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ABSTRACT

When organizational structures and contractual arrangements face agents with a significant risk of termination in the short term, such agents may under-invest in projects whose results would be realized only in the long term. We use NBA data to study how risk of termination in the short term affects the decision of coaches. Because letting a rookie play produces long-term benefits on which coaches with a shorter investment horizon might place lower weight, we hypothesize that higher termination risk might lead to lower rookie participation. Consistent with this hypothesis, we find that, during the period of the NBA's 1999 collective bargaining agreement (CBA) and controlling for the characteristics of rookies and their teams, higher termination risk was associated with lower rookie participation and that this association was driven by important games. We also find that the association does not exist for second-year players and that the identified association disappeared when the 2005 CBA gave team owners stronger incentives to monitor the performance of rookies and preclude their underuse.

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I. Introduction

In many organizational and contractual settings, agents who are granted discretion in decision making fear termination by the principal before the long-term consequences of their decisions are fully realized. In such cases, these agents might engage in "short-termism," underinvesting in projects whose payoffs would be partly realized only in the long term.[1] To investigate this agency problem empirically, we use National Basketball Association (NBA) data concerning decisions that coaches have made about whether to let rookies play in games.

The NBA setting provides us with abundant data for analysis:[2] coach contracts, detailed information about rookie participation decisions, a rich set of controls, variation in the relative significance of short- and long-term payoffs, and numerous variables that influence the extent to which principals leave decision making up to agents' discretion. In the NBA context, because NBA rookies are required to stay with the team for a significant period beyond their first season, letting a rookie play instead of a veteran player provides the team with long-term benefits that go beyond the current NBA season: it not only improves the rookie's ability to play in the NBA setting but also enables the team to gain information about the rookie that will be useful in future contract decisions. Thus, choosing to include a rookie in a game, rather than a veteran player, represents an investment in a long-term project that produces benefits beyond the current season.

After describing the institutional background and the dataset, we consider the relationship between the allocation of playing time to rookies and the improvement in their performance. We show that rookies improve significantly over the first two years when allocated more playing time. Together with the finding that rookies are, on average, considerably less productive in their first year than veterans on their teams playing in the same positions, this supports our premise that playing the rookies can be thought of as a costly investment that can bear fruit in the future.

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[1] For models of agency problems that result when agents face termination risk or otherwise have short time horizons, see Narayanan (1985); Stein (1988, 1989); Bebchuk and Stole (1993); Von Thadden (1995); and Bolton, Scheinkman, and Xiong (2006). As we explain below, the setting that we analyze is somewhat different from the settings analyzed in those models.

[2] The rich datasets available for professional sports have been noticed by economists, and a significant number of papers have conducted empirical economic analyses using them. See, e.g., Kahn (2000), Chiappori et al. (2002), Duggan and Levitt (2002), Farmer et al. (2004), Garicano et al. (2005), Romer (2006), Price and Wolfers (2010), Parson et al. (2011), Abramitzky et al. (2012), Kahane et al. (2013), and Matvos (2014).

We then move to develop a simple stylized model to generate hypotheses for testing. In our model, in any given game, the coach might have some private information about the value of including the rookie, information to which the team owner (or the general manager acting on the owner's behalf) is not privy. To avoid using the rookie should that information indicate such use to be undesirable, the owner might leave it up to the coach to decide whether to let the rookie play, even when the owner recognizes that the coach's decision might be somewhat biased against inclusion. And when coaches are granted such discretion, a coach who faces a high termination risk, and who therefore places less weight on the team's performance beyond the current season, can be expected (other things being equal) to use rookies less frequently.

We then test whether termination risk is indeed negatively associated with rookie participation. Our analysis focuses on decisions made by NBA coaches over the five-year period governed by the 1999 collective bargaining agreement (CBA). We first estimate the termination risk faced by each coach prior to the first game he coached in the season by running Probit regressions of whether that coach was eventually terminated on his characteristics and past performance. Using these estimates, we find that, consistent with our hypothesis, coaches who faced a higher risk of termination—and thus a smaller likelihood of being able to benefit from the long-term consequences of giving rookies more playing experience—were associated with a lower use of rookies to an extent that is both statistically significant and economically meaningful. In identifying this association, we control for the characteristics and past performances of rookies and their teams. We address potential concerns about endogeneity of termination risk by including an exogenous variable (the number of years left on the coach's contract) in our estimation of termination risk.

We subsequently test additional hypotheses generated by our model concerning the interaction between termination risk and game importance. The NBA data provide us with substantial variation between regular-season games that were and were not important in terms of affecting the odds of the team making the playoffs. Consistent with the prediction of our model in this connection, we find that the association of termination risk and rookie participation is particularly strong in important games; in such games, given the relative value of the coach's private information with respect to how including the rookie would affect the game's outcome, owners were less likely to intervene and instruct coaches to use rookies. In contrast, the association of termination risk and rookie participation did not exist for games that were unimportant.

We then consider circumstances in which the short-term cost of playing the rookie is low, and the model predicts that termination risk is not expected to be associated with lower rookie participation. While the data indicate that rookies benefit from gaining NBA experience and their performance systematically improves from the first year of NBA playing to the second, the data also indicate that such effect is weaker in the second year of playing, and that using second-year players does not produce the kind of long-term benefits flowing from increased human capital that using rookies does. Consistent with the prediction of our model, we find that the association of termination risk and lower rookie participation does not exist for second-year players. We also establish that the association does not exist for top rookies, who in their first year in the NBA are already among of the top two players in their position on their team.

Finally, we consider the effects of the introduction of the 2005 CBA; as we explain below, the options granted to owners by the 2005 CBA increased the long-term benefits of playing rookies and thereby gave owners incentives to intervene. Consistent with the prediction of our model, we find that the association of termination risk and lower rookie participation did not exist in the years governed by the 2005 CBA.

Much of the empirical literature on agency problems concerning long-term projects has focused on CEOs of public companies and on how their decisions compare with those of CEOs of private companies (see, e.g., Dechow and Sloan 1991, Xu 2012, Aghion et al. 2010, Edmans et al. 2013, Ladika and Sautner 2013, and Asker et al. 2015). However, with the exception of Azoulay, Manso, and Zivin (2011), who focus on investments by medical researchers in long-term risky projects, there has been little focus on agency problems afflicting choices with long-term consequences in other contexts. Our paper highlights the potential value of studying such contexts.

The remainder of our paper is organized as follows. Section II describes the relevant institutional background concerning the NBA and its teams, rookie players, coaches, and CBAs. Section III describes our data. Section IV considers the contribution of playing time to the development of the rookies. Section V develops a simple formal model that we use to put forward hypotheses for testing; the model predicts that, when coaches retain discretion over rookie participation decisions, their termination risk can be expected to be negatively correlated with rookie participation; it also identifies the circumstances in which owners will instruct coaches to use rookies and thereby eliminate the association between termination risk and rookie participation. Section VI tests our hypotheses concerning the correlation between termination risk, game importance, and rookie participation. Section VII presents results concerning rookie participation decisions for top rookies, for second-year players, and during the 2005 CBA. Section VIII makes concluding remarks.

II. Institutional Background

The NBA is the leading professional basketball league in North America. It consists of thirty teams divided into an Eastern Conference and a Western Conference. Each team has a roster of twelve to fifteen players. An NBA season is divided into the regular season and the playoffs. During the regular season, each team participates in eighty-two games, facing each of the other twenty-nine teams from two to four times.[3] At the end of the regular season, the eight teams with the best win-loss records from each conference go to the playoffs and compete for the championship in an elimination tournament.

A. The NBA Life Cycle: The Draft, the Rookie Contract, and Free Agency

The vast majority of players enter the NBA through the draft. The draft consists of two rounds, during which the teams take turns selecting rookies. Typically, prospects enter the draft after playing between one and four years of college basketball, although during the period of our study, several players entered the draft straight from high school. Thirty rookies are chosen in each round of the draft. First-round picks are allocated to teams according to a procedure that is designed to give an advantage to teams that did not fare well in the preceding season.[4] However,

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[3] Teams play rivals in the same conference three or four times a year and play rivals in the opposite conference twice.

[4] The draft operates as follows: first, the first three picks are allocated through a lottery among the fourteen teams that did not make the playoffs in the previous year. The lottery is weighted so that the team with the lowest ranking in the previous season has the highest chance of obtaining the first draft pick. Picks 4–14 are then allocated among the remaining nonplayoff teams in reverse order of their previous season's performance. Picks 15–30 are allocated among the remaining sixteen teams that made the playoff in reverse order of their record in the previous season. Picks 31–60 belong to the second round and are also granted to the teams in reverse order of their previous season's ranking.

because the top three picks are allocated by a lottery and since teams swap or trade picks in exchange for veteran players or cash, the correlation between the team's ranking in the previous season and its draft position is only –0.45 in our sample.

First-round rookies are guaranteed a contract with the team that drafted them. Each rookie gets a contract for the same period and is paid according to a predetermined scale that decreases with the rookie's draft rank (the “rookie scale”). The exact terms of those contracts are defined by the CBA, as explained below. During the period of our sample, rookies were guaranteed at least two years in their contracts, and the teams had an option for an additional year or two, depending on the CBA. Unlike first-round picks, second-round picks are not guaranteed a contract, and many are not signed by the team that drafted them. If one is signed, the terms of the contract are negotiated between the team and the rookie. Rookies typically begin playing in the NBA in the year after they are drafted, although foreign rookies sometimes choose to stay abroad for several years before coming to the NBA.

Once a player has played out his rookie contract, he becomes a free agent and can sign with other teams. The team that drafted the player is given an advantage in signing him and can offer him a higher salary and a longer contract. Typically, post-rookie contracts are fully guaranteed (i.e., they must be paid in full even if the team decides to release the player), and only a small fraction of pay, if any, is tied to explicit performance measures. Hence, in terms of incentives, the contract environment for players in the NBA is best described as one of “career concerns” (Hölmstrom 1999). In addition to intrinsic motivation, players are motivated by reputational considerations and play for their next contract. Their salaries increase significantly after the rookie contract. To demonstrate, the median first-year salary for the cohort of first-round rookies who started playing in the NBA in 2001 was a little over $1 million. In their fifth year, the first year after the end of their rookie contracts, the median salary increased to $8 million, and by their tenth year, the median salary of those players who remained in the league was over $11 million.

In this paper, we consider first-round rookies and follow them through their first and second years in the NBA. We focus on first-round rookies because, unlike second-round picks, they are guaranteed contracts whose terms are exogenously determined throughout the period. We also focus on regular-season games because, at this stage of the season, all teams play the exact same number of games and play them against all the other teams.

B. Team Hierarchies: Owners, General Managers, and Coaches

NBA teams are owned by either a single owner or an ownership group. The estimated value of the six most valuable NBA franchises exceeds $2 billion,[5] and their owners are very wealthy individuals with vast business holdings. Owners typically hold teams for long periods, up to several decades (an average of twenty-two years in our sample period).

Owners select a general manager who is put in charge of personnel decisions, including hiring the team's coaching staff, drafting rookies, signing free agents, renewing contracts, and making trades with other teams. The head coach is in charge of preparing the team during practices, running the game, and making all game-time decisions, including starting players, substitution patterns, and defensive assignments. Although coaches seem to have substantial discretion over such matters, owners (and the general managers working on their behalf) have the power to fire the coaches and hence the ability to intervene and influence their coaches' decisions with respect to issues that they deem important.

Coaches' typically sign multiyear, fully guaranteed contracts. Similar to players' contracts, coaches' contracts have very little pay tied directly to explicit performance measures, nor are coaches provided with a stake in the team. Hence, coaches can also be best described as motivated by implicit incentives or "career concerns."

C. The Collective Bargaining Agreement (CBA)

Each CBA defines the framework for contracts with players and all other labor-related transactions during the period it governs. Roughly every five years, team owners and the National Basketball Players Association (the union for the league's players) bargain over a new CBA. Our study covers the seasons governed by the CBAs of 1999 and 2005. Under these two agreements, first-round rookies were guaranteed a three-year contract in the first period and a two-year contract in the latter period. Because the CBAs differ over several important dimensions, the main part of our study focuses on the 1999 CBA only. We discuss the differences between the CBAs in more detail and consider the 2005 CBA in Section VII.

[5] "Forbes Releases 19th Annual NBA Team Valuations," *Forbes Magazine,* February 15, 2017.

III. The Data

Our data consist of all rookies who played in the NBA in regular-season games during the period of 1999–2010, the years governed by the 1999 and 2005 CBAs. As there are eighty-two games during a regular season and we followed each rookie through his first and second years in the NBA, our data contain a maximum of 164 games for each player. We obtained most of our data from Basketball-Reference.com, a site that provides statistical data on every player and game in the NBA since 1945. We supplemented these data with both information from additional sources and hand-collected information about coaches as described in detail below.

Rookie Characteristics: Rookies' characteristics were obtained from Basketball-Reference.com player-level data. For each rookie, we have information about his draft year, draft rank, position played, years spent in college,[6] age, and salary.

For the vast majority of rookies, we have information about their first two full seasons with the NBA.[7] We excluded from our data six rookies who were sent by their NBA teams to spend their entire first season playing at the development league and who joined the NBA only in their second year under the contract. A small fraction of rookies were traded during their first and/or second contract season,[8] and we included these players during (and only during) the two seasons in which they played for the same team.[9] However, all the results reported in this paper are robust to excluding the traded rookies.

Rookie Participation and Performance: For each rookie, we obtained from Basketball-Reference.com player-season-game-level information on each regular-season game in which he played. This information consists of game information, such as the identity of the home and visiting teams and the final score, and detailed information on the rookie, including the number

[6] About 8% of all rookies in the sample skipped college. Among those who did not, the average number of years spent in college was about 2.1. Because of the age requirement introduced in the 2005 CBA, the incidence of rookies who skipped college was lower, and the average number of college years was higher, under the 2005 CBA than under the 1999 CBA.

[7] After being drafted, twelve foreign rookies deferred the start of their NBA careers to play overseas. We followed these players during their first two years after they started playing in the NBA.

[8] In total, twenty-seven players, or 8.5% of all rookies, were traded during their first or second season.

[9] For example, if a rookie was traded during the middle of his first season, we counted all the games for which he played for the team to which he was traded. If he was traded during his second season, we counted all the games for which he played for the first team.

of minutes he played in the game and his performance statistics, such as shots attempted, points scored, assists, rebounds, steals, turnovers, blocks, free throws attempted and made, and personal fouls. Using these statistics, we constructed a compound game-level performance measure for each game-rookie observation, as described below.

Using the different dimensions of the cumulative season performance, Basketball-Reference.com calculates for each player a player efficiency rating (PER), which is a rating of a player's productivity per minute. This measure, which was developed in the late 1990s by John Hollinger, compiles all of the player's different performance dimensions during the season into one number, which is computed and reported only at the season level. To construct such a measure at the game level, we first regress the season PER on all the player's different performance dimensions (these measures explain PER almost entirely with an R^2 equal to 0.99) and then use the coefficients of this regression to construct a player's game PER using all his different performance dimensions in each game. In addition, we also construct a cumulative PER measure for any part of the season.

In addition to the information on the rookies, we collected from Basketball-Reference.com information on the performance of all the other players on the rookie's team in order to compare the rookie to those players. Last, we collected detailed information on injuries from a website called ProSports Transcation.com.

Table 1 presents summary statistics for our sample. The main sample consists of more than 48,000 player-season-game observations involving 308 different first-round rookies over their first two years in the NBA. Of these observations, 46% were under the 1999 CBA and 54% were under the 2005 CBA. The table provides summary statistics for the whole sample, as well as for four subsamples broken down by player tenure (first- and second-year players) and by the two CBAs (1999 and 2005).

On average, in our data, players played in about 73% of the regular-season games. Their average PER was 11.7 and they played an average of 16.2 minutes per game. The levels are lower for rookies than for second-year players. Differences among the subsamples with respect to the other variables are not statistically significant.

Team Ranking: Using Basketball-Reference.com season-game-level data, we generated information about each team's ranking within its conference at any point throughout the season. The data indicate the date of the game, the home and visitor teams, and the final score. For each team in a given game, we generated a variable that indicates its conference ranking at the beginning of the game. For any given game in a particular season, we calculated each team's cumulative win-loss record to date and then compared it with those of the other teams in the same conference. We then ranked the teams from 1 to 16 (where 1 represents the highest ranking and 16 the lowest). Ties were broken in favor of the team that had more wins (mostly relevant when two teams had the same record but a different number of games played). In the first game of the season, we initialized this variable with the team's ranking at the end of the preceding regular season. We also obtained information about whether the team reached the playoffs.

Coach Data: Basketball-Reference.com also contains information on all NBA coaches during our period of examination. Our coach-season-level dataset includes information about all the NBA teams that the coach trained during his career, the number of regular-season wins and losses during his career, the number of playoff wins and losses during his career, and the age of the coach.[10] For each coach in each season, we calculated his cumulative career wins and losses up to the current season, his tenure with the NBA, and his tenure with his current team. For the period of our study, our data consist of 416 coach-season observations involving 111 different coaches.

Information about the length of coaches' contracts was obtained from various online sources. For 70% of our coach seasons, we found such information from "Weak Side Awareness," a blog that publishes various NBA statistics.[11] For the remaining 30%, the information was hand-collected from various online resources and articles.

Table 2 presents summary statistics for the coach-season data. On average, coaches were granted contracts of 3.3 years, had 1.4 years left on their contracts, had 4.5 years of experience prior to joining the current team, spent 2.5 years with the current team, and were 50.5 years of age.

Information on whether coaches were fired or left their teams voluntarily was also hand-collected from various online resources and articles. Of the 416 coach-season observations during the period of our study, 116 involved termination (i.e., firing) by the beginning of the subsequent year.[12] Such firing accounted for 83% of coach-season observations in which the

[10] Basketball-Reference.com did not have age data for 24 of the 111 coaches during the period of 1999–2010, so this information was collected from online articles and biographies of the coaches.

[11] For each coach-season, the blog provides a reference to an online source (usually an article) from which the information was extracted. This made it possible to double-check the accuracy of the contract data.

[12] Unless they moved to another team, took an executive position in the team, or resigned, we treat those coaches whose contracts expired at the end of the season and were not extended by their teams as fired.

coach was not with the team at the beginning of the subsequent season. The 17% of coaches who left their teams before the beginning of the subsequent year without having been fired were, on average, seven years older that those who were fired, and their decision to leave often seemed to have been made for personal reasons.

Being fired appears to have significant adverse consequences for coaches. About 60% of fired coaches did not find a new head coach position in the NBA during the period that we studied. For the remaining 40% who did find a new coaching position in the NBA, it took them, on average, more than two years to find it.

IV. Playing Rookies as an Investment: Some Evidence

In this section, we explore a central premise of our analysis: that playing rookies carries important long-term benefits to the team, and so rookies are played even when it is not optimal to play them from a short-term perspective.

To see why it may not be in the team's short-term interest to play most rookies much, note that rookies are, on average, less productive than their teammates. As can be seen from Table 3 the mean season PER of first-year rookies is 11.7, compared to 12.7 for all veteran players, with the difference being significant at the 1% level. For the guard and forward positions, for which a team typically plays two players at a time, the median rookie is ranked fifth in his season performance between players in his position.[13] [14] Thus, based on performance only, the median rookie is not even one of the first backups in his position.

The benefits of playing rookies can stem from several sources. First, to the extent that playing time contributes to the development of the rookie's skills and accelerates his integration with the team, it can be viewed as an investment in the rookie's human capital, which will benefit the team during the subsequent years of his contract and beyond.[15] We consider the

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[13] Teams typically have a smaller number of centers, and it is quite common for them to have none or only one on their rosters. Hence, rookies playing in the center position are naturally ranked higher.

[14] Nevertheless, around 10% of rookies in the guard and forward positions have one of the two highest PERs for their position. One has to keep in mind, however, that PER is an offensive metric and that rookies are known to have difficulties, especially on the defensive side.

[15] Most of the benefits from the improvement in the rookie's performance in the years after the rookie contract are expected to be captured by the player himself, who will be free to leave the team after his rookie contract ends. However, the league's bargaining agreement gives the current team an advantage in

evidence on this below. In addition, playing the rookie allows the team to learn important information about his potential, which can be instrumental for decisions on contract extension and trade. Last, since rookies represent the future of the team, fans may be eager to see them play.

Consistent with the idea that participation enables rookies to improve their performance, Table 1 shows that the performance of players is, on average, higher in their second year than in their first year. To gain more accurate evidence on how the allocation of minutes affects rookies' future performance, we run the following regression:

$$per_{ig} = \beta_0 + \beta_1 \exp_{ig} + \beta_2 \left(\exp_{ig}\right)^2 + \beta_2 time_g + \delta_i + \epsilon_{ig},$$

where per_{ig} is rookie i's performance in game g (measured by PER), $\exp_{ig}$ are the cumulative number of minutes the rookie played since his NBA debut and prior to game g, $time_g$ is a time trend, and δ_i a player fixed effect.

The results are shown in Table 4. Column (1) presents an OLS regression, without a time trend and fixed effects. In column (2) we add a time trend to account for the possibility that the player improves over time even if he is not playing (e.g., by practicing with his team). We also add player fixed effects to control for observed and unobserved rookie characteristics that do not vary over time. While the effect of experience on performance is somewhat attenuated in column (2) compared to column (1), it remains significant and large. Playing time contributes substantially to the improvement in a player's performance over his first two years. On the basis of the estimates in column (2), if a player plays fifteen minutes in every one of the 164 games over his first two seasons (2,460 minutes overall), his PER at the end of his second year will be higher by 1.8 than if he played five minutes per game (820 minutes overall). Since the mean PER in the beginning of the first season is below 10, this represents an additional 18% growth. The quadratic form in experience is maximized at 4,900 minutes, suggesting that additional playing time increases performance throughout the entire first season (the maximal number of minutes over a single season is $82 \times 48 = 3{,}936$ minutes) and for a large part of the second season. In contrast, the time trend is not significantly different than zero, suggesting that a rookie's performance does not change much over time if he is not playing.

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keeping a player drafted as rookie, and the team might be able to capture at least some of the benefits that accrue from the rookie from his fifth year of playing on.

The results presented above may not warrant casual interpretation as the allocation of minutes is endogenous. Nonetheless, they are consistent with the view that playing time is crucial for rookies' development and improves rookies' future performance to a significant degree.

V. A Model of NBA Coach Decisions

This section presents a simple model of rookie participation decisions made by NBA coaches. This model provides us with a framework for developing hypotheses that subsequent parts will test.[16]

A. The Optimal Decision from the Owner's Perspective

In line with the preceding discussion, we posit that, while letting a rookie play in a game has a potentially adverse effect on the outcome of that game and thus on the overall outcome of the current season, such rookie participation can also produce some long-term benefits beyond the current season. Playing time has a positive effect on the rookie's future performance, which would contribute to the team's success in future years, either directly or by increasing the rookie's future trade value. We assume that team owners care about these long-term benefits. The team's long-term success provides the owners with substantial prestige and status in addition to large monetary benefits. During the ten-year period that we investigate, owner turnover was infrequent (only ten cases), and owners held their teams for an average of twenty-two years. Even if an owner is planning to sell his or her team soon, the long-term value of the rookie would affect the team's sale value. Thus, the model assumes that, in general, teams do not make rookie participation decisions in a given game with a sole focus on that game's outcome.

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[16] Our model is related to, but also considerably different from, models of short-termism by public company CEOs such as those of Narayanan (1985) and Stein (1988). An important element of these models, which our model does not have to include, concerns how agents take into account the effect of their project selection choices on the short-term stock market price, which affects their payoffs. Also, because shareholders in public companies are often passive, some of these models abstract from the possibility of a direct intervention by the principals. In contrast, our model allows for such direct intervention and analyzes when owners will choose to grant coaches discretion over rookie participation decisions.

Let the short-term net effect of playing the rookie in a given game over the best alternative allocation of these minutes among other veteran players be denoted by $s + \theta$, which can be positive or negative. The component denoted by s is based on *public* information and is thus known to both the coach and the team's owner. The value of s is determined by several factors. Perhaps the most important one is the relative ability of the rookie compared to veteran players in the same position on his team. Early in the season, the perception of the rookie's ability is based on his draft rank and his performance before entering the NBA. As the season progresses, his performance in previous games during the current season is given more weight. Playing the rookie can also reflect a team's strategy to rest its best players during the regular season so that they will be well rested for the playoffs, and hence s may also depend on the team's schedule (is the game played back-to-back to another game? how many days of rest did the team have?) and on the attributes of its veterans (are the team's starters relatively old and in need of more rest?). The value of s is also influenced by the expected difficulty of the game and thus depends on the opponent's record: playing the rookie may be inconsequential against a very weak opponent but not against a strong one. Finally, the value of s depends on the importance of the game to the team. We discuss this point in more detail in the next section.

The short-term benefits of playing the rookie in the coming game also depend on *private* information $\theta \in \mathbb{R}$, which is known by the coach but not by the owner. This may include information concerning (i) how the rookie, and substitute veteran players in the same position, performed in the practices preceding the current game, (ii) how the rookie's skills fit the game plan and the offensive and defensive matchups that the coach has in mind for the coming game, and (iii) game-time information revealed during the game that affects the benefit of using the rookie. In assessing the extent to which such private information is likely to be material, it is worth noting that, in trying later in the paper to explain rookie participation decisions, we are able to explain only about 30% of the variation using the wide range of publicly known variables we have.

A higher value of the privately known θ indicates states in which the short-term effects of playing the rookie are higher. We assume that, even though the owner does not observe θ, he knows it to be distributed according to a uniform distribution function on $[-\overline{\theta}, \overline{\theta}]$, where $\overline{\theta} > s$. This implies that when the coach's private information is sufficiently unfavorable, playing the rookie would be costly for the short-term outcome of the game and the current season.

We denote by l the long-term (discounted) benefits to the team of playing the rookie. Playing the rookie in a given game is optimal from the perspective of the team's owner only if

$$(s + \theta) + l > 0. \quad (1)$$

Let $\theta^* \equiv -s - l$. It follows from (1) that it is optimal to play the rookie if and only if $\theta \geq \theta^*$. However, as the owner does not observe θ directly, he cannot implement this rule by himself.

B. Optimal Decisions for Coaches Facing Termination Risks

Let us first assume that the owner delegates to the coach the decision about whether to play the rookie (we analyze the owner's choice about whether to grant such discretion in Section V.C. below). On the basis of our discussion in Section II, we assume that the coach is motivated by reputational concerns since the value of his future career contracts depends on the market's perception of his coaching ability. The perception of his ability increases with the team's performance in this season, and hence the coach internalizes in full the short-term effect $s + \theta$ of playing the rookie. The future perception of his ability will increase if the team performs well in the future, but only if the coach remains with the team. If the coach faces no termination risk, he internalizes the long-term benefits of playing the rookie and would make the decision according to equation (1) above. However, a coach who faces a non-negligible termination risk would place a discounted weight on the long-term benefits of having the rookie participate since he would reap these benefits only if he remains with the team.

In particular, if the coach faces a termination risk $\pi \in (0,1)$ prior to the game, he places a weight (1- π) on the long-term benefits of playing the rookie. Because he observes the state θ, he will let the rookie participate if and only if

$$s + \theta + (1 - \pi)l > 0. \quad (2)$$

Let $\hat{\theta}(\pi) \equiv -s - (1 - \pi)l$. It follows from (2) that a coach facing termination risk will let the rookie participate if and only if $\theta > \hat{\theta}(\pi)$, and we can state the following result:

Lemma 1: (a) For any given myopic coach with $\pi < 1$, if the coach can decide whether to let the rookie play, he will play the rookie if and only if $> \hat{\theta}(\pi)$, where $\hat{\theta}(\pi) > \theta^*$. Thus, the coach will not let the rookie play in some states of private information—specifically, in the range of states $[\theta^*, \hat{\theta}(\pi)]$—in which such participation will be optimal from the owner's perspective.

(b) The threshold $\hat{\theta}(\pi)$ increases with π. Thus, increasing the risk of termination increases the range of states of the private information θ in which letting the rookie play will be optimal for the owner but not the coach and thus raises the "bias" in favor of rookie underuse introduced by the coach's risk of termination.

Part (b) of Lemma 1 provides the key prediction of a negative association between termination risk and rookie participation, which we test in Section VI below.

C. Why Owners May Provide Coaches with Decision-Making Discretion

Having assumed in the analysis in the previous section that the coach has discretion over whether to let the rookie play in the given game under consideration, we now examine why and when the owner might grant such discretion in the first place. Given that a coach with a short "investment horizon" is expected to underuse rookies, the question is whether an owner might be better off directing the coach to let the rookie participate whenever the owner's information indicates that the expected value of such participation is positive.

Consider such a case. If the owner grants the coach discretion over whether to play the rookie, the coach will make choices following (2), and the owner will obtain, compared with playing the veteran, an expected value of

$$V^D = \frac{1}{2\overline{\theta}} \cdot \int_{\hat{\theta}}^{\overline{\theta}} (s + \theta + l)\, d\theta.$$

If the owner takes away the coach's discretion, then, given that the owner does not observe the state θ, he cannot base his decision on this information or instruct the coach to play the rookie in accordance with it. If he directs the coach to let the rookie play, in this "no discretion" case the expected net value to the team from playing the rookie (over a veteran) will be

$$V^{ND} = \frac{1}{2\overline{\theta}} \int_{-\overline{\theta}}^{\overline{\theta}} (s + \theta + l)\, d\theta\ .$$

The owner would prefer to grant discretion to the coach if $V^D - V^{ND} > 0$, or

$$V^D - V^{ND} = -\frac{1}{2\overline{\theta}} \cdot \int_{-\overline{\theta}}^{\widehat{\theta}} (s + \theta + l) d\theta$$
$$= -\frac{1}{2\overline{\theta}} \cdot \int_{-\overline{\theta}}^{\theta^*} (s + \theta + l) d\theta - \frac{1}{2\overline{\theta}} \cdot \int_{\theta^*}^{\widehat{\theta}} (s + \theta + l) d\theta > 0. \quad (3)$$

The decomposition in the second line above enables us to see both the benefits and the costs of granting coach discretion. Recall that, by definition, $s + \theta + l > 0$ if and only if $\theta > \theta^*$. The first term above, which is positive, is the benefit of discretion; this term is the expected net value of not playing the rookie in states in which the private information known to the coach indicates that letting the rookie play is undesirable from the team's perspective. The second term, which is negative, is the cost of discretion in states in the interval $[\theta^*, \widehat{\theta}]$ in which a myopic coach would elect not to play the rookie even though playing him would yield a higher overall value to the team.

If it is sufficiently valuable to use the coach's private information—that is, if the effect of playing the rookie in low realizations of θ is sufficiently negative—the owner will prefer to grant the coach decision-making discretion. In such a case, the owner accepts the expected cost of the rookie not being included in a game in which he *should* play in order to take advantage of the coach's private information and avoid the risk of having the rookie play in case this private information suggests that he should *not* play. Note that, if the owner grants the coach discretion, he will know that the coach's decision will be biased in expectation, but if the coach does not include the rookie, the owner will never know whether the decision was suboptimal or driven by negative private information.

In conclusion, our simple model establishes that when coaches have private information about the value of using the rookie, team owners sometimes prefer to grant them discretion over rookie participation, even though owners realize that such discretion would result, in expectation, in an "underinvestment" in the development of rookies (i.e., an underuse of rookies). Moreover, when discretion is granted, the expected decrease in rookie participation is larger the higher is the termination risk that the coach is facing.

There is quite a bit of anecdotal evidence of disagreements between general managers and coaches over the playing time of rookies. It is not unusual for general managers to try press coaches to play rookies more or even dictate to them outright how much to play them. Consider, for example, the following quote from the *Bleacher Report,*[17] describing an interaction between Sam Mitchell and Brian Colangelo (the coach and general manager, respectively, for the Toronto Raptors) over playing time for rookie Andrea Bargnani, the first pick in the 2006 draft.

"When the season started, however, Sam Mitchell's club fell to 2–8 and Colangelo had a meeting with his coach. The meeting was discussed in detail by Colangelo afterwards, but the general point of emphasis was the playing time of rookie Andrea Bargnani. The young Italian was in Sam Mitchell's doghouse and it seemed that Colangelo couldn't understand Mitchell's logic of hindering the development of his talented youth while the losses mounted. After the meeting, Bargnani's minutes took a leap and the Raptors were looking much improved…."

Another example of a clash between management and a coach over players' playing time involves the Chicago Bulls and head coach Tom Thibodeau.[18] Management believed that Thibodeau had overused his star players over the regular season, which, in management's view, led to their disappointing playoff performance and an increase in injuries. While the main issue of disagreement was not rookie development directly, the increased playing time allotted to veterans resulted indirectly in fewer minutes allotted to rookies. Before firing Thibodeau at the end of the 2015 season, management tried to limit his discretion by restricting the number of minutes in which several veteran players could play.

As these examples demonstrate, team owners can exert various degrees of pressure on coaches to play rookies. We next consider in more detail when such intervention is more likely.

D. Game Importance and the Magnitude of Long-Term Benefits

The above analysis shows that the existence of coach discretion can be expected to produce a negative correlation between termination risk and rookie participation. We now turn to examine the effect of two potential dimensions—the importance of a given game for the current season's results and the magnitude of long-term benefits—on whether the owner will allow the coach to decide whether to play a rookie in a given game.

For this purpose, we introduce two additional parameters. Let $\alpha > 0$ denote the relative importance of the current game, and let $\beta > 0$ represent various institutional parameters that

[17] http://bleacherreport.com/articles/64624-sam-mitchell-still-has-much-to-learn-as-raptors-coach.
[18] http://www.nba.com/2015/news/features/steve_aschburner/05/28/bulls-management-diss-tom-thibodeau/.

determine the long-term benefits of letting the rookie play in the game. With these two parameters, playing the rookie is optimal from the perspective of the team's owner if

$$\alpha(s + \theta) + \beta l > 0. \qquad (4)$$

In this case, proceeding as earlier, we can show that, from the owner's perspective, the threshold for including the rookie is $\theta^* \equiv -s - \frac{\beta l}{\alpha}$ and that the optimal threshold for a coach with termination risk π is $\hat{\theta}(\pi) \equiv -s - \frac{(1-\pi)\beta l}{\alpha}$. We can then establish the following lemma, which considers how the importance of the current game α and the magnitude of the long-term benefits β affect the decision about whether to grant the coach discretion over rookie participation in the game.

Lemma 2: The more important the game is for the current season's results (i.e., the higher that α is) and the smaller the magnitude of the long-term benefits of the rookie's participation (i.e., the higher that β is), the more likely the owner (or the general manager acting on the owner's behalf) is to let the coach decide whether to let the rookie participate in that game.

The intuition behind this lemma is as follows. An increase in the importance of the current game, or a decrease in the magnitude of the long-term benefits of including the rookie, enhances the importance of the coach's private information as to the effect that the rookie's participation will have on the current game relative to the concern that the coach undervalues the long-term benefits of the rookie's participation. The proof of the lemma, which is provided in the Appendix, proceeds by adjusting (3) for the introduction of the two new parameters; differentiating the difference between the expected value to the owner with and without discretion, first with respect to α and then with respect to β; and then rearranging terms to show that these expressions have the signs implied by the lemma.

In the polar case in which the game has no short-term consequences ($\alpha = 0$), there is no longer a misalignment between the owner's and the coach's preferences. The owner can grant the coach discretion without worrying that the coach's termination risk will bias his decisions about the rookie's playing time. In the empirical analysis in the next section, we consider a natural measure of game importance: the effect of winning the current game on the likelihood of the team making the playoffs. For a team that has lost any chance of making the playoffs, subsequent games become unimportant. Another interesting situation in which winning regular-season games has no short-term consequences occurs when the team is intentionally “tanking” —that is, trying to lose as many games as possible in order to increase its chances of earning a high pick in the next draft. The possibility of tanking arises because the NBA draft mechanism grants the team with the worst record the highest probability of winning the first pick in the next draft.[19]

The stylized model presented in this section disregards important dynamic aspects of the problem. Each game-time decision as taken in isolation, based only on game-level information and the coach termination risk prior to the game, and without any linkage to past and future decisions. Nevertheless, this static agency model manages to highlight some of the fundamental aspects of the problem.

In the next sections we test the predictions of the model concerning changes in game importance and the relative importance of the long-term benefits of rookie participation.

VI. Coach Termination Risk and Rookie Participation

We now test whether the predicted association between coach termination risk and rookie participation exists in the data. We begin by explaining how we estimate termination risk (Section A) and game importance (Section B). We then study the relationship between termination risk, game importance, and rookie participation (Section C).

A. Estimating Termination Risk

To estimate coach termination risk, we match our team-season data with coach characteristics data. We then estimate the following Probit model to determine how the coach’s risk of being fired depends on his characteristics before the first game he coached in the season:[20]

$$Coach\ Fired_{c,t,s} = X'_{c,t,s}\beta + \delta_t + \varepsilon_{c,t,s}.$$

[19] Teams rarely acknowledge deliberately trying to lose games, as it is considered by many fans, commentators, and owners to be an abuse of the league roles.

[20] We use the Probit model when we aim to predict probabilities. We use the linear probability model (LPM) when we estimate how rookie participation decisions depend on other variables; this is because LPM is well suited to the use of many fixed effects and is easy to interpret. Throughout, whether we use a Probit model or the LPM, we verify that the results are robust to using the other model.

The dependent variable, $Coach\ Fired_{c,t,s}$, is an indicator that is equal to 1 if coach c was fired by his current team t during or at the end of season s and is equal to 0 otherwise. $X'_{c,t,s}$ is a vector of coach-team-season covariates, including the initial number of years in the coach's contract, the number of years left in that contract after this year, the age and age squared of the coach, the tenure and tenure squared of the coach in the NBA before joining the current team, the tenure and tenure squared of the coach with his current team, the percentage of wins the coach had prior to joining the team, the percentage of wins the coach had with the team, and a dummy variable indicating whether the coach had not coached the team in the past. Finally, δ_t is a vector of team fixed effects. Standard errors are clustered by team.

Using the Probit model shown above, we assign to each coach the preseason predicted value of his termination risk—that is, the probability of his being fired by the end of the season.

The results of the regression, shown in Table 5, indicate that the probability of the coach being fired decreases with the number of years left on his contract. Because coaches' contracts are guaranteed, a team that fires its coach before the contract ends has to pay the coach the remainder of his salary if he is not hired by another team or, if he is hired by another team at a lower salary, the excess of his salary over the lower salary with the other team.[21] Therefore, the negative coefficient reflects the fact that the size of the severance payment that would have to be paid to the coach if he is fired increases with the number of years left in his contract. In addition, the probability of termination decreases with both the coach's NBA experience and his winning percentage before joining the team (although the latter effect is insignificant).

All the right-hand side variables in the regression are determined before the season has started and hence are not affected by subsequent decisions about whether to play rookies or by the season's outcome. In particular, we view the number of years left on the coach's contract as exogenous, as it is determined (mechanically) by the time passed since the start of the contract. The initial contract length is in the regression as well (and its coefficient is small in magnitude and statistically insignificant), so the effect we identify of "Contract Years Left" on the termination probability is therefore controlling for the initial length of the contract.

[21] As discussed in Section III, it takes a considerable time for a fired coach to find a new position, if at all. A team that chooses to terminate its coach should therefore expect to pay most of the remainder of the coach's salary.

B. Estimating Game Importance

To compete for the NBA championship and to reap the substantial monetary rewards from participating in playoff games, teams must first get into the playoffs. We therefore construct a measure of game importance for regular-season games that is based on the expected marginal impact that a win in the next game will have on the odds of the team making the current season's playoffs.

To compute this measure, we begin by estimating the probability of teams making the playoffs at any particular point of time in the season and for any standing in the ranking. Using the full team-season-game data, we estimate this probability by running the following Probit model for each team *t,* season *s,* and game number *g:*

$$Playoffs_{t,s} = \alpha_0 + \alpha_1 Conference\ Rank_{t,s,g} + \alpha_2 Games\ Played_{t,s,g} + \\ + \alpha_3 Distance\ from\ 8_{t,s,g} + \alpha_4 Games\ Played_{t,s,g} x Distance\ from\ 8_{t,s,g} + \varepsilon_{t,s}.$$

The dependent variable, $Playoffs_{t,s}$, is a dummy variable that is equal to 1 if the team reached the playoffs at the end of the regular season *s* and is equal to 0 otherwise. For covariates, we use the following variables: $Conference\ Rank_{t,s,g}$ indicates the ranking of the team in its conference at the beginning of the game g; $Games\ Played_{t,s,g}$ is the number of games played prior to game g by team *t*; $Distance\ from\ 8_{t,s,g}$ is the difference between the win-loss record of team *t* and that of the team ranked eighth in the same conference prior to game g;[22] and $Games\ Played_{t,s,g}\ x\ Distance\ from\ 8_{t,s,g}$ is an interaction term that captures the increasing effect of $Distance\ from\ 8_{t,s,g}$ as the season progresses.

Our playoff probability model (whose results are not tabulated) performs well. For the entire sample, the count R^2 of the model equals 0.86, indicating that 86% of playoff participations are

[22] Recall that eight teams from each conference make the playoffs. Thus, the larger the gap between the wins of a given team and the wins of the eighth team in its conference, the more likely it is that the given team will reach the playoffs at the end of the season (and vice versa if the gap is smaller).

predicted correctly,[23] while the adjusted count R^2 equals 0.7. Furthermore, unreported results show that this model's predictions become more accurate as the season progresses.

Finally, we measure the importance of a given game by the estimated difference between the probability of the team reaching the playoffs if it wins the game and the probability of it reaching the playoffs if it loses.[24] Formally, we define game importance as follows:

$$Game\ Importance = Prob(playoffs = 1 | team\ wins) - Prob(playoffs = 1 | team\ losses).$$

The conditional two probabilities are generated by updating the team's ranking prior to the game, once with an additional win and once with an additional loss, and calculating the predicted probabilities using the estimates from the Probit regression above.

A larger difference between the two predicted probabilities indicates that the individual game matters more. Figure 1 provides a graphic illustration of our game importance measure for two seasons of the Chicago Bulls, 2009–2010 (Figure 1.1) and 2010–2011 (Figure 1.2). The dots in each graph represent the Bulls' ranking in the Eastern Conference before each individual game. The line in each graph represents the importance of the next individual game, as reflected in our game importance measure.

As Figure 1.1 shows, the Bulls' conference ranking during the 2009–2010 season was quite volatile: game importance peaked toward the end of the season when it was unclear whether the Bulls would finish eighth in the Eastern Conference (reaching the playoffs) or ninth (failing to make the playoffs). By contrast, during the 2010–2011 season, the Bulls performed very well. Figure 1.2 shows that, after fewer than twenty games, game importance for the Bulls dropped substantially as it became clear that they would make it to the playoffs.

[23] In the count R^2 measure, if a predicted probability is above 0.5, it is regarded as a prediction that the team will reach the playoffs; if it is smaller than 0.5, it is regarded as a prediction that the team will not reach the playoffs.

[24] Note that our importance measure is determined for a given game on the basis of information available before the game. If we had data about the score as the game progressed, we could have defined alternative measures that take into account results during the game. Unfortunately, our data include only the score at the end of each game and not information about scores and other outcomes during the progress of each given game. Future research might consider investigating coaches' decisions at different stages of each game.

In our sample, the mean of *Game Importance* is 0.045 and the maximal value is 0.2. Over 10% of the games have a game importance equal to zero. This percentage changes substantially as the season progress. Whereas in the first twenty games of the season, all games have positive game importance, over 50% of the last twenty games are not important for one of the teams.

Finally, while making the playoffs is a first-order determinant of game importance for most games, the outcome of the games may still be important to teams who make the playoffs if those outcomes can affect the team's seeding and home court advantage in the playoffs.[25]

C. The Association of Termination Risk and Rookie Participation

Our theoretical model predicts (Lemma 1) that coaches with a high risk of termination—and thus a short investment horizon—are less willing to let rookies play than coaches with a low risk of termination. The model also indicates (Lemma 2) that team owners are less likely to intervene in rookie participation decisions (rather than grant coaches full discretion to make such decisions) in games that are important for the current season's results and in which the benefit of using the coach's private information as to the effect of the rookie's participation on the current game is high. The association between termination risk and rookie participation should thus be expected to be strong in important games and to weaken or disappear in unimportant games.

To test these hypotheses, we first run the following linear probability regression:

$$Played_{p,c,t,s,g} = Termination\_Risk_{c,t,s}\,\tau + Game\ Importance_{t,s,g}\rho\ + \\ +Z'_{p,c,t,s,g}\theta + X'_{p}\gamma + \gamma_c + \varepsilon_{p,c,t,s,g.}$$

In the above specification, p indicates the player, c the coach, t the team, s the season, and g the specific game. Our dependent variable, $Played_{p,c,t,s,g}$, is a dummy variable that equals 1 if player p from team t with coach c participated in game g during season s, and equals 0 otherwise. Our main explanatory variables of interest are the coach's termination risk, as perceived in the beginning of the season, $Termination\ Risk_{c,t,s}$,[26] which is the predicted value

[25] Every playoff series can reach up to seven games, in which case four of the games would be played at the court of the team who holds the home court advantage.

[26] Starting from its preseason value, the coach's perceived termination risk is likely to change over the season according to the team's performance. However, since most variables that capture season

based on the estimation reported in Table 5, and the importance of the game, $Game\ Importance_{t,s,g}\rho$, as was estimated in Section V.B.

The vector X_p includes control variables on the player's general characteristics—those that do not change over time. This vector includes the rookie's draft rank and position (center, forward, or guard); a dummy variable indicating whether the rookie is a foreigner; the number of years he spent in college; and a dummy variable indicating whether he was traded.

The vector $Z_{p,c,t,s,g}$ includes characteristics that do vary over time: the team's record going into the current game, the number of games played so far in the season, a dummy variable indicating whether the opponent is from the same conference, a dummy variable indicating whether this is a home game for the rookie's team, the opposing team's record, the importance of the game to the opponent, and the number of rest days between the previous game and the current one.[27] The vector also contains controls for the rookie's performance in the season up to this game: cumulative PER, rank within his position based on cumulative PER, and cumulative number of minutes. Last, γ_c are coach fixed effects. Standard errors are clustered by player. While we used coach fixed effects here, we confirm in Section VII that our results hold when owner- and general manager−fixed effects are added. The error term $\varepsilon_{p,c,t,s,g}$ captures game-specific factors that are unobserved by the researcher, such as the rookie being particularly well-suited (or ill-suited) to match against a certain opponent player, etc.

Column (1) of Table 6 presents the results of the above regression. Coaches who face a higher termination risk tend to play rookies less frequently. In this specification, the coefficient of *Termination Risk* is –0.187 and is statistically significant at the 5% level. The coefficient suggests that, holding other things equal, a 10 percentage point increase in the probability that the rookie's coach will be fired is associated with a 1.87 percentage point reduction in the probability that the rookie will play in the current game. Considering that the range of coach termination risk in our sample is between 0% and 99% (with a mean of 21% and a standard deviation of 41%), a 10 percentage point increase in coach termination risk is well within the range of potential changes in termination risk.[28]

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performance can also have a direct effect on the value of playing the rookie, we do not to include them in our measure of termination risk but directly through the vector $Z_{p,c,t,s,g}$.

[27] The number of rest days could affect the team's decision to rest veteran starters, especially older ones.

[28] Because our main variable of interest, *Termination Risk*, is based on an estimate produced by a separate regression, we need to adjust our standard errors to avoid a downward bias. In unreported tables, we use

Next, to test the prediction that the effect of termination risk is more pronounced when game importance is high, we add an interaction between *Game Importance* and *Termination Risk* and run the following regression:

$$Played_{p,c,t,s,g} = Termination\_Risk_{c,s}\,\tau + Game\ Importance_{t,s,g}\rho\ +$$
$$Termination\_Risk_{c,s} \times Game\ Importance_{t,s,g}\pi + +Z'_{p,c,t,s,g}\theta + X'_{p}\gamma + \gamma_c + \varepsilon_{p,c,t,s,g.}$$

The results are reported in column (2) of Table 6. The coefficient on *Termination Risk* is no longer significantly different from zero. This is to be expected, as the coefficient measures the effect of termination risk when game importance equals zero. The coefficient on the interaction between *Game Importance* and *Termination Risk* equals –1.99 and is statistically significant at the 5% level. The result is consistent with Lemma 2's prediction that team owners are less likely intervene in rookie participation decisions in important games and that coaches are therefore granted more discretion in these games, and with Lemma 1, which states that granted discretion, coaches with a higher risk of termination are less likely to play rookies.

For a game at the 90th percentile of importance (*Game Importance* = 0.11), a 10 percentage point increase in the probability that the coach will be fired is associated with a 3 percentage point reduction in the probability that the rookie will play in the current game. In contrast, for a game in the 10th percentile of importance (*Game Importance* = 0), the effect is not statistically significant different from zero.

Table 7 tests whether our results are robust to different definitions of the dependent variable. We define three new dependent dummy variables—"Played ≥ 5 minutes," "Played ≥ 10 minutes," and "Played ≥ 15 minutes"—which are equal to one for rookies who played at least five, ten, and fifteen minutes, respectively, and to zero otherwise. Opting to play the rookie for a substantial number of minutes could have a far larger effect on the game's outcome than

bootstrapping, as suggested by Petrin and Train (2003), to add the additional source of variance to the estimated variance of the parameters of our regressions. Using bootstrapped samples, we repeatedly predict termination risk 100 times for each coach's game. We then estimate our LPM from column (1) 100 times, where the only variation between one run and the other is in the value of the predictions of termination risk, which we obtain from the different bootstrap samples. We then add the variance in the parameter estimates obtained from these 100 estimations to the variance estimates obtained from the original model presented in column (1). The qualitative results do not change, with the coefficient of *Termination Risk* remaining statistically significant.

allowing him to play for a single possession at the end of the first quarter (in order to rest a starter or keep him from picking another personal foul). Thus, we expect the association between termination risk and rookie participation to be stronger in these regressions.

Table 7 provides the results of using each one of the three new dependent variables for specification (2) of Table 6. As the table indicates, our results are indeed robust to using different cutoff values for the definition of "Played." In all the regressions, the coefficient on the interaction of *Termination Risk* and *Game Importance* is negative and statistically significant. The size of the effect is larger than in Table 6, column (2), which considered a cutoff value of zero. For a game at the 90th percentile of game importance (*Game Importance* = 0.11), a 10 percentage point increase in the probability that the rookie's coach will be fired is associated with a 4.3 percentage point reduction in the probability that the rookie will play for at least five minutes.

It could be argued that the identified association might be driven by some mechanism other than short-termism introduced by termination risk and a short time horizon. To begin with, it might be suggested that some coaches (because of their personality, basketball philosophy, or other personal traits) simply prefer not to play rookies and that such coaches also tend to be unsuccessful and to face higher termination risk. However, our specifications use coach fixed effect, and our findings thus cannot be fully explained by differences in personal traits and attitudes among coaches. It might also be speculated that coaches whose teams have weak rookies tend to let rookies play less often and to be less successful because of the weak rookies they have. However, our specifications control for both the perceived ability of the rookie prior to the season (his rank in the draft) and his actual performance in earlier games of the season.

In assessing the identified association, we also should take into account the other findings that we document below. That is, for our findings as a whole to be driven by some other mechanism, that mechanism would have to explain not only the association documented in this part but also the findings documented in the subsequent Section VII, including that section's findings that the identified association between termination risk and lower use did not exist for top rookies, ranked as either the best or the second best player in their positions, or for second-year players. Each of these findings is consistent with the agency mechanism on which we are focusing.

As discussed in the Section V.A., the number of years left in the coach's contract is a main driver of termination risk, appears to be exogenous, and is thus unlikely to be correlated directly with lower rookie participation. In an unreported table, we replace our estimate of the termination risk variable with the number of years left on the coach's contract. Analogous to the results in Table 6, column (2), the coefficient on the interaction of *Coach Contract Years Left* and *Game Importance* is positive and significant.

Our regressions control for many different factors that can affect the allocation of playing time to rookies.[29] One omitted variable is whether the team was tanking. In Section V, we argued that a tanking strategy is captured in our model by the teams putting a weight of zero on the short-term consequences of playing rookies. We believe that the omission of tanking from the regression does not lead to a bias in our estimates. Tanking is quite rare,[30] and a team that is tanking would accumulate losses and quickly lose any realistic chance of making the playoffs. This would make the rest of the season's games unimportant by our measure and would be captured by the *Game Importance* variable. Tanking would have a distinct effect for only a very small number of team seasons and a small number of games during the beginning of the season (in which game importance is low, anyway). Therefore, we do not believe its omission introduces a bias in our results.[31]

VII. Further Results

In this section, we present additional results on the association between coach termination risk and rookie participation. We first look at circumstances in which the short-term costs of playing rookies are low and the association between coach termination risk and rookie participation can be expected to be weaker or nonexistent. We consider participation decisions for rookies who are one of the two best players in their positions on their teams (Section A) and decisions with respect to second-year players (Section B). Next, we consider how the team's age

[29] An additional control, which is not included in Table 6, concerns the relative importance of games to teams that have already secured a playoff appearance. As discussed in Section VI.B. above, such teams can still be competing for playoff seeding and may be reluctant to play rookies. In an unreported table, we show that teams that have locked their position for the playoffs play rookies more frequently. All the qualitative results reported in this section are unaffected.

[30] See, for example, "What actually is tanking, and which NBA teams actually do it?," Mark Deeks, *SB Nation,* January 10, 2014 (https://www.sbnation.com/2014/1/10/5266770/nba-draft-lottery-tanking-gm).

[31] Moreover, our results continue to hold even if we consider only games in the later part of the season for which tanking should not have an additional effect over *Game Importance,* as discussed above.

composition affects the decision to play the rookies (Section C). We then turn to consider the 2005 CBA. We discuss how the new CBA changed the incentive structure for players, coaches, and owners, and consider how these changes affected the participation of rookies in comparison to the 1999 CBA (Section D).

A. "Top" Rookies

While, on average, rookies are not as productive as veterans in their positions, some rookies are very good from the start. Over 5% of all rookies in the guard and forward positions were the best players in their positions (in terms of PER) on their team during their first season, and over 10% of the rookies were among the top two in their positions. Teams typically play two players at a time in each of these positions, and by this measure, playing the rookies would improve the team's short-term outcomes over the possible alternatives.

In the model, the coach's decision rule (2) implies that if the short-term gain of playing the rookie, $s + \theta$, is positive, the coach will elect to play him irrespective of termination risk. Hence, we would expect that the coach's termination risk would not be associated with lower participation for this group.

To test this hypothesis, we ran the specification from Table 6, column (2), separately for rookies ranked among the best two in their positions[32] during their first season and for rookies ranked third and below. The results are reported in columns (1) and (2) of Table 8. For the rookies ranked 1 or 2 in their positions in column (1), the interaction term between *Termination Risk* and *Game Importance* is positive and insignificant. In contrast, for the rookies ranked 3 and above in their position in column (2), the interaction term is negative and significant at the 10% level.[33]

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[32] We include in the regression only rookies in the guard and forward positions. As argued above, the center position is unusual in that teams often would not use a true center and would play a power forward instead. Some teams may have only a single center on their roster or even none. Hence, for a rookie to be ranked first in the center position is far less indicative of his ability than it would be in the guard and forward positions (in which each team typically has, on average, five or six players on its roster).

[33] In an unreported regression, we ran the specification separately for players who were among the top three draft picks and for all other rookies. Similarly to the results reported here, the interaction term between *Termination Risk* and *Game Importance* for the top three rookies was positive and insignificant, and was negative and significant for all other rookies.

The results confirm that the short-termism effect disappears when rookies are among the best in their positions, as in this case there is no short-term cost of playing the rookie. The "short-termism" effect we identify in the full sample is attributed to the larger group of rookies who are less productive in their first year than other veterans on their team and their participation in the game carries therefore a short-term cost.

B. Second-Year Players

Our analysis has thus far focused on rookies who are, on average, noticeably less productive on their teams than the veterans. We would like to contrast our findings with the outcomes for the same players in their second year in the NBA. Table 3 shows that the average performance of second-year players is significantly higher than that of rookies and is not significantly different from that of veterans. Note that our dataset includes only players who played in their team both as rookies and as second-year players, and so the difference in average performance should not be expected to be the product of survivorship bias. The short-term costs of playing second-year players in comparison to rookies are smaller, as are the long-term benefits of letting them participate. Hence, we would not expect to see the same correlation between termination risk and the participation of second-year players that we have found for rookies.

We test the conjecture that coach termination risk and player participation are not correlated for second-year players by running the regression of Table 6, column (2), on second-year players. Table 8, column (3), presents the results for second-year players. In comparison to the results for rookies in column (4), which are reproduced from Table 6, the interaction term of *Termination Risk* and *Game Importance* is no longer significant, consistent with the hypothesis that the association identified for rookies between coach termination risk and lower participation does not exist for second-year players.

C. Team's Age Composition

In this section, we consider how the coach's willingness to play rookies depends on the age of other team members. We divide teams into quartiles by the mean age of all players, excluding the rookies. The rookies' teammates in teams in the fourth quartile of the age distribution are, on average, more than 3.5 years older than those on teams in the first quartile (29.7 vs 26.0 years). Older teams had a far better record in the last season (+10 in wins vs. −17 for teams in the first quartile and −6 for teams in the second quartile). We conjecture that these teams enter the season with high expectations, possibly even contending for the championship. Moreover, their window of opportunity is narrower, as their best players are older and at the peak of their careers.

To test how the age of the teammates affects the allocation of playing time to rookies, we add to the regression an indicator for teams in the fourth quartile of the age distributions of the veteran players (the "oldest teams") and interact this variable with *Termination Risk, Game Importance,* and their interaction (resulting in a triple interaction term). The results are reported in Table 9 for the four dependent variables used in Tables 6 and 7. Rookies are less likely to play in the oldest teams than in other teams. The triple interaction term is negative in columns (1) through (4), is negative and significant in all specifications except for (1), and is larger in size than the interaction between *Termination Risk* and *Game Importance*. This suggests that short-termism is particularly strong when an older team is headed by a coach with a high termination risk. A natural interpretation of the result is that the team's high expectations makes the coach very averse to using the rookies in important games.

D. The 2005 CBA

Our study so far has considered rookies under the 1999 CBA. In this section, we describe the main changes introduced by the 2005 CBA, which governed rookies drafted between 2005 and 2010, and we hypothesize about how those changes likely affected their use in their first year. We then look at the data for the 2005 CBA to test our hypotheses.

During the period preceding the 1999 CBA, weak teams kept losing their best rookies to strong teams after the first three-year contracts ended.[34] This pattern reduced the teams' incentives to invest in training talented young rookies. The 1999 CBA addressed this issue by extending the length of first-round rookie contracts from three years to four, providing a salary scale for the fourth year as well as for the first three. This change enabled teams to keep their star rookies for an additional year for relatively low pay.[35]

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[34] Banaian and Gallagher (1999) document that, out of the top twelve picks in the 1995 draft, only two rookies remained with their original teams.

[35] An additional change further helped teams capture the long-term benefits of investing in a rookie's human capital. After reaching his fifth year, a player became a "restricted" free agent, not a free agent as in the past. By giving the player a one-year qualifying offer, the team kept the rights to match the best

To avoid scenarios whereby teams were bound to pay salaries to nonproductive players for four years, the 1999 CBA also introduced a team-option clause in rookie contracts. This option allowed teams to choose at the end of the contract's second year to "waive" the fourth year of the contract of a nonproductive player without bearing any costs.

The 2005 CBA retained the basic elements of the 1999 CBA with respect to the contracts offered to first-round rookies. However, it made one change that could have had an impact on behavior: it added another team-option clause for the third year. Teams that wished to exercise the option on a rookie had to do so by the end of his first year. Thus, under the 2005 CBA, teams were able to waive unwanted players earlier than before, depending on the rookie's performance during his first year. Out of 116 first-round rookies drafted under the 2005 CBA for whom data are available concerning their second NBA year, 9 (6.5%) were waived from their third year, with the decision made after the first year, and 11 (9.5%) were waived from their fourth year, with the decision made after the second year.

The 2005 CBA also introduced some other important changes. To address the issue of players skipping college and going directly to the NBA,[36] it specified that drafted players, both foreign and American, must be at least nineteen years of age at the draft year and that American players must have at least one year behind them since graduating from high school.

Both CBAs imposed a salary cap on the salaries of veteran players. The cap was higher under the 2005 CBA, which allocated a much larger share of the league's basketball-related income to the players: 48% under the 1999 CBA and 57% under the 2005 CBA.

How were the changes introduced in the 2005 CBA likely to affect the allocation of playing time to rookies compared to their time under the 1999 CBA? The 2005 CBA shortened the guaranteed contract to two years and added an option on the third year, which has to be exercised

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offer that the player received from another team, and if it matched that offer, the player had to stay with the team.

[36] The rookie scale introduced in the 1995 CBA limited the amount that the best rookies could expect to earn in their first year in the NBA and made it advantageous for star rookies to try and extend their NBA careers by skipping college. Moreover, because of the lower costs, teams were more willing to take chances on players who lacked the full college experience (see "How the NBA Turned a Trickle of Underclassmen Leaving School Early into a Flood," by Dan T. Rosenbaum, Dept. of Economics: University of North Carolina–Greensboro; September 2003). The adoption of the 1995 CBA was indeed followed by an increase in the incidence of rookies choosing to drop out of college, or to skip college altogether, to join the NBA (see Groothuis, Hill, and Perry 2007).

by the end of the first year. This contractual change increased the benefits to team owners of obtaining information about rookie performances and of providing rookies with opportunities to play during the first year. Our model predicts (Lemma 2) that circumstances with higher long-term benefits of playing rookies make owners more likely to intervene in rookie participation decisions and thereby weaken the correlation between termination risk and lower rookie participation. We therefore hypothesize that by giving owners incentives to intervene in rookie participation decisions, the 2005 CBA weakened the association between termination risk and lower rookie participation that existed under the 1999 CBA.

Columns (2) and (4) in Table 1 show that first-year rookies have been used more intensively under the 2005 CBA than under the 1999 CBA. They played in more games (75% vs. 67%) and for more minutes per game (15.12 vs. 13.66). They also performed better and had higher performance indicators for their first season (PER of 11.02 vs. 10.87). The contractual changes discussed above could also have had an incentive effect on these rookies.[37] The improvement in their performance lowered the short-term cost of using them and may have contributed to their increased usage. The imposed age limit implied that rookies arrived at the NBA, on average, with more experience, having played at least one year of college. This may also have lowered the short-term cost of using rookies.[38]

Table 10 redoes the regressions from Table 6 for rookies playing under the 2005 CBA. Consistent with our hypotheses, and in contrast to the results we obtain for the 1999 CBA, the

[37] Since the first year became a contract extension year under the 2005 CBA, rookies may have had more powered incentives to exert effort than before. Stiroh (2007) shows that veteran NBA players perform significantly better in the year before signing a multiyear contract. A closer look reveals that the effect on performance was particularly strong for rookies who were drafted tenth or below (an 18% improvement in PER compared to under the 1999 CBA) and much weaker for rookies drafted in the top ten spots (a 4% improvement). Since it seems quite unlikely that a team's general manager would not extend a very high draft pick after only one year, we expect the incentive effect to have been weaker for these players.

[38] We believe, however, that the change in the salary cap had a much smaller incentive effect on rookies than on veterans. The updating of the rookie scale by itself had no incentive effect as the salary is exogenously fixed, depending on the draft position. The increase in cap certainly has raised the payout that rookies can expect in the future, after their rookie contracts have expired in year 5. However, even under the smaller cap, rookies already had powered incentives to perform well in their first year in order to remain in the league. Without exception, the alternative to playing in the NBA for all rookies was significantly less lucrative financially, even under the smaller cap. Hence, we believe that the effect of the change in the cap was secondary to that of adding a contract extension decision at the end of the first year. The downside of not being renewed and dropping out of the NBA must have loomed larger.

coefficient for the interaction term of *Termination Risk* and *Game Importance* in column (2) is now close to zero and statistically insignificant. Our results are consistent with the hypothesis that the introduction of the 2005 CBA has led to a decrease in the discretion granted to coaches over rookies' playing time and thus has weakened and even eliminated the association between termination risk and lower rookie participation.

While we cannot quite distinguish whether the result is driven by the increased importance to ownership of evaluating the rookies' first-year performance in order to make well-informed contract-extension decisions by the end of the year (an increase in long-run benefits) or by the decrease in the short-run cost of playing the rookies (for the reasons discussed above), indirect evidence suggests that the first effect was important. Under the 2005 CBA, the minutes allocated to rookies have increased for any number of years of college experience, suggesting that the rookies' increase in total experience attributable to the introduction of the age limit does not fully explain the results. We have also looked at whether there were other changes in the NBA environment that coincided with the 2005 CBA and might explain the improved play of rookies. One such change has been a revision of the league's defensive rules introduced at the beginning of the 2004 season: the new rules forbid any hand-checking by a defensive player. For rookies, this rule seems to have favored mainly guards and has had very little effect on forwards.[39] In unreported results, we ran the regressions for rookie forwards only—for those playing under the 1999 CBA, and for those playing under the 2005 CBA. The short-termism effect is present and significant for the former group but not for the latter. Since the performance of forwards was nearly identical over the two periods, the results for this group are unlikely to be explained by a decrease in the short-run cost of playing the rookies. This gives further support to our interpretation that the change in long-term benefits and the effect on owners' incentives to intervene played an important role.

[39] The average performance (PER) of rookie guards increased from 10.54 under the 1999 CBA to 12.4 under the 2005 CBA, whereas that of forwards did not improve. The rule has made it more difficult to defend quick players, and we conjecture that it has boosted the performance young rookie guards who, on average, are quicker, but less physical, than opposing veteran players.

VIII. Conclusion

This paper has studied empirically the agency problems that arise when decision making is delegated to agents with short-time horizons. When those agents have private information that is relevant for making optimal decisions, organizations might elect to grant them decision-making discretion even when the agents' objective function is not perfectly aligned with that of the organization. Agents with such discretion who face a significant risk of termination may underinvest in projects that provide some of their payoff only in the long term. We have studied this issue using data from the NBA.

The agents in our study are NBA coaches who make "investment'' decisions concerning rookie players. These players lack NBA experience when they join their teams, and their long-term performance can benefit from gaining such experience. We have developed a simple model that identifies when owners will choose to grant coaches discretion over rookie participation decisions and shows that, in the presence of such discretion, coaches facing a higher termination risk can be expected to use rookies less often. Analyzing data on the participation of all rookies in NBA games during the period of 1999–2010, we find that the evidence is consistent with the predictions of our model.

In particular, during the period of the NBA's 1999 CBA, coaches who faced a significant risk of termination by the end of the season let rookies participate in games less frequently. This association between termination risk and rookie participation was particularly strong in important games, did not exist for unimportant games, and ceased to exist after the 2005 CBA increased owners' incentives to ensure that rookies get opportunities to play. This association also did not exist for second-year players who already had NBA experience or for top rookies.

Our analysis highlights the value of studying agency problems that are due to short-termism among agents other than CEOs of business firms. Future work might seek to examine the extent to which, and the circumstances under which, termination risk and investment in long-term projects are associated in the wide range of settings in which agents with short time horizons make decisions with long-term consequences. Agents in our context operate under contracts with a predefined length, do not receive explicit incentives, are motivated by career concerns, and divide their effort among multiple tasks whose outputs are realized in different time periods. Similar conditions exist, for example, for elected public officials such as governors and district attorneys, and it would be interesting to see if similar issues arise in these contexts.

More closely related to our paper are setups in which the agents in question are in charge of the development of their subordinates' human capital. In addition to other professional team sports, there are similarities to law firms and other service partnerships. Partners who are concerned about their reputations may hesitate to give young associates who are assigned to work with them significant assignments on important cases, even though such cases provide crucial learning opportunities.[40] Similar issues may arise in other firms, in which unit managers need to make choices regarding the allocation of tasks between more experienced and new workers within their units.

A central finding of our paper is that long-term guaranteed contracts help to align the objectives of principals and agents and that this alignment is weakened over the years of the contract. Principals can counter this by granting long contracts and renewing them at an early stage. While this would result in fewer biased decisions by agents, such long-term commitments would make it more costly for principals to make changes in the future in response to changing circumstances. It might also dilute the general power of the incentives given to agents to exert effort. It would be interesting to consider the use of long-term contracts in similar environments.

[40] A BCG article suggests that the lack of training, mentoring, and development opportunities is one of the major reason why associates leave law firms. See https://www.bcgsearch.com/article/900044920/What-Causes-Associates-to-Leave-Law-Firms/.

References

Abramitzky, Ran, Liran Einav, Shimon Kolkowitz, and Roy Mill (2012), "On the Optimality of Line Call Challenges in Professional Tennis," *International Economic Review*, Vol. 53, No. 3, pp. 939–964.

Aghion, Philippe, John Van Reenen, and Luigi Zingales, (2010), "Innovation and institutional ownership," *American Economic Review*, Vol. 103, No. 1, pp. 277-304.

Asker, John William, Joan Farre-Mensa and Alexander Ljungqvist, (2015), "Corporate Investment and Stock Market Listing: A Puzzle?," *Review of Financial Studies*, Vol. 28, pp. 342-390.

Azoulay, Pierre, Gustavo Manso and Joshua Graff Zivin (2011), "Incentives and Creativity: Evidence from the Academic Life Sciences. *RAND Journal of Economics*," Vol. 42, No. 3, pp. 527-554.

Banaian, King; Gallagher, Dan (1999), "When a Cap is not a Cap: Player Mobility and Pay in the NBA," mimeo.

Bebchuk, Lucian and Lars Stole, "Do Short-Term Managerial Objectives Lead to Under- or Over-Investment in Long-Term Projects?," *Journal of Finance*, Vol. 48, pp. 719-729.

Bernstein, Shai (2015), "Does Going Public Affect Innovation?," *Journal of Finance*, Vol. 70, pp:1365-1403.

Bolton, Patrick, Jose Scheinkman and Wei Xiong (2006), "Executive Compensation and Short-termist Behavior in Speculative Markets," *Review of Economic Studies*, Vol. 73, pp. 577-610.

Camerer, Colin F., and Roberto A. Weber, (1999), "The Econometrics and Behavioral Economics of Escalation of Commitment: A Re-Examination of Staw and Hoang's NBA Data," *Journal of Economic Behavior & Organization*, Vol. 39, No. 1, pp. 59-82.

Chang J. and Lai, C. (1999), "Carrots or Sticks? A Social Custom Viewpoint on Worker Effort," *European Journal of Political Economy*, Vol. 15, pp. 297-310.

Chiappori, Pierre-André; Levitt, Steven; and Groseclose, Timothy. "Testing Mixed-Strategy Equilibria When Players Are Heterogeneous: The Case of Penalty Kicks in Soccer." *American Economic Review,* September 2002, Vol. 92, No. 4, pp. 1138-51.

Dechow, P. and R. Sloan (1991) "Executive incentives and the horizon problem: An empirical investigation," *Journal of Accounting and Economics*, Vol14, Issue 1, pp. 51–89.

Dickinson, D. and Villeval M. (2008), "Does Monitoring decrease Work Effort? The complementarity between agency and crowding-out Theories," *Games and Economic Behavior*, Vol. 63(1), pp. 56-76.

Duggan, Mark and Steven D. Levitt (2002), "Winning is not Everything: Corruption in Sumo Wrestling," *American Economics Review*, Vol. 92, No. 2, pp. 1594-1605.

Edmans, Alex, Vivian W. Fang and Katharina A. Lewellen (2013), "Equity vesting and managerial myopia," National Bureau of Economic Research Working Paper No. w19407.

Farmer, Amy, Paul Pecorino, and Victor Stango (2004), "The Causes of Bargaining Failure: Evidence from Major League Baseball," *Journal of Law and Economics*, Vol. 47, No. 2, pp. 543-568.

Frey, B.S (1993), "Does monitoring increase work effort? The rivalry with trust and loyalty," *Economic Inquiry*, Vol. 31, pp. 663-670

Garicano, Luis, Ignacio Palacios-Huerta, and Canice Prendergast (2005), "Favoritism Under Social Pressure," *The Review of Economics and Statistics*, Vol. 87, No. 2, pp. 208-216

Gonzalez, Angelica and Paul André (2014), "Board Effectiveness and Short-Termism," *Journal of Business Finance & accounting*, Vol. 41, Issue 1-2, pp; 185-209.

Groothuis, Peter A., James Richard Hill, and Timothy J. Perri (2007), "Early Entry in the NBA Draft. The Influence of Unraveling, Human Capital, and Option Value," *Journal of Sports Economics*, Vol. 8, No. 3, pp. 223-243.

Hollinger, John. *Pro Basketball Forecast, 2005-06*. Potomac Books, 2005.

Holmstrom, Bengt (1999), "Managerial Incentive Problems: A Dynamic Perspective," *The Review of Economic Studies*, Vol. 66, No. 1, pp. 169-182

Kahane, Leo, Neil Longley, and Robert Simmons (2013), "The Effect of Coworker Heterogeneity on Firm-Level Output: Assessing the Impacts of Cultural and Language Diversity in the National Hockey League," *The Review of Economics and Statistics*, Vol. 95, No.1, pp. 302-314.

Kahn, M. Lawrence (2000), "The Sport business and a Labor Market Laboratory," *Journal of Economics Perspective*, Vol. 14, No. 3, pp. 75-94.

Karaca-Mandic, Pinar, and Kenneth Train (2003), "Standard error correction in two-stage estimation with nested samples," *The Econometrics Journal*, Vol. 6, No. 2, pp. 401-407.

Ladika, Tomislav and Zacharias Sautner (2013), "The Effect of Managerial Short-Termism on Corporate Investment," Working Paper, available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2286789.

Matvos, Gregor (2014), "Renegotiation Design: Evidence from National Football League Roster Bonuses," *Journal of Law and Economics*, Vol. 57, No. 2, pp. 387-430

Narayanan, M.P (1985), "Managerial Incentives for Short-term Results," *Journal of Finance*, Vol. 40, No. 5, pp. 1469–1484.

Nikhil, Joshi (2011), "The Market for Talent: Are Top Draft Picks Overpaid?," mimeo.

Parson, Christopher A., Johan Sulaeman, Michael C. Yates, Daniel S. Hamermesh (2011), "Strike Three: Discrimination, Incentives, and Evaluation," *The American Economic Review*, Vol. 101, No. 4, pp. 1410-1435.

Petrin, Amil, and Kenneth Train (2003), "Omitted product attributes in discrete choice models," National Bureau of Economic Research Working Paper No. 9452.

Price Joseph and Justin Wolfers (2010), "Racial Discrimination among NBA Referees," *The Quarterly Journal of Economics*, Vol. 125, No. 4, pp. 1859-1887

Romer, David. "Do Firms Maximize? Evidence from Professional Football." *Journal of Political Economy,* April 2006, Vol. 114, No. 2, pp. 340-65.

Staw, Barry M., and Ha Hoang (1995), "Sunk costs in the NBA: Why draft order affects playing time and survival in professional basketball," *Administrative Science Quarterly*, Vol. 40, No. 3, pp. 474-494.

Stein, Jeremy (1988), "Takeover Threats and Managerial Myopia," *Journal of Political Economy*, Vol. 96, no. 1, pp. 61-80.

Stein, Jeremy (1989), "Efficient Capital Markets, Inefficient Firms: A Model of Myopic Corporate Behavior," *Quarterly Journal of Economics*, Vol. 104, pp. 655-669.

Stiroh, Kevin J. (2007) "Playing for Keeps: Pay and Performance in the NBA," *Economic Inquiry*, Vol. 45, No. 1, pp. 145-161.

Von Thadden, Ernst-Ludwig, (1995) "Long-term contracts, short-term investment, and monitoring," *Review of Economic Studies*, Vol. 62, pp. 557-575.

Xu, Moqi, (2013), "The costs and benefits of long-term CEO contracts," Working Paper, London School of Economics.

Figure 1: Game Importance Measure

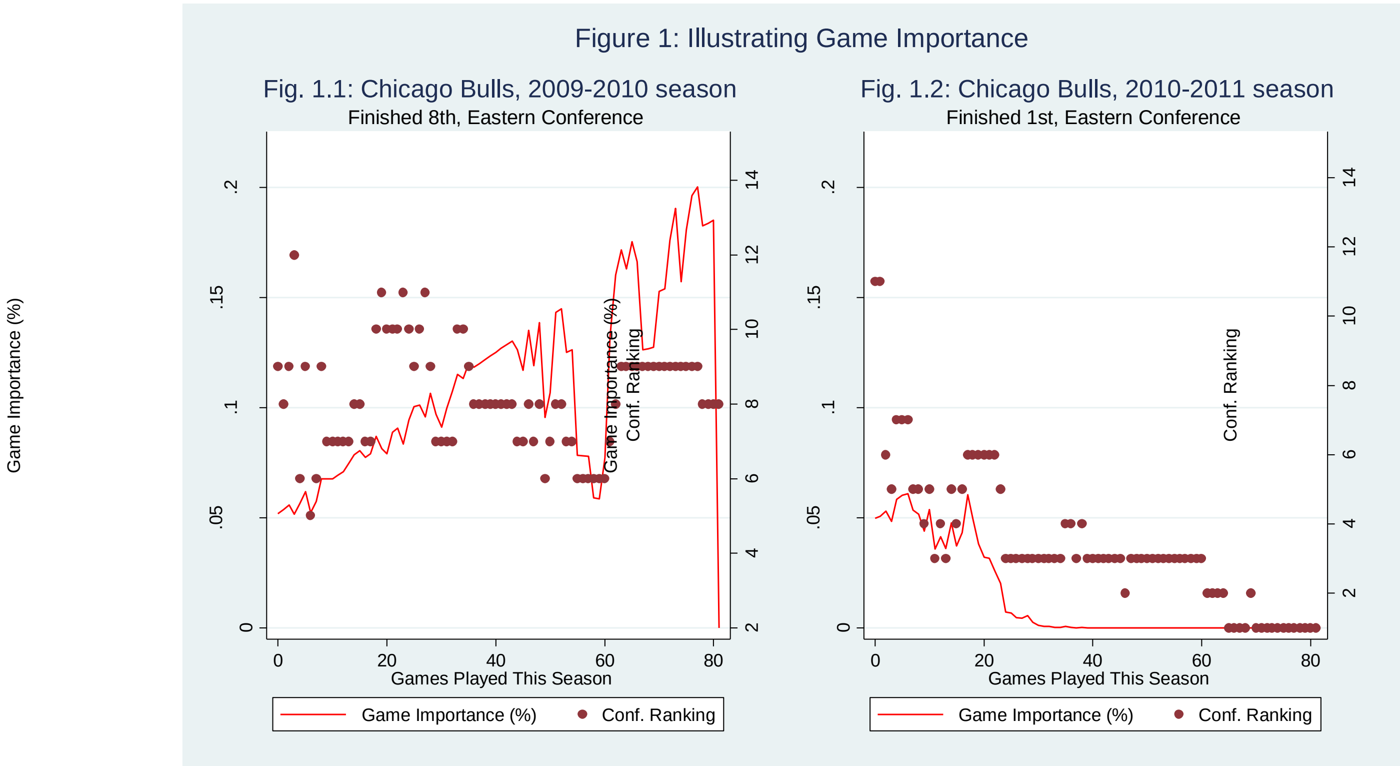

Table 1: Summary Statistics: Player-Game-Level Data

		1999 CBA		2005 CBA	
	(1)	(2)	(3)	(4)	(5)
	Total	Rookies	Second Year	Rookies	Second Year
Played	0.73	0.67	0.75	0.75	0.75
	(0.44)	(0.47)	(0.43)	(0.43)	(0.43)
Draft Rank	14.94	14.75	14.42	15.48	15.21
	(8.37)	(8.36)	(8.30)	(8.45)	(8.33)
Center	0.15	0.17	0.16	0.12	0.12
	(0.35)	(0.38)	(0.37)	(0.33)	(0.33)
Forward	0.45	0.44	0.45	0.47	0.45
	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)
Foreigner	0.15	0.17	0.16	0.13	0.12
	(0.35)	(0.38)	(0.36)	(0.33)	(0.33)
Skipped College	0.08	0.12	0.13	0.03	0.03
	(0.27)	(0.33)	(0.34)	(0.17)	(0.17)
College Years	2.1	1.96	2	2.26	2.23
	(1.51)	(1.57)	(1.58)	(1.41)	(1.40)
Traded	0.02	0.01	0.01	0.01	0.05
	(0.14)	(0.10)	(0.11)	(0.10)	(0.22)
Balance	-2.87	-2.59	-1.43	-4.05	-3.62
	(14.25)	(14.35)	(13.93)	(14.62)	(13.95)
Opponent Balance	0.04	-0.05	-0.01	0.16	0.07
	(14.26)	(13.92)	(13.50)	(14.85)	(14.89)
Games Played	41.34	41.76	41.24	41.7	40.53
	(23.69)	(23.73)	(23.69)	(23.68)	(23.65)
Same Conference	0.33	0.36	0.34	0.31	0.31
	(0.47)	(0.48)	(0.47)	(0.46)	(0.46)
Injured	0.1	0.15	0.11	0.04	0.1
	(0.35)	(0.38)	(0.35)	(0.30)	(0.34)
PER	11.7	10.87	12.42	11.02	12.53
	(13.20)	(13.67)	(12.92)	(13.50)	(12.57)
Minutes	16.18	13.66	17.84	15.12	18.49
	(14.18)	(13.80)	(14.61)	(13.23)	(14.51)
N	48,191	13,327	12,614	11,515	10,735

Notes: The sample include all games for all first-round rookies drafted from 1999 to 2009. It includes information concerning the rookies' first and second years at the NBA. Means are reported for the entire sample and are also broken down by CBA and years of experience (with standard deviations reported in parentheses). *Played* is a dummy variable indicating whether the rookie played in a specific game; *Draft Rank* is the rookie's draft ranking (the first drafted rookie is assigned the value 1); *Center* and *Forward* indicate the rookie's position; *Foreigner* indicates that the rookie was born and attended high school outside the United States; *Skipped College* indicates that the rookie was born in the United States and did not attend college; *College Years* indicates the number of years the rookie attended college; *Traded* indicates that the rookie was traded in the middle of the season; *Balance* is a calculation of wins minus losses of the rookie's team, prior to the current game; *Opponent Balance* is similar, only for the opposing team; *Games Played* indicates the number of games the team has played so far in the season; *Same Conference* indicates that the opposing team is from the same conference; *Injured* indicates games in which the rookie was inactive owning to a specific medical condition; *PER* is John Hollinger's player efficiency rating (computed at the game level); and *Minutes* is the number of minutes the rookie played in current game.

Table 2: Summary Statistics – Coach-Season Data

	(1) Total	(2) 1999 CBA	(3) 2005 CBA
Coach Age	50.48	49.38	51.63
	(8.07)	(7.85)	(8.15)
Coach Experience before Joining Team	4.52	4.25	4.81
	(6.11)	(6.46)	(5.72)
Tenure with Team	2.54	2.19	2.91
	(3.53)	(2.95)	(4.03)
% Wins before Joining Team	0.30	0.25	0.34
	(0.27)	(0.27)	(0.27)
% Wins with Team	0.35	0.34	0.36
	(0.26)	(0.27)	(0.26)
No Prior Experience with Current Team	0.31	0.34	0.28
	(0.46)	(0.48)	(0.45)
Joined Mid-Year	0.15	0.18	0.11
	(0.35)	(0.38)	(0.32)
Contract Length (years)	3.29	3.44	3.13
	(1.41)	(1.54)	(1.24)
Contract Years Left	1.39	1.56	1.2
	(1.23)	(1.33)	(1.09)
Fired	0.28	0.3	0.26
	(0.45)	(0.46)	(0.44)
N	416	213	203

Notes: The sample provides information concerning all coach seasons during the years 1999–2010. Means are reported for the entire sample in column (1) and are also broken down by CBA in columns (2) and (3) (with standard deviations reported in parentheses). *Coach Age* indicates the coach's age during the current season; *Tenure before Joining Team* indicates the number of coaching years the coach has spent in the NBA; *Tenure with Team* indicates the total number of years the coach has been coaching the current team; *% Wins before Joining Team* is the portion of wins in the coach's NBA career prior to joining his current team; *% Wins with the Team* is the portion of wins for the coach with his current team; *No Previous Experience with Current Team* indicates this is the first season the coach is coaching his current team; *Joined Mid-Year* is a dummy variable indicating that the coach started coaching the team in the middle of the season (following the firing of the previous coach or his departure for other reasons); *Contract Length* is the initial number of years in the coach's current contract; *Contract Years Left* is the number of years left in the coach's contract; and *Fired* indicates that either the coach was fired before the beginning of next season or his contract expired and was not extended.

Table 3: Performance of Rookies, Second-Year, and Veteran Players

Experience Group	Mean PER (Season Level)	S.D.	N	P-value: Compared with Second-Year Players
Rookies	11.709***	4.603	277	0.004
Second-Year Players	12.858	4.673	266	
Veterans	12.657	6.278	4,319	0.608

Notes: The sample includes all active players under a full-year contract. The top three drafted players are excluded from the sample. ***, **, * indicate statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 4: Performance and Playing Time (Dependent Variable: PER in a Game)

	(1)	(2)
NBA Experience	0.0026***	0.0016***
	(0.0003)	(0.0003)
$(\text{NBA Experience})^2$	-1.5e-07**	-1.7e-07***
	(5.69e-08)	(4.75e-08)
Time		0.0005
		(0.0012)
Constant	8.626***	2.006
	(0.251)	(19.34)
Player FE	No	Yes
N	35,119	35,119
R^2	0.033	0.086

Notes: The sample contains all games in the first two years of all first-round rookies during the years 1999−2010. *NBA Experience* is the cumulative number of minutes played by the rookie from his NBA debut and prior to this game. *Time* is a calendric time trend. Standard errors are clustered by player and are reported in parentheses. ***, **, and * indicate statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 5: Coach Termination Risk – Probit Regression Results, Team Fixed Effects (Dependent Variable – Coach Terminated by End of Season)

Coach Contract Years Left	-0.532***
	(0.138)
Coach Contract Initial Length (years)	-0.0278
	(0.128)
Coach Age	0.152
	(0.139)
Coach Age^2	-0.00120
	(0.00138)
Coach Experience before Joining Team	-0.187***
	(0.0632)
(Coach Experience before Joining Team)^2	0.00683**
	(0.00279)
Coach Tenure with Team	0.164
	(0.194)
(Coach Tenure with Team)^2	-0.0321
	(0.0224)
Coach % of Wins before Joining Team	-0.244
	(0.467)
Coach % of Wins with Team	0.0693
	(0.789)
No Experience with Current Team Prior to This Year	-0.0987
	(0.378)
Constant	-4.598
	(3.572)
N	389
Pseudo R^2	0.254

Notes: Regressions include team fixed effects. Robust standard errors are clustered by team and reported in parentheses. ***, **, *, indicate statistical significance at the 0.01, 0.05, 0.10 levels, respectively.

Table 6: Coach Termination Risk and Rookie Participation during 1999 CBA– Linear Probability Regression (Dependent Variable: Rookie Played)

	(1)	(2)
Termination Risk	-0.187**	-0.107
	(0.0864)	(0.0963)
Game Importance	-0.0761	0.304
	(0.191)	(0.232)
Termination Risk x Game Importance		-1.991**
		(0.877)
Draft Rank	-0.00651***	-0.00665***
	(0.00219)	(0.00218)
Center	-0.00422	-0.00702
	(0.0389)	(0.0386)
Guard	0.0389	0.0375
	(0.0253)	(0.0249)
Foreigner	0.0207	0.0118
	(0.0421)	(0.0427)
College Years	0.0271***	0.0276***
	(0.0102)	(0.0102)
Traded	0.133***	0.127***
	(0.0446)	(0.0456)
Team's Record	-0.000951	-0.000959
	(0.000995)	(0.000991)
Game Number	-0.00189***	-0.00192***
	(0.000595)	(0.000599)
Same Conference	-0.0205*	-0.0214**
	(0.0107)	(0.0108)
Home team	0.0107*	0.0105*
	(0.00572)	(0.00569)
Rest Days	-0.00474	-0.00474
	(0.00323)	(0.00322)
Opponent's record	-0.000241	-0.000251
	(0.000206)	(0.000207)
Game Importance to Opponent	-0.136*	-0.133*
	(0.0801)	(0.0805)
Cumulative PER up to game	0.00597***	0.00584***
	(0.00127)	(0.00127)
Rank in Position	-0.0183**	-0.0186***
	(0.00709)	(0.00699)
Minutes played up to game	0.000137***	0.000137***
	(2.81e-05)	(2.81e-05)
Final Score difference > 20	0.146***	0.145***
	(0.0179)	(0.0179)
Final Score difference <5	-0.0742***	-0.0743***
	(0.0128)	(0.0128)
Constant	0.862***	0.852***
	(0.0517)	(0.0513)
N	10,897	10,897
R^2	0.242	0.244

Notes: The sample contains all games during the years 1999–2004 except for those in which the rookie was inactive owing to a specific medical condition. *Termination Risk* is the predicted probability of coach termination. Regressions include coach fixed effects. Standard errors are clustered by player and are reported in parentheses. ***, **, * indicate statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 7: Coach Termination Risk and Rookie Participation during 1999 CBA - Alternative Dependent Variables

Dependent Variables	(1) Played ≥ 5 minutes	(2) Played ≥ 10 minutes	(3) Played ≥ 15 Minutes
Termination Risk	-0.154	-0.105	-0.0687
	(0.120)	(0.120)	(0.107)
Game Importance	0.415	0.482	0.284
	(0.314)	(0.320)	(0.285)
Termination Risk x Game Importance	-2.512**	-2.970***	-2.349**
	(1.098)	(1.114)	(1.079)
N	10,897	10,897	10,897
Adj. R^2	0.336	0.370	0.395

Notes: The table reports estimation results of a linear probability model for alternative dependent variables. Played ≥ x minutes is a dummy variable indicating that the rookie played above $x = 5, 10, 15$ minutes in the current game; *Termination Risk* is the predicted probability of coach termination, based on the regression in Table 5; and *Game Importance* is an estimated measure of the importance of a game, discussed in Section VI.B. Regressions include coach fixed effects, and all other independent variables are defined as in Table 6, although not reported. Standard errors are clustered by player and are reported in parentheses. ***, **, * indicate statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 8: Settings Where Termination Risk Is Not Associated with Lower Rookie Participation (Dependent Variable - Played)

	(1) ^ Ranked 1 or 2 in position	(2) ^ All others	(3) Second-Year Players	(4) ^^ First-Year Rookies
Termination Risk	0.178	0.0005	-0.094	-0.107
	(0.118)	(0.131)	(0.0941)	(0.0963)
Game Importance	0.0113	0.146	0.411**	0.304
	(0.499)	(0.279)	(0.206)	(0.232)
Termination Risk × Game Importance	0.206	-1.907*	-0.876	-1.991**
	(1.401)	(1.006)	(0.645)	(0.877)
N	1,880	7,324	10,846	10,897
Adj. R^2	0.159	0.263	0.165	0.244

Notes: The table reports estimation results of linear probability models with different samples. All specifications include coach fixed effects in addition to the entire list of controls as in Table 6, although not reported. Standard errors are clustered by player and reported in parentheses. ***, **, * indicate statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

^ Only rookies in the guard or forward positions are included.

^^ Column (4) is reproduced from Table 6 column (2) for comparison.

Table 9: The Effect of Teammates' Age on Rookies' Playing Time

Dependent Variables	(1) Played	(2) Played ≥ 5 minutes	(3) Played ≥ 10 minutes	(4) Played ≥ 15 Minutes
Termination Risk	-0.145	-0.211*	-0.139	-0.0436
	(0.0994)	(0.121)	(0.126)	(0.119)
Game Importance	0.00487	0.0123	0.148	0.148
	(0.215)	(0.296)	(0.325)	(0.318)
Termination Risk × Game Importance	-1.558*	-1.616	-2.137*	-1.920
	(0.905)	(1.108)	(1.177)	(1.192)
Older Team	-0.108**	-0.152**	-0.106*	-0.0151
	(0.0497)	(0.0620)	(0.0635)	(0.0642)
Older Team× Termination Risk	0.143	0.208	0.112	-0.154
	(0.217)	(0.264)	(0.247)	(0.207)
Older Team× Game Importance	1.202**	1.733***	1.550**	0.821
	(0.507)	(0.648)	(0.610)	(0.614)
Older Team × Termination Risk × Game Importance	-2.120	-5.470*	-5.565**	-4.065*
	(2.146)	(2.885)	(2.549)	(2.414)
Constant	0.876***	0.806***	0.738***	0.668***
	(0.0499)	(0.0562)	(0.0578)	(0.0574)
N	10,897	10,897	10,897	10,897
Adj. R^2	0.246	0.340	0.372	0.396

Notes: The table reports estimation results of a linear probability model for different dependent variables, as defined in Table 7. *Termination Risk* is the predicted probability of coach termination (based on the regression in Table 5). *Game Importance* is an estimated measure of the importance of a game, as discussed in Section VI.B; *Older Team* is an indicator for teams in the fourth quartile of the mean age of players, excluding rookies. Regressions include coach fixed effects, and all other independent variables are as in Table 6, although not reported. Standard errors are clustered by player and are reported in parentheses. ***, **, * indicate statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 10: Coach Termination Risk and Rookie Participation during the 2005 CBA
Linear Probability Regression (Dependent Variable: Rookie Played)

	(1)	(2)
Termination Risk	0.00134	-0.00820
	(0.109)	(0.121)
Game Importance	0.0678	0.00108
	(0.204)	(0.327)
Termination Risk x Game Importance		0.240
		(0.917)
Draft Rank	0.000589	0.000578
	(0.00184)	(0.00184)
Center	-0.215***	-0.215***
	(0.0516)	(0.0515)
Guard	-0.00425	-0.00454
	(0.0304)	(0.0306)
Foreigner	-0.0440	-0.0442
	(0.0516)	(0.0516)
College Years	-0.00832	-0.00855
	(0.0124)	(0.0124)
Team's Record	-0.00248**	-0.00249**
	(0.000964)	(0.000965)
Game Number	-0.00305***	-0.00306***
	(0.000634)	(0.000634)
Same Conference	0.0170	0.0172
	(0.0132)	(0.0132)
Home team	0.00554	0.00558
	(0.00631)	(0.00628)
Rest Days	-0.00291	-0.00290
	(0.00300)	(0.00300)
Opponent's record	-0.000346*	-0.000345*
	(0.000207)	(0.000208)
Game Importance to Opponent	-0.0277	-0.0279
	(0.0698)	(0.0697)
Cumulative PER up to game	-0.00168	-0.00169
	(0.00358)	(0.00358)
Rank in Position	-0.0476***	-0.0475***
	(0.00965)	(0.00969)
Minutes played up to game	0.000179***	0.000180***
	(2.96e-05)	(2.96e-05)
Final Score difference > 20	0.105***	0.105***
	(0.0136)	(0.0136)
Final Score difference <5	-0.0618***	-0.0617***
	(0.0107)	(0.0107)
Constant	1.014***	1.018***
	(0.0740)	(0.0751)
N	10,391	10,391
Adj. R^2	0.261	0.261

Notes: The sample contains all games played during the years 2005–2010 except for those in which the rookie was inactive owing to a specific medical condition. *Termination Risk* is the predicted probability of coach termination. Regressions include coach fixed effects. Standard errors are clustered by player and are reported in parentheses. ***, **, * indicate statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

Appendix

Proof of Lemma 2:

To incorporate α and β into the model, we modify equations (1) and (2) as follows:

$$\alpha(s+\theta)+\beta l>0. \qquad (A1)$$

$$\alpha(s+\theta)+\beta(1-\pi)l>0. \qquad (A2)$$

and

$$V^{ND}-V^{D}=\frac{1}{2\overline{\theta}}\cdot\int_{-\overline{\theta}}^{\hat{\theta}}(\alpha(s+\theta)+\beta l)d\theta \qquad (A3)$$

In addition, redefine $\theta^{*}\equiv -s-\frac{\beta l}{\alpha}$ and $\hat{\theta}(\pi)\equiv -s-\frac{(1-\pi)\beta l}{\alpha}$.

(i) Taking a derivative of (A3) with respect to β,

$$\frac{d(V^{ND}-V^{D})}{d\beta}\propto\left(\alpha\left(s+\hat{\theta}\right)+\beta l\right)\frac{\partial\hat{\theta}}{\partial\beta}+l\left(\hat{\theta}+\overline{\theta}\right).$$

Observe that $\left(s+\hat{\theta}\right)+\beta l=\alpha(s+\theta^{*})+\beta l+\alpha\left(\hat{\theta}-\theta^{*}\right)=\alpha\left(\hat{\theta}-\theta^{*}\right)$, where the second equality follows from the definition of θ^{*}. As $\frac{\partial\hat{\theta}}{\partial\beta}=-\frac{(1-\pi)l}{\alpha}$,

$$\frac{d(V^{ND}-V^{D})}{d\beta}\propto -(1-\pi)l\left(\hat{\theta}-\theta^{*}\right)+l\left(\hat{\theta}+\overline{\theta}\right)=\pi l\hat{\theta}+(1-\pi)l\theta^{*}+l\overline{\theta}>0.$$

(ii) Taking a derivative of (A3) with respect to α,

$$\frac{d(V^{ND}-V^{D})}{d\alpha}\propto\left(\alpha\left(s+\hat{\theta}\right)+\beta l\right)\frac{\partial\hat{\theta}}{\partial\alpha}+\int_{-\overline{\theta}}^{\hat{\theta}}(s+\theta)d\theta,$$

where $\frac{\partial\hat{\theta}}{\partial\alpha}=\frac{(1-\pi)\beta l}{\alpha^{2}}$ and hence,

$$\left(\alpha\left(s+\hat{\theta}\right)+\beta l\right)\frac{\partial\hat{\theta}}{\partial\alpha}=\alpha\left(\hat{\theta}-\theta^{*}\right)\frac{(1-\pi)\beta l}{\alpha^{2}}=\left(\hat{\theta}-\theta^{*}\right)\frac{(1-\pi)\beta l}{\alpha}=-\left(\hat{\theta}-\theta^{*}\right)\left(s+\hat{\theta}\right).$$

Thus, as $s+\hat{\theta}=-\frac{(1-\pi)\beta l}{\alpha}<0$,

$$\frac{d(V^{ND}-V^{D})}{d\alpha}\propto -\left(\hat{\theta}-\theta^{*}\right)\left(s+\hat{\theta}\right)+\int_{-\overline{\theta}}^{\hat{\theta}}(s+\theta)d\theta$$

$$<-\left(\hat{\theta}-\theta^{*}\right)\left(s+\hat{\theta}\right)+\int_{\theta^{*}}^{\hat{\theta}}\left(s+\hat{\theta}\right)d\theta=0. \quad \blacksquare$$