142)	-0.424***	(0.130)
11.Year (2010)	-0.181	(0.144)	-0.175	(0.136)
Constant	11.726***	(0.457)	12.091***	(0.437)
Adjusted R^2	0.663		0.681	

Note. $N = 628$.

***p < .01. **p < .05. *p < 0.1.

Of primary interest among the estimates for Model 1A, which did not contain the changed-teams variables, is the coefficient on RFA. The estimate is insignificant at the 5% level, which suggests that RFA status did not have statistically significant effect on wages, that is, RFA salaries were not statistically different from UFA salaries, ceteris paribus. The Model 1A results also indicate that there was a significant wage premium associated with sign-and-trade transactions and that players received a wage premium when signing with a Canadian franchise and the New Orleans/Oklahoma City Hornets. Signing with an expansion team (in this case Charlotte in 2004–05) was associated with a lower salary.

Model 1B adds *change* and the interaction term *RFA* × *Change* to investigate the wage effects of the mobility decision, and the estimates indeed provide further insight. The coefficient on *RFA* is insignificant, indicating no statistical wage difference between RFAs and UFAs who did not change teams (i.e., when *change* = 0). The coefficient on *change* (the main effect) is significant and negative, which suggests wages were about 25% lower for UFAs who changed teams than for UFAs who did not change teams. Finally, the coefficient on the interaction term, *RFA* × *Change*, indicates a significant, positive effect of *change* on wage for the RFA group compared to the UFA group.

Taking one further step to aid interpretation, a quick calculation reveals that a wage premium of about 24% is associated with RFAs who changed teams (-0.294 + 0.509 = 0.216, sum statistically different than zero). Noting again that there was no wage difference between RFAs and UFAs who did not change teams, the results show that, ceteris paribus, wages were significantly higher for RFAs who changed teams and significantly lower for UFAs who changed teams. Eschker et al. (2004), in comparison, reported that changing teams had a large, negative impact on salary for all players in the sample (the analysis did not include free agent rights).

Table 2.3 presents the results of the second phase of analysis, which employs the TE model to account for the endogeneity of *change*.[18] The estimates for the key variables reveal some notable findings. The coefficient on *RFA* is significant and negative, indicating salaries were significantly lower for RFAs who did not change teams than for UFAs who did not change teams. The main *change* effect is considerable and suggests wages were about 50% lower for UFAs who changed teams than for UFAs who did not change teams. Last, but not least, the figures show that wages were about 17% lower for RFAs who changed teams (-0.712 + 0.525 = -0.187, sum statistically different than zero). Thus, changing teams is associated with lower wages for both RFAs and UFAs.

[18] To investigate the validity of the instrument, *roster stability*, the model was estimated via instrumental-variables regression (cluster-robust two-stage least squares estimator). The first-stage results suggest the instrument is not weak ($F[1, 30] = 11.07$, $p < .01$) and a test of exogeneity indicates *change* is not endogenous, that is, the null of *change* is exogenous cannot be rejected ($F[1, 30] = 2.59$, $p = .12$).

Table 2.3

Regression Results for Phase 2, Treatment Effects Model

	Model 2		Change	
Variable	β	SE β	β	SE β
Minutes	0.021**	(0.009)	-0.008	(0.025)
Points	0.056***	(0.012)	-0.045	(0.031)
Total rebounds	0.071***	(0.023)	0.086	(0.057)
Steals	0.130	(0.085)	0.092	(0.220)
Assists	0.072**	(0.031)	-0.062	(0.080)
Blocks	0.107	(0.080)	-0.622***	(0.172)
Turnovers	-0.104	(0.086)	0.269	(0.220)
Personal fouls	0.044	(0.057)	-0.076	(0.149)
Field goal percentage	1.537**	(0.659)	-3.026*	(1.619)
Free throw percentage	0.829***	(0.311)	0.728	(0.799)
Start ratio	0.064	(0.089)	0.053	(0.233)
Experience	0.027	(0.030)	0.059	(0.077)
$Experience^2$	-0.004**	(0.002)	-0.003	(0.004)
1.Position (PG)	0.100	(0.081)	0.007	(0.215)
3.Position (SF)	0.084	(0.075)	-0.160	(0.191)
4.Position (SF)	0.190*	(0.099)	-0.011	(0.263)
5.Position (C)	0.366***	(0.116)	0.328	(0.304)
RFA	-0.232**	(0.112)	-0.849***	(0.190)
Roster stability			-2.168***	(0.452)
Change	-0.712***	(0.226)		
RFA x change	0.525***	(0.113)		
Canadian team	0.239*	(0.138)	-0.129	(0.371)
Population (millions)	0.010*	(0.006)	0.027**	(0.014)
Per-capita income (thousands)	-0.002	(0.004)	-0.013	(0.010)
Team win percentage (prior season)	0.152	(0.254)	0.044	(0.668)
Postseason (prior season)	-0.066	(0.073)	-0.099	(0.190)
League champion (prior season)	-0.252**	(0.113)	-0.114	(0.292)
2.Year (2001)	-0.242**	(0.103)	-0.321	(0.254)
3.Year (2002)	-0.336***	(0.112)	0.330	(0.293)
4.Year (2003)	-0.301***	(0.101)	0.141	(0.262)
5.Year (2004)	0.037	(0.098)	-0.105	(0.258)
6.Year (2005)	-0.170*	(0.096)	-0.296	(0.242)
7.Year (2006)	-0.109	(0.107)	0.162	(0.273)
8.Year (2007)	-0.108	(0.108)	0.000	(0.273)
9.Year (2008)	-0.102	(0.107)	-0.094	(0.277)
10.Year (2009)	-0.387***	(0.107)	0.219	(0.271)
11.Year (2010)	-0.167*	(0.100)	-0.039	(0.258)
lambda			0.259*	(0.136)
Constant	12.623***	(0.540)	3.351***	(1.216)

Note. N = 628. Rho = 0.500. Sigma = 0.519.

***p < .01. **p < .05. *p < 0.1.

The results of the first stage of the TE model are also shown in Table 2.3.[19] Surprisingly, the probit model does not fit particularly well (pseudo $R^2 = .158$), and the independent variables, by and large, did not do a good job of explaining the mobility decision. Nonetheless, there are some notable findings. As expected, the estimates indicate RFAs are significantly less likely to change teams. The coefficient on *roster stability* is significant and negative, which suggests greater stability reduces the likelihood of changing teams. Metro area population also had a significant effect, with an increase in market size increasing the likelihood of a change.

Discussion

What can be said, then, about monopsony power, wages, and mobility? When player mobility is not included in the wage determination model (Model 1A), there is no statistical evidence that RFAs received lower wages and thus no evidence of monopsony power. However, when player mobility is accounted for, and the endogeneity of *change* is ignored, a different picture emerges. Indeed, we see that free agent status matters. The findings for Model 1B show RFAs who signed with a new team received higher salaries than RFAs who re-signed with their prior team. One could argue that this is evidence of monopsony power—it suggests teams are able to re-sign their RFAs at a wage rate that is lower than the rate for comparable RFAs acquired from another team. But, the estimates are presumably biased due to the endogeneity and should thus be interpreted with caution.

[19] The significance of rho (= 0.500) was tested using bootstrap standard errors (Cameron & Trivedi, 2005). The test results indicate rho = 0 cannot be rejected at the 5% level ($p = .054$), which suggests the two equations are independent, that is, the mobility decision is statistically independent of wage determination.

Model 2, which addresses the endogeneity of mobility, provides the strongest evidence that restricted free agency allows teams to exercise monopsony power. Those results indicate RFAs were less likely to change teams and RFAs who re-signed with their prior team fared worse than UFAs who did the same. The results of the TE model (and Model 1B) also indicate changing teams is associated with lower wages for RFAs (although this was true for UFAs as well).

UFAs who changed teams received lower salaries than UFAs who did not change teams (Model 1B, Model 2). Furthermore, while changing teams resulted in lower wages for both RFAs and UFAs, the effect was particularly pronounced for UFAs (Model 2). These findings are perhaps counterintuitive given that UFAs are expected to be more proven commodities, to have more teams vying for their services (and thus more bargaining power), and so forth.

This analysis points to a couple of factors that may be contributing to the lower wages received by UFAs who change teams. First, UFAs may be more likely to take a pay cut in order to join a winning team. The variable indicating that the new team was the league champion in the prior season is negative and becomes significant when the changed-teams variables are added (Model 1B, Model 2). It is plausible that UFAs are the ones driving this result because they comprise the majority of the sample and they tend to be older and to have considerably more years of NBA experience (and thus greater career earnings) than RFAs.[20] A second possibility is that the free agent market is a "market for lemons" (Eschker et al., 2004). With long-term contracts and guaranteed salary (i.e., in the event of a decline in performance), it may simply be that many free

[20] The mean age and experience for UFAs was 29.85 years and 7.96 years of NBA service, respectively. For RFAs, the mean age was 24.97 years and the mean years of experience was 3.37 years.

agents were earning a salary that exceeded their MRP under their prior deal and a considerable adjustment is made when they sign a new deal. Here again, this is more likely to be true for UFAs than RFAs, who tend to be coming off of Rookie Scale Contracts.

7. ESSAY THREE: COMPENSATING DIFFERENCES AND FREE AGENCY IN THE NBA

A prominent factor contributing to imperfect competition in labor markets is workers' heterogeneous preferences for nonwage job characteristics (Bhaskar, Manning, & To, 2002). A worker may be equally productive in two jobs (as measured by MRP) but prefers the nonpecuniary aspects of one job over the other. If this is the case, the worker may be willing to accept a lower wage if a job has desirable working conditions, he may choose not to (immediately) leave a job with preferable working conditions if his employer reduces his compensation, and so forth. In the context of professional sport, the implication is that some teams may have desirable nonwage attributes that allow them to offer relatively lower wages and thus maintain a competitive advantage in the players' labor market. Furthermore, players' valuations of these amenities are clearly relevant to the IP discussion as they could impact player migration and thus the distribution of talent in a league.

As Krautmann (2008) points out in his treatment of the conditions that underlie the IP, the standard assumption motivating the IP is that both owners and players maximize their net pecuniary benefits. If we assume that players care about the nonpecuniary benefits offered by the teams on which they play, such as whether the team is a contender or plays in a city with a nice climate, then the important question is whether players are willing to make a compensating wage trade-off that favors more desirable teams (Krautmann, 2008). If players are willing to accept a lower salary in exchange for nonpecuniary benefits, and they share similar preferences for teams' nonwage characteristics, then certain teams will be able to hire players for below-market compensation (Sanderson & Siegfried, 1997). Furthermore, if a player's (marginal) willingness to pay for amenities increases with income (i.e., amenities are a normal good), then the higher salaries associated with free agency result in a higher willingness to pay. As player wealth rises, salary becomes relatively less important when deciding which team to join and "non-compensation considerations, such as endorsement income prospects and living conditions" become more important (Sanderson & Siegfried, 1997, p. 11).

This essay examines the effects of nonwage team and market characteristics on free agent salaries in the NBA. The goal, however, is not only to test whether such characteristics result in significant compensating wage trade-offs but also whether the implicit or hedonic values of the characteristics are different for players who made different migration decisions. While other researchers have considered the wage effects of nonmonetary job attributes in MLB and the NBA, these studies have primarily investigated their existence, not their implications for player movement. Accordingly, this study extends the IP literature by focusing on the job attributes that are likely to affect teams' abilities to attract free agents.

Background and Literature Review

Compensating Wage Differentials and Locational Attributes

The importance of nonwage job characteristics is central to the theory of compensating wage differentials (CWDs) (also called "compensating differences" or "equalizing differences"). Different jobs have different nonwage characteristics, and the theory of CWDs simply asserts that, ceteris paribus, the wages that workers receive equalize the differences between jobs in the value of these characteristics (Rosen, 1986;

Sullivan & To, 2014). Hence, jobs with desirable working conditions can attract workers with lower than average wages, while jobs with undesirable working conditions must offer a compensating wage premium to attract workers (Rosen, 1986).

A well-developed empirical literature on CWDs has tested this theory. Researchers have focused on estimating the worker wage function, typically using market-level data, in an effort to measure the hedonic prices of various nonwage job characteristics. Reviews of the empirical work indicate that the evidence is mixed and consequently support for the theory is somewhat limited (e.g., Brown, 1980). The lack of consistent empirical evidence has most often been attributed to omitted variable bias due to the difficulties associated with adequately controlling for unobserved worker ability (Brown, 1980; Daniel & Sofer, 1998; Duncan & Holmlund, 1983).

The compensating differentials literature also includes pertinent studies of urban migration that demonstrate the importance of locational attributes. Roback (1982) employed U.S. Census data and wage and rent (i.e., housing cost) regressions to investigate the impact of city attributes on regional differences in earnings. She found a persistent “western effect” that suggests wages are lower in the West than elsewhere, even when controlling for urban amenities (p. 1271). A quality of life index based on the imputed prices of the amenities showed that the top four U.S. metropolitan areas were in the West (Los Angeles, Anaheim, San Francisco, Dallas).

Cragg and Kahn (1997) took a similar approach and estimated migrants’ demand for the bundle of environmental amenities offered by every U.S. state. The model’s estimates were used to construct a hedonic quality of life index that ranked the locations based on willingness to pay for amenities. The top five states for male high school graduates 30–40 years of age were Florida, Arizona, California, Louisiana, and Texas. For all age/education categories, Florida was the top-ranked state and Arizona and California were typically ranked in the top three. The authors also note that the rankings did not reveal a "big state effect," as Pennsylvania, New York, and Illinois were typically ranked very low.

Rappaport's (2007) study also relates to weather's contribution to quality of life and the well-known migration of U.S. residents toward places with nice weather. He examined the determinants of population growth at the county level and found that local population growth "has been positively partially correlated with winter temperature and negatively partially correlated with summer temperature and summer humidity" (p. 386). Furthermore, the author concludes that the weather-related migration appears to be the result of rising incomes and an increasing valuation of nice weather as a consumption amenity.

CWDs and Wage Determination in Sport

Given the availability of individual-level data on earnings and productivity, it is not surprising that there have been many empirical studies of wage determination in professional sport. Surprisingly, few of these studies are directly related to CWDs. Sports economists who have studied compensating differences have mainly examined the relationship between player salaries and contract length in MLB. The question is whether players trade salary for the security of a longer contract, that is, whether differences in player salary can be explained by differences in contract length, with the latter being considered a nonpecuniary part of the employment relationship (Link & Yosifov, 2012).

Among the MLB studies, Kahn (1993) found that free agency eligibility raised contract duration, and Maxcy (2004) similarly showed that greater bargaining status increased the likelihood of obtaining a long-term contract. Krautmann and Oppenheimer (2002) and Link and Yosifov (2012) found evidence of a CWD associated with contract length as the monetary returns to performance were lower with longer contracts. Maxcy (2004), however, argues that long term contracts are a risk-allocation mechanism and thus they do not act as a CWD.

Michaelides (2012) found significant evidence supporting the theory of CWDs in the context of the NBA. For a sample of all NBA players observed during a single CBA period (1999–2003), the estimates from a hedonic wage equation show wage premiums associated with a larger population, a higher crime rate, a Canadian franchise, and an increase in undesirable weather conditions such as average monthly snowfall. Further analysis of weather conditions and the mean predicted wage for each city suggests that four of the top five most desirable cities were home to Western Conference teams (Los Angeles, Sacramento, Oakland, and Phoenix). There is also the work of Carlino and Coulson (2004), who used hedonic wage and rent equations to measure CWDs in metropolitan areas that have NFL franchises. They found that the presence of an NFL team had no effect on wages but raised annual rents approximately 8% in the areas' central cities.

Finally, two studies suggest that personal income tax rates are an important determinant of player compensation, which may inhibit some teams' abilities to sign high-income free agents. Alm, Kaempfer, and Sennoga (2012) investigated the impact of income taxes on the pretax salaries of MLB free agents and found that each percentage point of the tax increased salaries by about $24,000 and $21,000 for non-pitchers and pitchers, respectively. As the authors affirm, the implication is that there is a competitive edge or "home field advantage" for teams who play in low-tax areas, such as Florida and Texas, as they do not have to significantly increase their pretax salary offers in order to sign free agents. In the context of the NBA, Kopkin (2012) similarly argues that teams located in cities with higher income tax rates are at a disadvantage when it comes to signing highly-skilled free agents because of the salary restraints imposed by the league's CBA. The author examines the effect of the relative income tax rate of the city in which the signing team plays on player performance (as a proxy for skill) and player wages; he finds that an increase in the tax rate leads to a decrease in the average skill of free agent signees.

Methodology

The empirical work employs a comprehensive panel dataset and takes a fixed-effects approach in order to minimize the role of unobserved player heterogeneity and emphasize the effects of nonpecuniary job characteristics. To that end, the sample of NBA players is limited to unrestricted free agents because they are free to negotiate with any team. Focusing on UFAs allows me to assume that nonwage team and locational attributes play a prominent role in players' migration decisions and that they received market-clearing wages that reflected their true MRP (Krautmann & Oppenheimer, 2002). Lastly, although contract length has been prominently featured in the MLB compensating differences literature, it is largely ignored here because it would be endogenous in a wage determination equation. I do, however, employ average annual salary figures.

Empirical Model and Estimation

The empirical model proceeds from the assumption that supply and demand in the labor market are both functions of the price of labor *w*. Consequently, equilibrium is characterized by the market-clearing wage function $w^* = f(\boldsymbol{X}, \boldsymbol{Z})$ where $\boldsymbol{X}$ is a vector of worker characteristics and $\boldsymbol{Z}$ is a vector of nonwage job characteristics. The theory of CWDs maintains that the market-clearing wage function is decreasing in "goods" so that desirable characteristics negatively affect player wages ($\partial w/\partial Z < 0$) and vice versa.

The linear econometric model is:

$$ln(w_{ijct}) = \boldsymbol{X}_{it}\boldsymbol{\beta} + \boldsymbol{Z}_{jct}\boldsymbol{\theta} + \alpha_i + CBA_t + u_{ijct} \qquad (1)$$

where *i* indexes player, *j* indexes acquiring team, and *c* indexes metropolitan area. The dependent variable w_{ijct} is the pretax, guaranteed salary of player *i*, annualized and adjusted for inflation, as specified by the contract he signed in period *t* with team *j* located in market *c*. $\boldsymbol{X}_{it}$ is a vector of observed player characteristics including productivity, $\boldsymbol{Z}_{jct}$ is a vector of nonwage job characteristics that includes attributes of both the team ($\boldsymbol{Z1}_{jt}$) and its home market ($\boldsymbol{Z2}_{ct}$), α_i is the unobserved individual effect, CBA_t is a dummy variable indicating the CBA that was in effect when the contract was signed (0 = 1998 CBA, 1 = 2005 CBA), and u_{ijct} is a random error term. The individual fixed effects control for time-invariant differences among free agents, and the CBA dummies control for factors that affect the salaries of all free agents over time. Finally, $\boldsymbol{\beta}$ and $\boldsymbol{\theta}$ are the parameters to be estimated. The coefficients of primary interest are those on $\boldsymbol{Z2}$; these estimates indicate the implicit prices paid for the locational attributes and thus the presence and magnitude of any compensating differences.

To begin, Equation 1 is estimated for all UFAs (i.e., whether they migrated or not) via the within-group fixed effects estimator. Standard errors are robust to heteroskedasticity and clustered on player (i). While the parameter estimates for this initial model, Model 1, are of some interest, I take further steps to address the implications of CWDs for player migration. Unfortunately, the extant compensating differences literature offers little guidance in this regard. In a few studies, a mobility-related variable (e.g., a contract renewal indicator) was included as a regressor in the wage determination model. It is difficult to argue, however, that such variables are exogenous.

Therefore, to investigate player migration, Equation 1 was also estimated separately for different groups of UFAs. First, the model was estimated twice, once for *stayers* who re-signed with their prior (i.e., $t - 1$) team, and once for *movers* who played for a different team in period t. These stayers and movers models, which correspond to Models 2 and 3, respectively, provide greater insight into the two different mobility groups. Then, the model was again estimated twice according to whether the free agent

i) re-signed with his Eastern Conference team or moved to a different Eastern team (*stayed or moved East*); or

ii) re-signed with his Western Conference team or moved to a different Western team (*stayed or moved West*).

These final two models, which correspond to Models 4 and 5, respectively, again provide further, group-specific detail.

Data and Variables

As with Essay 2, the dataset is a panel that starts with the 2000–01 season and goes through the 2010–11 season. Thus, it encapsulates contracts signed under the 1999 and 2005 CBAs. I included all UFAs that met the conditions outlined in Essay 2, namely that they played at least 20 games in the NBA and averaged 12 minutes per game in each of the prior two seasons.

Descriptive statistics are shown in Table 3.1. The variables included in $\boldsymbol{X}_{\text{it}}$ and $\boldsymbol{Z}_{\text{jct}}$ are as follows.

Player characteristics and productivity measures ($\boldsymbol{X}_{\text{it}}$):

- Experience and experience^2 (NBA years of service and its square)
- Minutes played, points, total rebounds, steals, assists, blocks, and field goal percentage (on a per-game basis, average of the prior two seasons)

Team characteristics ($\boldsymbol{Z1}_{\text{jt}}$):

- Expansion team indicator
- New Orleans in Oklahoma City indicator
- Regular season win percentage in the prior season
- Qualified for postseason play indicator (prior season)
- League champion indicator (prior season)

Table 3.1

Descriptive Statistics for Variables Used in Regressions

Variable	*M*	*SD*	*MIN*	*MAX*
Annual wage (millions)	4.874	4.566	0.706	22.499
ln(wage)	15.021	0.869	13.467	16.929
Minutes	24.94	7.06	10.90	42.12
Points	9.61	4.96	1.69	29.06
Total rebounds	4.10	2.16	0.80	13.83
Steals	0.81	0.40	0.07	2.60
Assists	2.33	1.77	0.12	9.38
Blocks	0.465	0.522	0	3.006
Field goal percentage	0.446	0.044	0.341	0.614
Experience	7.96	3.56	2	18
$Experience^2$	75.98	64.29	4	324
Expansion team	0.004	0.062	0	1
New Orleans in Oklahoma City	0.004	0.062	0	1
Sign-and-trade	0.052	0.222	0	1
Team win percentage (prior season)	0.539	0.144	0.146	0.817
Postseason (prior season)	0.676	0.469	0	1
League champion (prior season)	0.046	0.210	0	1
Canadian team	0.027	0.162	0	1
Population (millions)	5.245	4.687	0.943	19.601
Per-capita income (thousands)	42.619	6.720	29.789	65.215
Relative tax rate	-0.13	4.46	-11.16	11.16
PRCP	36.89	16.65	2.83	79.31
DP1	9.30	6.16	0	25
$DP1^2$	124.41	137.23	0	625
HIGH	69.61	9.91	54.1	88
LOW	51.42	9.38	35.9	71
DH90	49.44	46.80	0	190
$DH90^2$	4630.35	7104.65	0	36100
DL32	56.92	52.31	0	175
$DL32^2$	5970.86	7301.66	0	30625
2005 CBA	0.520	0.500	0	1

Note. *N* = 521.

Market characteristics (***Z2***$_{ct}$):

- Canadian franchise indicator
- Population of the metropolitan area (in millions)
- Per-capita income of the metropolitan area (in thousands of inflation-adjusted U.S. dollars)
- Relative state income tax rate (i.e., acquiring location relative to prior location)
- Climate measures (on annual basis, prior year)
    - PRCP: Liquid precipitation (in inches)
    - DP1 and $DP1^2$: Number of days with precipitation ≥ 1.00” and its square
    - HIGH: Mean maximum temperature (°F) (e.g., average daily high)
    - LOW: Mean minimum temperature (°F) (e.g., average daily low)
    - DH90 and $DH90^2$: Number of days with maximum temperature ≥ 90°F and its square
    - DL32 and $DL32^2$: Number of days with minimum temperature ≤ 32°F and its square

The relative tax rate is the difference between the state (or provincial) income tax rate in the acquiring (t) location and the previous ($t - 1$) location. As such, a positive value indicates an increase in the relative rate and re-signing with the same team results in a relative tax rate of 0%.[21] The figures used represent the highest marginal tax rate and were obtained from the Tax Foundation, the Canada Revenue Agency, and state- and province-specific tax return documents. The climate data were obtained from the

[21] Although the state and provincial tax rates were not constant over the time period in question, the current sample did not contain any free agent re-signings that coincided with a year-over-year change in the state’s tax rate.

National Climatic Data Center. If the historical weather data were available from more than one weather station in the metropolitan area, I chose the weather station that was closest to the team's arena. For the Canadian locations, Buffalo, NY was used to represent Toronto, ON, and Bellingham, WA was used to represent Vancouver, BC.

Results and Discussion

The results of Model 1, the primary model estimated for all UFAs, are shown in Table 3.2. Looking at the key parameters, the market characteristics, an increase in the relative tax rate has a significant, positive effect on pretax wage. This is to be expected, as prior research suggests teams in higher-tax cities must make higher pretax salary offers in order to sign free agents (Alm et al., 2012). The only weather-related estimate that is significant, *PRCP*, indicates a wage premium associated with an increase in precipitation. This finding provides evidence that average annual rainfall as an undesirable market characteristic, all other factors held constant. It is also consistent with the work of Michaelides (2012), who studied CWDs in the NBA and reported a similar finding for average monthly rainfall.

Table 3.2

Regression Results for Model 1

	All UFAs (*N* = 521)	
Variable	*B*	*SE B*
Minutes	-0.028	(0.024)
Points	0.078**	(0.030)
Total rebounds	0.091	(0.078)
Steals	0.369*	(0.214)
Assists	0.094	(0.082)
Blocks	0.923***	(0.189)
Field goal percentage	6.502***	(1.521)
Experience	0.065	(0.057)
Experience^2	-0.006*	(0.003)
Expansion team	0.101	(0.675)
New Orleans in Oklahoma City	-0.106	(0.321)
Sign-and-trade	0.179	(0.167)
Team win percentage (prior season)	0.423	(0.450)
Postseason (prior season)	-0.040	(0.121)
League champion (prior season)	0.148	(0.163)
Canadian team	-0.601	(0.523)
Population (millions)	0.005	(0.010)
Per-capita income (thousands)	-0.004	(0.007)
Relative tax rate	0.024***	(0.009)
PRCP	0.017**	(0.007)
DP1	-0.040	(0.028)
DP1^2	0.001	(0.001)
HIGH	-0.029	(0.019)
LOW	0.010	(0.023)
DH90	0.002	(0.004)
DH90^2	0.000	(0.000)
DL32	-0.006	(0.005)
DL32^2	0.000	(0.000)
2005 CBA	0.109	(0.129)
Constant	11.899***	(1.460)
R^2	0.639	

***p < .01. **p < .05. *p < 0.1.

The results for Models 2 and 3, which correspond to the primary model estimated separately for stayers and movers, respectively, are displayed in Table 3.3. Overall, the independent variables take on greater importance when the model is estimated separately based on whether the UFA changed teams. For the stayers in particular the model's explanatory power increases considerably and a number of team- and market-related variables have a significant impact.

Looking first at the stayers, the *experience* and *experience*^{2} estimates are negative and positive, respectively, and thus suggest a wage-experience profile that is the opposite of the one typically found in wage determination studies. It appears that, in the case of UFAs who re-sign with their prior teams, higher wages are only associated with the most experienced players. The coefficient on *league champion*, the variable indicating that the acquiring team won the league championship in the prior season, is negative and implies that these UFAs were willing to take a pay cut to re-sign with a championship-caliber team. An increase in *population* is associated with a decrease in salary, suggesting free agents were also willing to accept a lower salary in order to stay in a larger market. This is consistent with the notion that larger markets have more to offer in terms of non-wage benefits.

Table 3.3

Regression Results for Models 2 and 3

	Stayers (N = 181)		Movers (N = 340)	
Variable	*B*	*SE B*	*B*	*SE B*
Minutes	0.013	(0.018)	-0.084**	(0.034)
Points	0.234***	(0.083)	0.134***	(0.045)
Total rebounds	-0.614***	(0.105)	0.261**	(0.132)
Steals	0.653	(0.620)	0.125	(0.425)
Assists	-0.197**	(0.095)	0.168	(0.112)
Blocks	2.690***	(0.323)	1.134**	(0.458)
Field goal percentage	2.281	(4.279)	4.542**	(1.954)
Experience	-0.380***	(0.084)	0.116	(0.110)
$Experience^2$	0.018***	(0.006)	-0.008	(0.007)
Expansion team			0.502	(0.516)
New Orleans in Oklahoma City			-0.688*	(0.403)
Team win percentage (prior season)	1.067*	(0.621)	0.035	(0.669)
Postseason (prior season)	0.162	(0.315)	-0.073	(0.156)
League champion (prior season)	-0.647***	(0.205)	0.481*	(0.258)
Canadian team			-0.457	(0.558)
Population (millions)	-0.142***	(0.019)	0.016*	(0.010)
Per-capita income (thousands)	-0.013	(0.034)	-0.013	(0.010)
Relative tax rate			0.034***	(0.010)
PRCP	0.055***	(0.018)	0.024**	(0.010)
DP1	0.072*	(0.038)	-0.035	(0.039)
$DP1^2$	-0.009***	(0.003)	-0.000	(0.001)
HIGH	-0.108***	(0.011)	-0.051*	(0.030)
LOW	-0.029*	(0.017)	0.014	(0.026)
DH90	0.021**	(0.010)	0.004	(0.005)
$DH90^2$	-0.000***	(0.000)	0.000	(0.000)
DL32	0.002	(0.007)	-0.014**	(0.007)
$DL32^2$	-0.000***	(0.000)	0.000**	(0.000)
2005 CBA	0.216	(0.226)	0.043	(0.197)
Constant	22.321***	(3.207)	14.232***	(2.202)
R^2	0.983		0.670	

***p < .01. **p < .05. *p < 0.1.

The stayers estimates also suggest a wage premium associated with *PRCP* and a wage discount associated with *HIGH*, the average maximum temperature. The latter result suggests this group of UFAs was willing to trade salary for warmer temperatures, ceteris paribus. Given that the average high temperature during the sample period was about 5°F higher in Western Conference markets than in Eastern Conference markets, one can infer that the Western Conference had a competitive advantage in this regard. The coefficient on *DH90* (number of days with maximum temperature ≥ 90°F) is positive, indicating that hot days are a disamenity. (The estimate for $DH90^2$ is also significant and carries the opposite sign, signifying a concave relationship between *DH90* and log wage, but the coefficient on the squared term is approximately equal to zero.)

Turning to the results for movers in Table 3.3, we see that, unlike stayers, *league champion* and *population* were insignificant (at the 5% level). A higher relative tax rate is shown to result in higher pretax wages and *PRCP* is again associated with higher wages. The number of hot days (*DH90*) was not an important factor for the movers group, but an increase in *DL32*, the number of days with minimum temperature ≤ 32°F, is unexpectedly associated with *lower* salaries. This, of course, implies that cold days, at least by this minimum-temperature measure, are an amenity. (The estimate for $DL32^2$ is significant and positive, signifying a convex relationship between *DL32* and log wage, but here again the coefficient on the squared term is approximately equal to zero.)

Finally, Table 3.4 shows the results of Models 4 & 5, which correspond to the primary model estimated separately for those who stayed or moved East and those who stayed or moved West, respectively. For the East group, the *experience* variables are significant and indicate the typical earnings-experience profile. Signing with an expansion team was associated with considerably lower salaries, which is contrary to expectation given that expansion teams generally perform poorly in their early years and players prefer to play for winning teams. In this sample, however, there were only $n = 2$ expansion team signings, so it is probably best not to read into this result any further. Similarly, there is a considerable wage premium associated with Canadian franchises but those signings were also a relatively infrequent ($n = 14$).

Table 3.4

Regression Results for Models 4 and 5

Variable	Stayed/Moved East (*N* = 202)		Stayed/Moved West (*N* = 167)	
	B	*SE B*	*B*	*SE B*
Minutes	0.055	(0.062)	0.074*	(0.044)
Points	-0.012	(0.069)	-0.120	(0.105)
Total rebounds	0.151	(0.128)	-1.216***	(0.387)
Steals	-0.320	(0.493)	2.329***	(0.878)
Assists	-0.119	(0.184)	0.756***	(0.241)
Blocks	0.801***	(0.252)	1.092	(0.694)
Field goal percentage	5.768***	(2.130)	0.688	(6.764)
Experience	0.295**	(0.114)	-0.105	(0.147)
Experience^2	-0.021***	(0.007)	0.008	(0.010)
Expansion team	-1.552***	(0.360)		
New Orleans in Oklahoma City			1.471	(1.041)
Team win percentage (prior season)	0.341	(0.790)	2.226	(1.457)
Postseason (prior season)	-0.403*	(0.207)	-0.531	(0.745)
League champion (prior season)	0.173	(0.239)	0.417	(0.258)
Canadian team	1.721***	(0.580)		
Population (millions)	0.006	(0.023)	0.027	(0.061)
Per-capita income (thousands)	0.027	(0.027)	0.083*	(0.043)
Relative tax rate	-0.015	(0.022)	0.031**	(0.013)
PRCP	0.011	(0.014)	-0.004	(0.020)
DP1	0.021	(0.067)	-0.087	(0.074)
DP1^2	-0.000	(0.002)	0.008***	(0.002)
HIGH	-0.057	(0.101)	0.126	(0.106)
LOW	-0.019	(0.076)	-0.072	(0.044)
DH90	0.015	(0.010)	-0.044***	(0.013)
DH90^2	-0.000	(0.000)	0.000***	(0.000)
DL32	-0.015	(0.012)	0.063***	(0.022)
DL32^2	0.000	(0.000)	-0.000***	(0.000)
2005 CBA	0.163	(0.320)	-0.591	(0.393)
Constant	12.978**	(5.908)	5.799	(7.120)
R^2	0.891		0.838	

***p < .01. **p < .05. *p < 0.1.

As for the West group, it is clear that, compared to the East group, the weather-related variables do a better job of explaining player salaries. This alone implies that the climate measures were of greater importance to the West group. The *DH90* and *DL32* estimates are negative and positive, respectively. The former suggests that the number of hot days was an amenity, while the latter suggests that the number of cold days is a disamenity. These findings seem fitting given that these UFAs chose to stay with or move to a Western Conference team.

In conclusion, while further study is needed, the analysis demonstrates that CWDs and players' preferences for non-wage job characteristics are meaningful in the context of player mobility, the distribution of talent, and the IP. Indeed, the results show that the important team and market characteristics varied depending on the UFA group under consideration. The climate-related measures appear to matter more to stayers and, most notably, to those who stayed with or moved to the Western Conference. Not much more can be said about the conference differences, however, as the results are certainly clouded by the fact that there are Eastern teams with warm climates (e.g., Miami, Orlando), Western teams with cold climates (e.g., Minnesota), and so forth. The logical next step is to investigate if and how these team and market effects create labor market advantages at the team and conference levels.

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