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ABSTRACT

Strategic Behaviours in a Labour Market with Mobility-Restricting Contractual Provisions: Evidence from the National Hockey League

We follow workers' performance along an unbalanced panel dataset over multiple years and study how performance varies at the end of fixed-term contracts, in a labour market where some people face a mobility restricting clause (i.e., a noncompete clause). Focusing on the labour market of the National Hockey League, we analyse players' performance data and contracts with a fixed effect estimator to address empirical limitations in previous studies. We find that, on average, NHL players' performance does not vary. However, our estimations detect substantially heterogeneous behaviours, depending on tenure, perceived expected performance and mobility. Only younger players (i.e., restricted free-agents) with high expected mobility but low expected performance tend to behave strategically and perform better. Differently, older players (i.e., unrestricted free-agents) with high expected mobility tend to underperform, as the option of moving back to European tournaments is more appealing.

JEL Classification: D82, J24, J33, M52, Z22
Keywords: strategic behaviour, mobility, noncompete clauses

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1 Introduction

Individuals adopt strategic behaviours and, thus, perform better when performance goals—such as quotas—and the end of the contract are approaching. For example, Asch (1990) finds that Navy employees increase their effort when rewards are within reach, while they decrease it when rewards are surely achieved. Oyer (1998) finds that salespeople try harder to reach their quotas when the payment period is approaching. However, over 30 years of studies, little consideration has been paid to possible mediators; in particular, no study investigates the role of workers' personal characteristics and mobility in determining their strategic behaviour.

We contribute to the literature by filling this gap. We utilize a large panel data set of National Hockey League (NHL) players, covering a 10-season span. Differently from most labour market data, these data provide us with rich details on workers, including proxies for their actual and expected performance, observable tenure, and potential geographic mobility. Furthermore, we can follow workers over time. The NHL setting is additionally interesting: its labour market is characterized by rules and tacit norms that, in theory, should reduce strategic behaviour and workers' incentives to manipulate effort. Similar rules are adopted also in the standard labour market; examples of such rules are the noncompete clause—which restricts the workers' outside employment—and buyout payments—which allows workers to be released from the former clause (Shi, 2023).

The usage of professional sports data in the study of performance is well established in the labour economic literature (Kahn, 2000; Szymanski, 2003). However, studies on employees' performance dynamics during fixed-term contracts lead to ambiguous results (Lehn, 1984; Krautmann, 1990; Sommers, 1993; Woolway, 1997; Oyer, 1998; Maxcy, Fort, and Krautmann, 2002; Berri and Krautmann, 2006; Stiroh, 2007; Purcell, 2009; Krautmann and Donley, 2009; Frick, 2011; Landry, Edgar, Harris et al., 2015; Feess, Gerfin, and Muehlheusser, 2015; Buraimo, Frick, Hickfang, et al. 2015). Maxcy (2018) suggests that such contradictory results may be driven by various empirical problems.

We identify, and address, two main empirical problems. First, most studies are based on relatively small samples; so, they face low statistical power and over-weight contract length outliers (Buraimo,

Frick, Hickfang, et al., 2015). Second, to the best of our knowledge, none of the previous studies follows individuals over time. Usually, individual observations are pulled over time: data are investigated with repeated cross-section techniques, in lieu of panel data techniques that control for time-invariant individual characteristics.

We provide some evidence of how some dimensions of the expected 'end-of-contract' opportunities faced by employees could impact their performance during their current contract. Several well-known theoretical factors can be taken into consideration; in a labour relationship, additionally to innate ability, employees' effort—and thus performance—is affected by employees' preferences, bargaining power, outside options, and potentially imperfect performance measures.[1] Additionally, we know that individuals might want to signal their abilities to future employers with high performance (Spence, 1973).

As we discuss below, the market we analyse and the dataset we use give us proxy information on multiple of the above factors. First, the bargaining power and the alternative options employees might face. In the NHL, the bargaining power of a player (i.e., the employee) crucially depends on the contract's clauses and on the possibility of freely accepting alternative offers. Second, our dataset provides information about the official measures used to evaluate employees' performance (and to reward them with contractual bonuses); this variety of measures helps us addressing the above issue on the potentially imperfect performance measures. Being able to account for such factors, our results allow us to illustrate how preferences and alternative options might counterbalance the signalling incentive.

The signalling comes at a cost. While the existence of outside options is expected to reduce performance at the end of a contract, these outside options become available if the performance is high in the first place. While employees with high abilities find it easy to achieve good results, employees with lower ability face the cost-benefit effects of performing well: the effort is the cost of high performance, but only good performance makes new opportunities available and enhances their expected payoff.

[1] See for example, Holmström (1979) and Baker (1992).

Arguably, experience (and thus age) also plays a role: experienced employees might be less willing to continue to build up their reputation and might opt to move to less profitable markets. Our results reflect such considerations.

In the NHL, players whose contracts expire fall into one of two categories, based generally on their years of service in the league, which in turn is strictly related to their age: unrestricted free agents (UFAs) and restricted free agents (RFAs). Players who become UFAs enjoy an unfettered, open, market for their services. They are free to sign a contract with any club in the league, with the player's former club retaining no control whatsoever over the player, nor being entitled to any compensation from the player's new club. For RFAs, the situation is more complicated. While they are technically able to sign with other clubs, a convoluted set of rules governs the process; rules which give considerable bargaining power to the player's current club, and which almost always results in the player remaining with that club. A key question, then, and one that our paper examines, is whether this presumed inability of RFAs to fully capture a free-market salary then impacts their propensity to engage in strategic behaviours. So, while both types of free-agents may have an incentive to try to improve their performance in the last year of the contract to secure a new one, the strength of these incentives may be lower for some RFAs. It is important to note that, while arrangements like those faced by RFAs seem alien to the standard labour market, they are indeed frequent. As Shi (2023) illustrates, this type of noncompete employment contracts are prevalent among publicly listed US firms, where more than 60% of executives have signed similar contracts.

This first set of heterogeneity analyses by players' free-agency type show that workers' characteristics are fundamental in determining their behaviour at the end of the contract, even in such a regulated labour market. On average, workers' performance does not vary, and this is something that we would expect given the NHL labour market regulations.

We conduct two additional sets of heterogeneity analyses: one by players' expected performance and one by players' expected mobility. Here, we observe that workers with greater geographic mobility reduce their performance, as NHL teams' market power is less binding for them.

The remainder of the paper proceeds as follows. Section 2 discusses the literature on incentives and performance variation along fixed-term contracts. Section 3 provides an overview of the institutional rules governing free agency in the NHL and discusses why skaters with different free-agency status might behave differently. Section 4 discusses dataset and descriptive statistics. Section 5 discusses the methodology and conducts the main analyses on strategic behaviour. Section 6 illustrates heterogeneity analyses. Section 7 concludes.

2 Literature review

The performance variation over fixed-term contracts is rarely empirically studied in the 'standard' labour market because direct measures of productivity and contracts features are hardly observable. To the best of our knowledge, only a few studies investigate strategic behaviour in the standard labour market and the most important ones are the following two. First, Asch (1990) finds that Navy employees increase their effort when rewards are within reach, while they decrease it when rewards are surely achieved. Then, Oyer (1998) finds that salespeople try harder to reach their quotas when the payment period is approaching. Thus, these studies to not investigate how performance variation changes toward the end of a contract; rather, both studies focus on strategic behaviour in connection to a given bonus threshold, that is, how the performance changes when a given performance goal is within reach.

On the contrary, as Table A.1 in the Appendix shows, this research topic is more frequently studied in the sports labour market due to the vast availability of players' performance data and contracts details. Focusing on MLB pitchers' and hitters' performance and contracts, Maxcy, Fort, and Krautmann (2002) was the first paper to provided clarification regarding opportunistic behaviour during contract negotiations, emphasizing that effort exceeding expectations can also be seen as a strategic move. Thus, aside from slacking off in the period(s) following the establishment of a guaranteed contract, demonstrating above-average performance in the period immediately preceding negotiations (the contract year) could also be indicative of strategic behaviour on the part of a player. Although this behaviour might be viewed as a drawback – as the player may not replicate the same level of effort after securing the

contract and compensation based on that performance – it could also align with incentive-compatible efficiency gains. The primary contribution of Maxcy, Fort, and Krautmann (2002) lies in emphasizing that a certain level of strategic behaviour can be expected. However, to mitigate the inefficiency resulting from shirking, contracts should incorporate incentive-compatible mechanisms. Moreover, the authors also introduced an empirical framework that has become the standard for investigating strategic behaviour in sports. A valid test of the shirking hypothesis necessitates a comparison between players at a juncture where strategic behaviour is likely and those who are not in such a position. The test involves comparing players with contractual incentives for strategic behaviour against those without such incentives and assessing whether these incentives influence their effort and output.

Purcell (2009) investigates the principal-agent problem in NHL, NFL, NBA and MLB, focusing on the imperfect information between managers and players, along with the assured income from long-term contracts. Findings reveals a decline in players' performance during the first year of a long-term contract, indicating that the impacts of the principal-agent problem may outweigh alternative effects. However, there is no evidence of strategic behaviour as players do not enhance their performance in the contract's final year. Landry, Edgar, Harris, et al. (2015) measures potential inefficiencies in NHL contracts and delineates the parameters of the principal–agent problem. He recognizes that player performance tends to rise with salary, reaches a peak in the initial year of a contract, and, despite decreasing over the contract's duration, typically increase in the final year of the contract. Finally, Fan, Lien, Meng, et al. (2021) provide evidence that NBA basketball players in their first year of a big contract tend to shirk; although this effect is not very sizeable for players whose expected performance is high. Moreover, players in their last season of contract perform better to obtain better conditions in their next contract.

Beyond North American sports, performance variation over long-term contracts is studied in European soccer by focusing only on the German Bundesliga and using a subjective overall player rating from Kicker as a player’s performance proxy. Frick (2011) addresses two important, and highly contested, issues: player remuneration and contract duration (players are usually considered as overpaid and poorly

motivated). He finds robust evidence that player performance significantly increases in the last year of the contract, while performance variance is significantly lower in the last year of the contract. Fess, Gerfin, and Muehlheusser (2010) deal with the endogeneity of contract length by exploiting the Bosman ruling as a natural experiment. Taking advantage of the variation in the probability of getting a long contract induced by the well-known judgment, they were able to estimate a local average treatment effect, which led to the conclusion that longer contracts have a negative but insignificant effect on performance. Additionally, Buraimo, Frick, Hickfang, et al. (2015) chose an instrumental variable (IV) approach, employing the average remaining contract duration of teammates as an instrument. They argue that this variable is likely indicative of the club's practice in providing specific contract lengths, possessing predictive power on a player's contract offer while avoiding direct correlation with their performance, thus satisfying IV assumptions. Surprisingly, their findings not only contradict but also reverse the shirking hypothesis. This result is in contrast with the principal-agent theory, and they explain it with the fact that if remaining contract length is positively associated with the measure of performance being studied, selection effects dominate moral hazard effects.

3 Free agency in the NHL

A major goal of this paper is to extend the literature by analysing the impacts of an employee's expected end-of-contract opportunities on their propensity to engage in strategic behaviour. The hypothesis is that the better these perceived opportunities, the more incentive an employee has to increase their effort in their final year of their existing contract. The NHL provides an effective outlet to empirically test such a hypothesis. For all players, when their contract expires, they become a free agent; however, not all free agents are created equal, and some have more bargaining power than others. This differentiated free-agency condition offers a nice setting to conduct a series of heterogeneity analyses by players' free-agency type, as well as by expected performance and geographic mobility.

The rules governing free agency in the NHL are contained in the collective bargaining agreement (CBA) that the league has with its players. These rules are extensive and complex, but we can simplify

them and focus on the distinction between players who are either unrestricted (UFAs) or restricted (RFAs) free agents.

Players with at least seven seasons of experience in the NHL, or who are at least 27 years old, become UFAs upon the expiration of their contract, and are free to move to other clubs without impediment.[2] These players can benefit from the open-market and competitive bidding for their services, allowing them to extract maximum value for their services.

For RFAs, the process is more complex. Players become RFAs if their current team presents them a qualifying offer;[3] this type of proposed contract renewal allows the team to retain negotiating rights.[4] This characteristic of the contracts resemble the noncompete employment clause. If the qualifying offer is rejected, the player remains a RFA, but can then sign an 'offer sheet' with any other NHL club. However, this does not mean that the player will automatically move to that club, since a player's current club can retain the player by simply matching the offer. This can cause other clubs to question whether it is worth the effort and expense of even making an offer considering the 'veto-power' retained by players' current club.[5]

There are additional major barriers to RFAs getting an offer sheet from another club. Most importantly, clubs who ultimately sign an RFA are required to compensate the player's former team,

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[2] Rules for unrestricted free-agency did not change after the 2012-2013 lockout (Staudohar, 2013), that is, within the period in analysis.

[3] A qualifying offer is a contract with a length of at least one season and with a salary that is at least the same as the previous one.

[4] Formally, when a short-tenure player, who is at the end of his contract, receives a qualifying offer by June 29th—of any given year—he becomes a RFA. On the same date, he can start new contract discussions with rival teams, even if he has received a qualifying offer, as long as he did not accept it; however, in that case, he can leave for a rival team only with the current team's permission. Therefore, if the player has not received a qualifying offer by July 1st of the same year, this player becomes an UFA. If the player has not obtained a contract renewal, or a contract with a new team, by December 1st of the same year, he cannot be hired by any other team, and thus will not play in the NHL during that season.

[5] Additional CBA rules may counterbalance the veto-power of RFAs' current teams, but these rules pave long and arduous routes. Would-be RFAs can elect to take the club to arbitration, rather than declaring free agency; to simplify, these players can do that only after the completion of four NHL seasons. This means that players who signed the mandated three-year entry level contract upon entering the league are not eligible for arbitration until the expiration of their second NHL contract. Thus, most arbitration-eligible players tend to be at least 23 years old. Arbitration is also a very adversarial process, so players are often reluctant to go to arbitration: they know they will play for the same club in the future, and do not want to damage the employment relationship.

usually in the form of draft picks, and often at onerous levels. This characteristic of the contracts resembles the buyout payments.

Taken as a whole, these various institutional rules and norms governing restricted free-agency in the NHL strongly suggests that RFAs will have less bargaining power than their UFA counterparts. For our purposes in this paper, the key question is whether this reduced bargaining power translates into a decreased propensity to engage in a particular strategic behaviour. In other words, if—given their lower bargaining power—players do not see their RFA status as being particularly valuable, they may opt to not increase performance in the final year of their current contract-However, the issue is probably more complex than this, and it is possible that there are several other factors at work. First, if a player is found to engage in strategic behaviour, it necessarily means, by definition, that they are giving less than maximum effort in previous seasons. While strategic behaviour might more likely happen in other sports,[6] this is much less likely for RFAs in the NHL. Almost all RFAs are early in their career and have contracts for only three years. For many of these RFAs, they are simply battling to stay in the league, and could not afford to give anything less than maximum effort for fear of being replaced by any one of a plethora of other young players waiting to take their jobs. For some of the high-end RFAs—often those who were high draft picks three years earlier—they may be more secure in their long-term futures and not constantly battling to stay in the league, so they may not have the same incentive to give maximum effort each year. However, even then, they do run the risk of general managers looking unfavourably at them if their effort levels show patterns of inconsistency and opportunism.

There is one other complication that must be considered, particularly for RFAs. The lack of bargaining power of RFAs only pertains to their relationship with NHL clubs. For some players, primarily those of European origin, they may be willing to leave the NHL and play in one of the many European leagues. In this sense, then, strategic behaviour could have a larger payoff for European players, compared to North Americans.

[6] For example, in baseball free agents often sign contracts for five to seven years or more, and many of them are already established stars in the league, thus allowing players to coast for a few years early in their contract

For all these scenarios and possibilities, only through empirical testing can one determine the relative importance of these various (and often countervailing) individual factors.

4 Data

4.1 Dataset

We collected players' data from the website nhlnumbers.com. Our data set is extremely large when compared to those of traditional papers that investigate moral hazard in the employer-employee relationship; in fact, our data cover a ten-season period, from 2007/2008 to 2016/2017.[7] We conduct our study on 6,304 player-season observations, that is, 1,618 individual skaters; 93 players appear in the data set for all ten seasons, whereas 385 appear only once.

This is the general profile of our players and their performance. First, we focus on regular season performance of players who hold multi-year contracts.[8] There is one reason for doing so: during playoffs, players benefit from additional monetary incentives, so their performance per game could not be comparable with of the regular season. Second, we eliminate players who have not played a single game during the season, since they do not have any performance statistics. Third, we do not investigate goalkeepers, because their performance is proxied by measures that are not comparable to those of other players.

[7] There are two main motivations for focusing on this period. There are two main motivations. First, the last season in the sample, 2016/2017, is only a couple of seasons before the disruptive COVID19 pandemic struck (which is the beginning of season 2019/2020). We expect that the study of strategic behaviour during the pandemic years (mostly 2020 and 2021) would be affected by a lot of unobservable issues. Second, the starting time of the sample also seems to be suitable and limits the effect of unobservable factors. The first season, 2007/2008, comes a couple of seasons after a big NHL structural change: the season 2004/2005 is characterized by a protracted lockout that led to the cancellation of the entire regular and post season, with the redefinition of important aspects, such as salary cap and salary floor, as well as tv rights, that notably increased teams' income. All in all, we reckon that the period we are analysing is characterized by a certain degree of stability that allows greater comparability of the results across seasons and the limitation of unobservable factors that would affect our results.

[8] One-year contract are about 10% of NHL players and have characteristics that fall out of the scope of this paper. Players who sign one-season contracts usually come from a minor league (i.e., the American Hockey League, AHL), and they start their contract when the season has already begun, which makes their contract shorter than one year (e.g., to substitute injured players).

4.2 Performance measures

We investigate three measures of performance. First, *Points per game*, which measures the sum of an individual player's seasonal goals and assists, averaged across the amount out seasonal games; this is perhaps the most direct measure of the skaters' individual performance (Idson and Kahane, 2000; Landry, Edgar, Harris, et al., 2015; Fumarco, Gibbs, Jarvis, et al., 2017). Second, we study the seasonal *Plus-minus per game*, which is meant to measure the impact of an individual skater on the game;[9] this measure is used in past studies, such as Idson and Kahane (2000), and it is one of the fans' favourite measures of hockey players' productivity.[10] Third, similarly to Idson and Kahane (2000), we study *Penalty minutes per game*, which captures players' intensity in the rink and, thus, his willingness to sacrifice for the team. All these outcomes are measured at the end of the season.

We are not considering more recent performance measures, such as Corsi and Fenwick,[11] for one main reason: they are not officially recognized by the NHL,[12] and they are not included in players' contracts according to the collective agreement regulating the period under consideration. Although these statistics might better capture the impact of the player's performance on the team, performance bonuses cannot be based on them. [13] Thus, bonuses are not expected to have a direct positive impact on these statistics.[14] This is crucial for the purpose of this paper: as explained below, we use promised bonuses to

[9] This is given by the difference between the sum of 'pluses', which are awarded to a player each time he is on ice and his team scores without having a 'manpower advantage,' and the sum of 'minuses' which are awarded to a player each time he is on the ice and the opponent team scores a goal when the players team is not 'shorthanded.' When a player commits a penalty, this player has to temporarily leave the rink and go into a penalty box for a set number of minutes—depending on the kind of infraction (National Hockey League, 2017), and his team is said to be 'shorthanded;' in this case, his team has a 'manpower disadvantage,' whereas the opponent team has a 'manpower advantage' (see http://www.nhl.com/ice/page.htm?id=26374, last accessed on February 27, 2024).

[10] Moreover, 'NHL Plus-Minus Award' was seasonally awarded from 1982/1983 to 2007/2008, underlying how well regarded this measure is.

[11] Fenwick measures players' shots and missed shots toward the opposite team's net minus these same shots from the opposite team toward the net of the player's team. Corsi is equivalent, except that this measure includes blocked shots attempts as well.

[12] See NHL.com at: https://www.nhl.com/stats/skaters (last accessed on February 27, 2024).

[13] Page 326, exhibit 5 of the collective agreement 2012-2022 (about the period covered by our dataset) explicitly mentions only goal, goal per match, assists, and plus-minus as performance measures that can be inserted in contractual bonus items. Moreover, there is a fifth statistics: blocked shots. While we could analyse this measure, the statistical power would be low, since this performance measure can incentivize only defensemen through bonuses—not all players regardless of their role--and thus results would not be generalizable to other players.

[14] Although there could be an indirect effect, because goals are a positive function of individuals' shots.

construct a proxy for expected performance. Thus, although more recent measures can better capture general individual performance, for the purpose of this paper, we refer only to statistics that are recognized by the federation and that can be used in bonuses.

4.3 Descriptive statistics

The study on strategic behaviour focuses on how performance changes in the last contract period, so our independent variable of interest is the dummy variable *Last_season*, that equals 1 when t corresponds to the last season of the contract.

Simple pairwise correlations provide some basic evidence for strategic behaviour. Table 1 shows that *Last_season* has a negative and statistically significant correlation with *Points* per game, which suggests the reversal of strategic behaviour, that is, a reduction in performance at the end of the contract. However, the interpretations of these simple correlations should be considered with a grain of salt for two reasons. First, they do not account for experience in the NHL. Second, they do not account for unobservable characteristics that are fixed over time. Moreover, the Appendix reports Figures A.1 to A.3 that convey additional descriptive information. These figures represent the correlation between individual number of seasons to the end of the contract (x-axis) and the average of each performance measure (y-axis) for all skaters, for RFAs, and for UFAs. These figures show that skaters' performance tend to decrease along the duration of the contract on average, without a clear increase at the very end of it, as one would expect is players behaved strategically.

Table 1 about here

Econometric analyses control for observable characteristics as well. In particular, we control for *Age*, which captures both the effect of biological age and of seasons of service in the NHL. This variable has a positive and statistically significant correlation with *Points* and *Penalty minutes* per game. There is a positive correlation between *Age* and *Last_season;* in any given moment, there are more older players in their last season of contract. However, this is not a problem in our analyses: we conducted a joint

orthogonality test, where we run a regression with *Last_season* as outcome on *Age* as well as various fixed effects. This test is in the replication package, and it shows that *Last_season* is balanced across ages, while controlling for player, team, season, fixed effects.

To investigate the role of different incentive structures, we split the sample between UFAs versus RFAs; then, we further divide RFAs between what we call expected low and high-performance players. This status is given by the ratio of promised performance-bonus to seasonal wage—both are expressed in millions of dollars. It is important to stress the 'promised' adjective: this is the bonus that the player is promised to obtain at the end of the regular season, if he performed 'well-enough' (i.e., where well-enough is an ex-ante cumulated season performance expressed in terms of either goals, assists or plus-minus, as by page 326, exhibit 5 of the collective agreement 2012-2022).[15] Larger values of this variable are associated with expected low-performance players, because the bonus that the team can offer them is relatively larger than their salary.[16] It is important to note that, since only RFAs are split based on this expected performance status, the number of observations on this variable is lower: bonuses can be offered only to players who qualify as RFAs at the end of their contract. Table 1 provides a statistically significant and positive correlation between *High-expected-performance RFA* and *Points per game*, while the correlation with *Penalty* is negative. It is not surprising to observe a positive correlation between *Contract_length* and *High-expected-performance RFA*; these players tend to have longer contracts.

Table A.2 in the Appendix reports the quantity of UFAs, and low and high-expected performance RFAs, in the overall sample and by geographic origin (i.e., North-America versus Europe), which is an

[15] We think that this measure of expected performance is better than draft pick—a variable we do not have, because it is characterized with time-variation. Promised bonus per season is established at the signing of each contract and thus varies over time, while draft pick is a snapshot of players' potential performance at the beginning of their career. Moreover, we note that we are controlling for players' fixed effects, which would capture the effect of draft pick—that is constant in time for any player.

[16] To explain further, high-expected-performance players are offered contracts where their guaranteed compensation (salary) is higher, relative to their bonus. In other words, the team, rather than the player, is taking more of the player's performance risk. The opposite is true for low-expected-performance players, who have less guaranteed money but more bonuses if they perform well.

important distinction in the heterogeneity analyses. One can observe that the ratio of European versus North-American players is between 2.5 and 2.9 in the overall sample and in the three subsamples.

Contract_length has expected positive associations with *Points*, *Plus-minus,* and *Age*. The association with *Expected-high-performance RFA* is negative, this is the opposite of what one would expect, but again, these associations should be considered carefully, as they are unconditional.

Finally, econometric analyses account for a variety of fixed effects that are not included in Table 1. Our econometric model controls for unobservable season and team characteristics, as well as for time-invariant players' characteristics.

5 Main analyses

In this section, we study strategic behaviour as captured by a dummy variable, which equals 1 if it is the last season of the player's contract, that is, *Last_season*. Equation (1) illustrates the fixed effect model:

$$Y_{it} = \beta_0 + \beta_1 LastSeason_{it} + \beta_2 Age_{it} + \beta_3 Age_{it}^2 + \beta_4 Contract\_length_{it} + Player_i\theta + Season_t\delta + Team_{it}\gamma + \varepsilon_{it} \quad (1)$$

Model (1) includes control variables for age and its square to capture non-linear returns. Additionally, we control for fixed effects for season and team. Table 2 reports the results.

Table 2 about here

Table 2 does not provide statistical evidence of strategic behaviour.

Is the inclusion of contract length as control variable problematic? While one may argue that this variable is endogenous, it is important to note that we control for both unobservable time invariant individual and team characteristics. Moreover, we have conducted two tests: (i) the Durbin-Wu-Hausman test—or augmented regression test for endogeneity, and the (ii) Hausman specification test, and neither of them rejects the null hypothesis that *Contract_length* can actually be treated as exogenous. The caveat is

that these tests are simply suggestive of the non-endogeneity of contract length; however, if this variable was endogenous, and thus a bad control, its exclusion from the analyses would change the estimates. This is not what we find: the main analyses without controlling for contract length return results that are statistically indistinguishable from those obtained while controlling for contract length. These results are illustrated in Figures A.4 to A.6 in the Appendix. Moreover, one should note in these three graphs—that are obtained while adding one control variables at the time—that point estimates are stable; stability of point estimates suggests that the control variables are balanced between skaters in their last year of contract.

These results could hide heterogeneous effects. Players with a different free-agency status might behave differently, and, among RFAs, behaviours might change depending on their expected performance. Section 5 focuses on these heterogeneity analyses.

There are three additional notes. First, one may argue that team characteristics (e.g., team's market size) might impact the results. However, we control for team fixed effects in the main analyses. Moreover, we repeat the main analyses with two additional vectors of fixed effects: (i) team*season and, as an alternative, (ii) team*season_t-1; these two alternative model specifications relax the implicit assumption that the effects of teams' characteristics are constant over time. The results are similar to those in Table 2 and are available in the replication package. Second, in specification (i), the effect of the player's strategic behaviour on the outcome (i.e., performance measure) is expressed in terms of deviation from the mean outcome for that team in that season. In other words, the effect of strategic behaviour on a specific performance measure is purged from the general team performance. Third, in a similar study on NHL players (Fumarco, Longley, Palermo, et al., 2021), the authors additionally investigate shirking behaviour, and use the instrumental variable from Buraimo, Frick, Hickfang, et al. (2015). There, the authors find no evidence of shirking behaviour.

6 Heterogeneity analyses

6.1 Players' free-agency status and RFAs by expected performance

Past literature reports conflicting results on strategic behaviour. These results might be contradictory because players could behave differently based on both free-agency and expected performance. In particular, some free-agents may have countervailing incentives. Hence, we perform a heterogeneity analysis on three subsamples. First, we focus on UFAs; they can move to whatever team they want at the end of their contract. Then, we investigate two subsamples of RFAs—who are younger than UFAs. One of these two subsamples is composed of expected-low-performance players, for whom the bonus to wage ratio is larger than its mean, while the other subsample is composed of expected-high-performance players, for whom the ratio bonus to wage is lower than its mean. Table 3 reports the results.

Table 3 about here

Table 3 provides partial evidence of UFAs' strategic behaviour on *Plus-minus per game*. Similarly, there is partial evidence of the opposite of strategic behaviour for expected-low-performance RFAs, but only when we look at *Penalty minutes per game*. Moreover, we observe evidence of strategic behaviour on expected-high-performance RFAs, in terms of *Points per game*.

While, given the data at our disposal, it is not possible to investigate why there is evidence of performance variation for some outcomes and not for others, it is important to note two aspects. First, the consistency of the results: in these analyses, and in the next ones, we never observe evidence of strategic behaviour for one outcome and evidence of the opposite of strategic behaviour for another outcome, for the same subsample of players.[17] Second, the outcomes capture different dimensions of players' performance and use a different type of information.

[17] Within each group of players (i.e., UFAs, and the two types of RFAs) there is no inconsistent results (i.e., we do not observe a statistically significant and negative result for one outcome and a statistically significant and positive result for different outcomes, within the same group of players).

In general, results in this section provide weak evidence of strategic behaviour. This finding resonates with those in Shi (2023), where executives who do not face a noncompete clause are associated with higher separation rate than those who face such clauses.

There is still one intersectional aspect that is worth being studied and that relates to personal characteristics and how these influence incentives to strategically behave. European skaters could behave differently because they face an alternative option that is characterized by a non-pecuniary aspect: they have higher potential mobility and could go back to Europe. North American counterparts might be less likely to consider the option of moving to Europe (i.e., they are characterized by lower international geographic mobility).[18] This is what we explore in the last subsection of these results.

6.2 Players' free-agency status and RFAs' expected performance, by continent of origin

The model specification used in this section differs with respect to one detail only: here, we insert a semi-interaction between *Last_season* and a dummy for the skater being *European*. The main effect of *European* cannot be estimated, since it is captured by players fixed effects. Table 4 reports the results.

Table 4 about here

Table 4 provides several interesting insights. North American UFAs increase their performance in the last season, as measured by *Plus-minus per game*; they are expected to be less mobile than European colleagues: they do not see valuable alternatives and want to obtain a contract renewal.

Expected-low-performance North American RFA players reduce their performance, as measured by both *Points* and *Penalty minutes per game*. Perhaps, this result is due to demotivation: they are young

[18] Only recently, in 2020, North American players have started to move to Europe more frequently and at a younger age, but this is due to the COVID-19 pandemic being more under control in Europe: (https://www.eurohockeyclubs.com/news/europe-presents-another-dimension-for-young-north-americans; last accessed on January 27, 2024)

and not that good, they feel that they do not have enough leverage to get a contract renewal, and they do not have elsewhere to go, since they do not consider going to Europe.[19]

European UFA players reduce their performance facing lower incentives in their last season of contract; if they are offered a bad contract, they can go back to Europe. Why should they behave differently from North American UFAs? While the move to Europe might correspond to a pay cut, this is compensated for by non-pecuniary aspects, such as playing more and thus increasing the chances of still being selected by the national team. A similar view is illustrated in von Allmen, Leeds, and Malakorn (2015), who find that European NHL players are paid a premium due to their greater bargaining power, emanating from their potential willingness to return to Europe and play. Ergo, for the same—or even lower—salary, they might prefer to play in Europe. Anecdotal evidence stemming from our dataset shows that many, in fact, do return. Out of 69 European UFAs in their last year of contract, we find that 70% of them (i.e., 49 players) returned to Europe to play following the expiration of their NHL contract.[20]

Conversely, younger expected-low-performance RFAs increase their performance; they want to remain in the best league in the world rather than going back to Europe in the prime of their career. Why do they behave differently from North American low-skill RFAs? While we cannot investigate the mechanisms, we have some speculations. First, there is a signalling incentive because they acquire credentials by working in high level institutions. Second, the possibility of finding a team in Europe might not be much greater than in the NHL, given their low-perceived skills. Third, as immigration literature suggests, non-native players might have been positively selected in terms of grit, willingness to succeed.

[19] Officially, RFAs would only know for certain that they will not be renewed until June 30th following their last season—the date that their current club is required to provide them with a qualifying offer. In practice, however, most players that will not renewed have a strong sense of this well before the June 30th date.

[20] One might wonder why these players still offered game time, since presumably any disillusionment with contract status shows up in practice sessions. We can only speculate about two possible reasons. First, while we know whether a player played, we do not know how many minutes he played—we do not have information on played minutes. So, it is possible that these players still get to play each match, but for fewer minutes, as is expected for older players. Second, it is also possible that managers and trainers might intuit that disillusionment with contract status is showing up in practice sessions, but either they can do little about it (e.g., the player is in the roster, and is still a decent player, so he can be used as a substitute at least) or they cannot tell whether the lower performance is an underperformance (i.e., the player is playing worse than the best he could) or is a natural consequence of ageing.

Finally, this table does not provide evidence of strategic behaviour or its opposite for either European or North American expected-high-performance RFAs. These are highly committed players.

7 Conclusion

This study contributes to the literature on the employer-employee relationship in presence of moral hazard with respect to two aspects. First, we explore how employees' performance varies at the end of a multi-year static contract. Second, we study how preferences and signalling incentives might affect workers' performance at the end of the contract.

We use a unique and large panel data set on National Hockey League (NHL) players that are followed over ten seasons, where contracts between employers and employees (i.e., players) do not change for the duration of the contract. This large data set allows us to conduct empirical improvements over past studies by exploiting both within and between variation, while accounting for individual fixed effects.

We derive two set of main results. First, on average, players' performance does not vary. This result is in line with Shi (2023) results, where labour markets with noncompete clause are characterized by low mobility. Second, this result hides substantially heterogeneous behaviours, depending on tenure, expected performance, and potential mobility. Older players with high expected mobility decrease their performance at the end of the contract. Younger workers with similar expected mobility and low expected performance increase their performance. Younger workers with high expected performance keep a steady performance throughout the contract and regardless of their expected mobility.

While our data do not allow us to investigate the mechanisms behind these different behaviours, we can discuss some speculations. First, tenured workers with high expected mobility (i.e., immigrants) may face good alternative job placements elsewhere, while similar workers with low expected mobility (i.e., natives) face a narrower choice. Second, younger workers vary based on their mobility and expected performance. High-mobility workers with expected low performance may have higher willingness to

succeed than equivalent workers with lower mobility. Differently, the level of mobility does not matter much for young workers with high expected performance, who perform well and with stability.

These results are suggesting possible venues for future studies on strategic behaviour. With the help of even better data, future studies could test our speculations and investigate the mechanisms through which potential mobility and immigration status may affect performance stability depending on one's career stage. Moreover, this study offers one more piece of evidence—if ever needed, of how specific, hard-to-investigate, and timely phenomena in the standard labour market can in fact be studied with sports data. Future studies could expand on our work with respect to the effects of noncompete clauses. Finally, future studies could complement our results by investigating different dimensions of workers' performance and focus on the reasons why statistical evidence of strategic behaviour (or its inverse) might emerge depending on the workers' performance-dimension being studied. In fact, we suspect that even in the standard labour market evidence of strategic behaviour might emerge from the measurement of some performance dimensions, while not from others. For example, workers generally have different productivity-related strengths; thus, each worker at the end of the contract might decide to work harder on that particular strength—and increase its related productivity—rather than on others. Eventually, the estimate of strategic behaviour might depend on which productivity-related measure dominates among employees (or among a subsample of them).

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Tables

Table 1. Pairwise correlations and descriptive statistics.

	Pairwise correlations						
Variables	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1 Points	1.000						
2 Plus-minus	0.343***	1.000					
3 Penalty minutes	-0.110***	-0.016	1.000				
4 Last_season	-0.069***	0.0079	0.004	1.000			
5 Age	0.101***	0.075***	0.088***	0.095***	1.000		
6 Expected-high-performance RFA	0.139***	-0.024	-0.057***	0.045**	-0.421***	1.000	
7 Contract_length	0.416***	0.095***	-0.026***	0.004	0.196***	-0.040**	1.000
Statistics							
Mean	0.366	-0.030	0.624	0.236	27.308	0.268	3.396
SD	0.269	0.261	0.647	0.424	4.622	0.597	1.714
Min	0	-3	0	0	11	0	2
Max	1.681	3	17	1	42	4	15
Observations	6,304	6,304	6,304	6,304	6,279	3,105	6,304

Note: Source: authors calculations. Point, Plus-minus, and Penalty Minutes are per game. SD stands for standard deviation.

Table 2. Last season effects on points, plus-minus, and penalty time per game; fixed effects estimates.

Variables	Points per game	Plus-minus per game	Penalty minutes per game
	(1)	(2)	(3)
Last_season	0.001	0.006	0.004
	(0.004)	(0.007)	(0.013)
Age	X	X	X
Age_square	X	X	X
Contract_length	X	X	X
Player FE	X	X	X
Team FE	X	X	X
Season FE	X	X	X
Observations	6,279	6,279	6,279
Endogeneity tests on Contract_length			
Durbin-Wu-Hausman, p-value	0.215	0.242	0.237
Hausman specification test, p-value	0.312	0.987	0.882

Note: Source: authors calculations. Standard errors clustered on skaters in parenthesis. FE stands for fixed effects. *** p<0.01, ** p<0.05, * p<0.1.

Table 3. Last season effects on points, plus-minus, and penalty time per game. Fixed effects estimates, for UFAs, expected-low-performance RFAs, and expected-high-performance RFAs.

Variables	Points per game	Plus-minus per game	Penalty minutes per game
	(1)	(2)	(3)
UFAs			
Last_season	0.002	0.018*	-0.008
	(0.006)	(0.009)	(0.019)
Observations	3,179	3,179	3,179
Expected-low-performance RFAs			
Last_season	-0.026	0.003	-0.095**
	(0.022)	(0.034)	(0.040)
Observations	822	822	822
Expected-high-performance RFAs			
Last_season	0.015*	-0.001	0.002
	(0.008)	(0.013)	(0.025)
Observations	2,278	2,278	2,278
Control variables			
Age	X	X	X
Age_square	X	X	X
Contract_length	X	X	X
Player FE	X	X	X
Team FE	X	X	X
Season FE	X	X	X

Note: Source: authors calculations. Standard errors clustered on skaters in parenthesis. *** p<0.01, ** p<0.05, * p<0.1.

Table 4. Last season effects on points, plus-minus, and penalty time per game, interacted with continent of origin. Fixed effects estimates, for UFAs, for expected-low-performance RFAs, and for expected-high-performance RFAs.

Variables	Points per game	Plus-minus per game	Penalty minutes per game
	(1)	(2)	(3)
UFAs			
Last_season	0.006	0.018*	-0.013
	(0.006)	(0.010)	(0.022)
Last_season ×	-0.022*	0.001	0.026
European	(0.013)	(0.022)	(0.036)
Observations	3,179	3,179	3,179
Expected-low-performance RFAs			
Last_season	-0.058**	-0.027	-0.075*
	(0.025)	(0.037)	(0.042)
Last_season ×	0.097***	0.092	-0.060
European	(0.033)	(0.058)	(0.055)
Observations	822	822	822
Expected-high-performance RFAs			
Last_season	-0.004	-0.003	-0.015
	(0.009)	(0.015)	(0.026)
Last_season ×	0.002	-0.009	0.048
European	(0.019)	(0.034)	(0.069)
Observations	2,278	2,278	2,278
Control variables			
Age	X	X	X
Age_square	X	X	X
Contract_length	X	X	X
Player FE	X	X	X
Team FE	X	X	X
Season FE	X	X	X

Note: Source: authors calculations. Standard errors clustered on skaters in parenthesis. *** p<0.01, ** p<0.05, * p<0.1.

Appendix

Table A.1 Studies on strategic behavior in the sports labour market.

Author(s) and year of publication	League and data used	Basic findings
Maxcy, Krautmann, and Fort (2002)	MLB. Playing and traditional baseball performance metrics (slugging average for hitters and walk ratio for pitchers).	Both pitchers and hitters experience reduced time on the disabled list in the season just before contract negotiations, with playing time surpassing the average during that period. Notably, no statistical evidence of strategic behaviour was found for skill or playing time measures.
Purcell (2009)	MLB, NFL, NHL and NBA. Players' historical performance statistics from the years 1992 until 2008.	Players' performance levels decline during the first year of a long-term contract. The study does not, however, suggest that players increase performance in the final year of a contract.
Frick (2011)	German Bundesliga over six and 13 consecutive seasons respectively (1997-98 to 2002-03 and 1995-96 to 2007-08). Player's performance is measured by a subjective overall player rating from Kicker.	Moral hazard is a widespread phenomenon, even in professional soccer. There is robust evidence that player performance significantly increases in the last year of the contract. In addition, the variance in player performance is significantly lower in the last year of the contract.
Buraimo, Frick, Hickfang, et al. (2015)	German Bundesliga seasons from 2002/2003 to 2012/2013. Player's performance is measured by a subjective overall player rating from Kicker.	Selection effects in the award of long-term contracts dominate moral hazard effects as players with longer term contracts perform better, ceteris paribus.
Feess, Gerfin, and Muehlheusser (2015)	German Bundesliga seasons from 1996/97 to 1999/2000. Player's performance is measured by a subjective overall player rating from Kicker.	
Landry, Edgar, Harris, et al. (2015)	NHL seasons from 2005 to 2011. Historical player contracts and performance data of 670 players across 29 clubs.	Player performance generally increases with salary (higher in the first year of a contract) and, despite decreasing over the life of the contract, it usually peaks again in the final year of the contract.
Fan, Lien, Meng, et al. (2021)	NBA seasons from the 2004 to 2014. The Player Efficiency Rating (PER) is the response performance variable.	Players boost performance in the final season of their current contract to secure better terms for the next one. However, after securing a big contract, players tend to underperform in the first year. Higher ability players are less affected by contract year pressure but still show the impact of a significant contract. Contract year

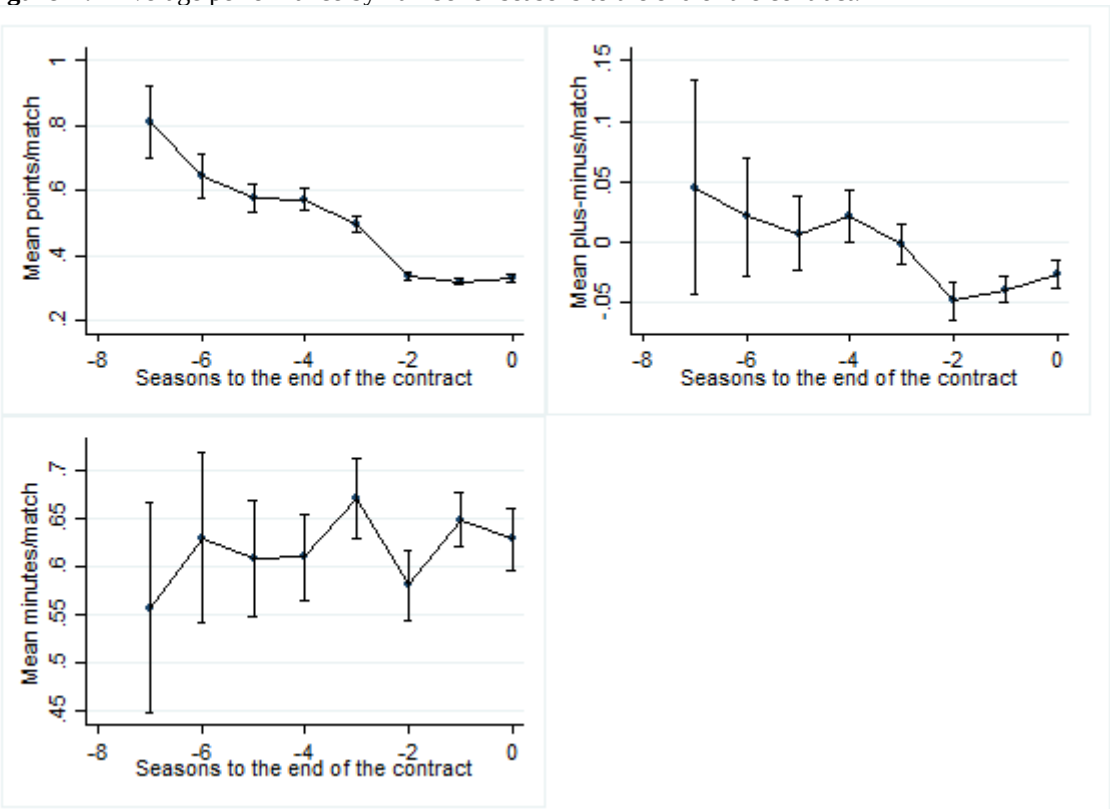
		effects diminish with remaining contract years, and longer new contracts amplify the disincentive effect of a big contract.

Table A.2 Number of players, by free-agency type, geographic origin, and expected performance.

Variables	North-American (1)	European (2)
Expected-low-performance RFAs	585	237
Expected-high-performance RFAs	1,697	586
UFAs	2,429	770
Total	4,711	1,593
Grand total	6,304	

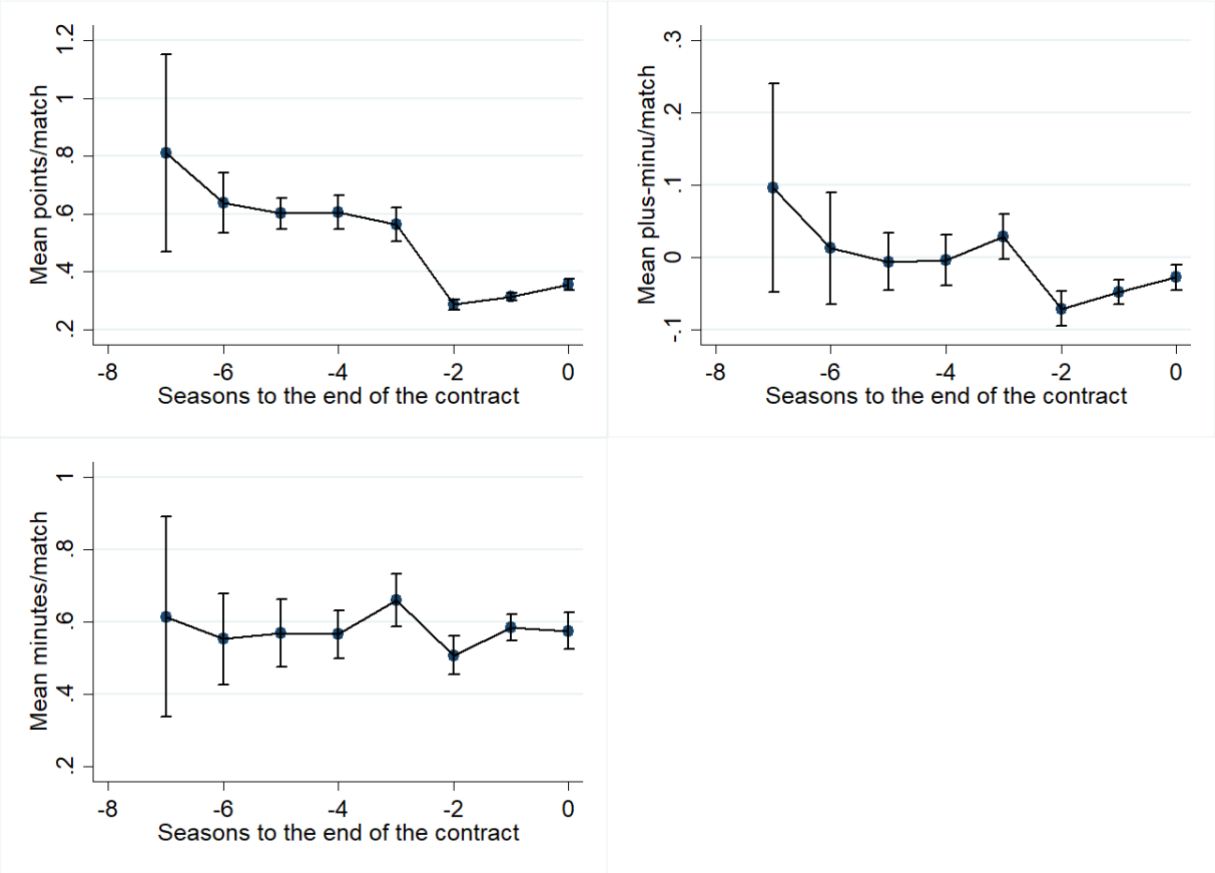
Source: Authors calculations.

Figure A.1 Average performance by number of seasons to the end of the contract.



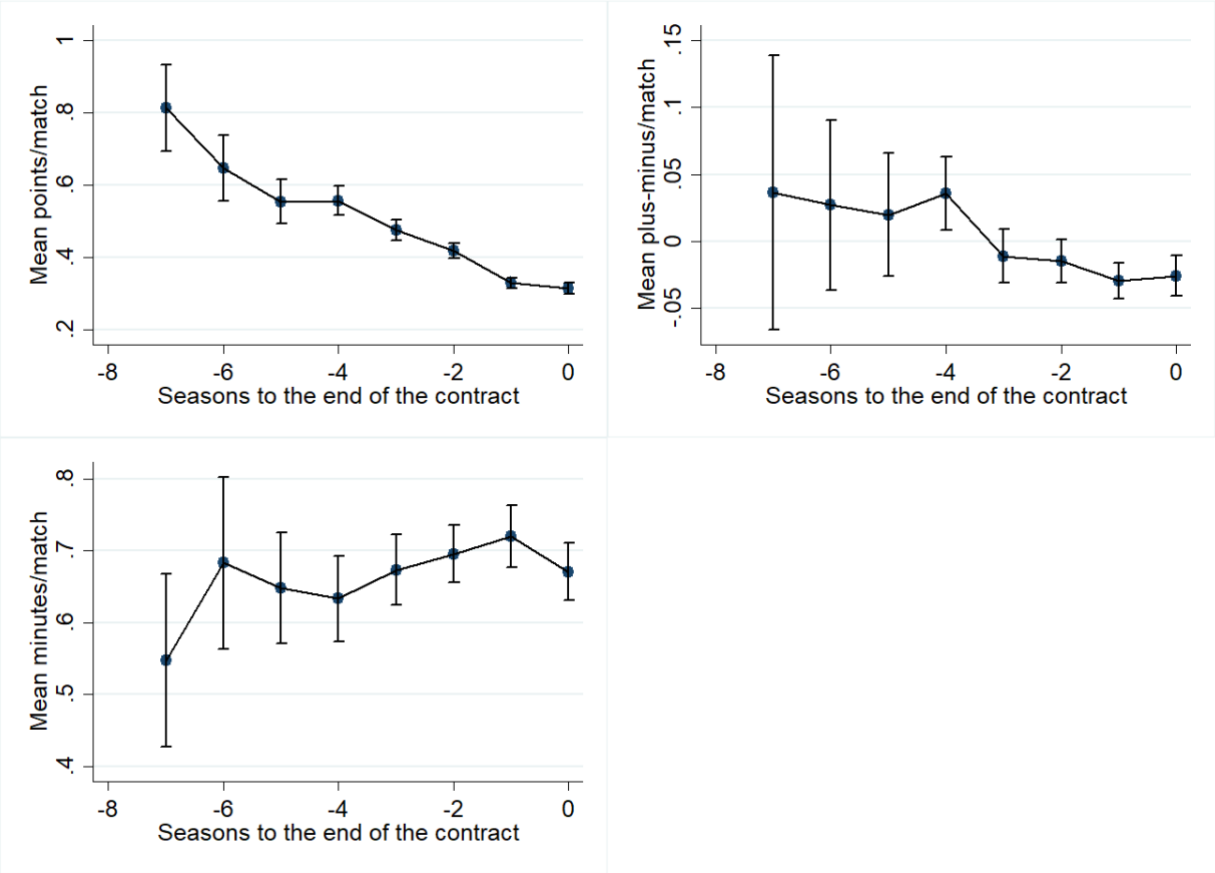
The performance tends to decrease toward the contract end for all players, as measured by points per match and played minutes per match—with some noise in the latter case, while it seems to increase slightly for plus-minus per match in the last season.

Figure A.2 Average performance by number of seasons to the end of the contract, for RFAs.



The performance tends to decrease over the contract duration for RFAs—although the decrease is less remarkable than for UFA (see below), as measured by points per match and plus-minus per match—in this case there is a slight increase at the very end of the contract, while the played minutes per match seems stable over the duration of the contract.

Figure A.3 Average performance by number of seasons to the end of the contract, for UFAs.



The performance tends to decrease over the contract duration for UFAs—more so than for RFAs. Concerning played minutes per match, there seems to be a decrease at the very end of the contract.

Figure A.4 Specification curve for Points per game.

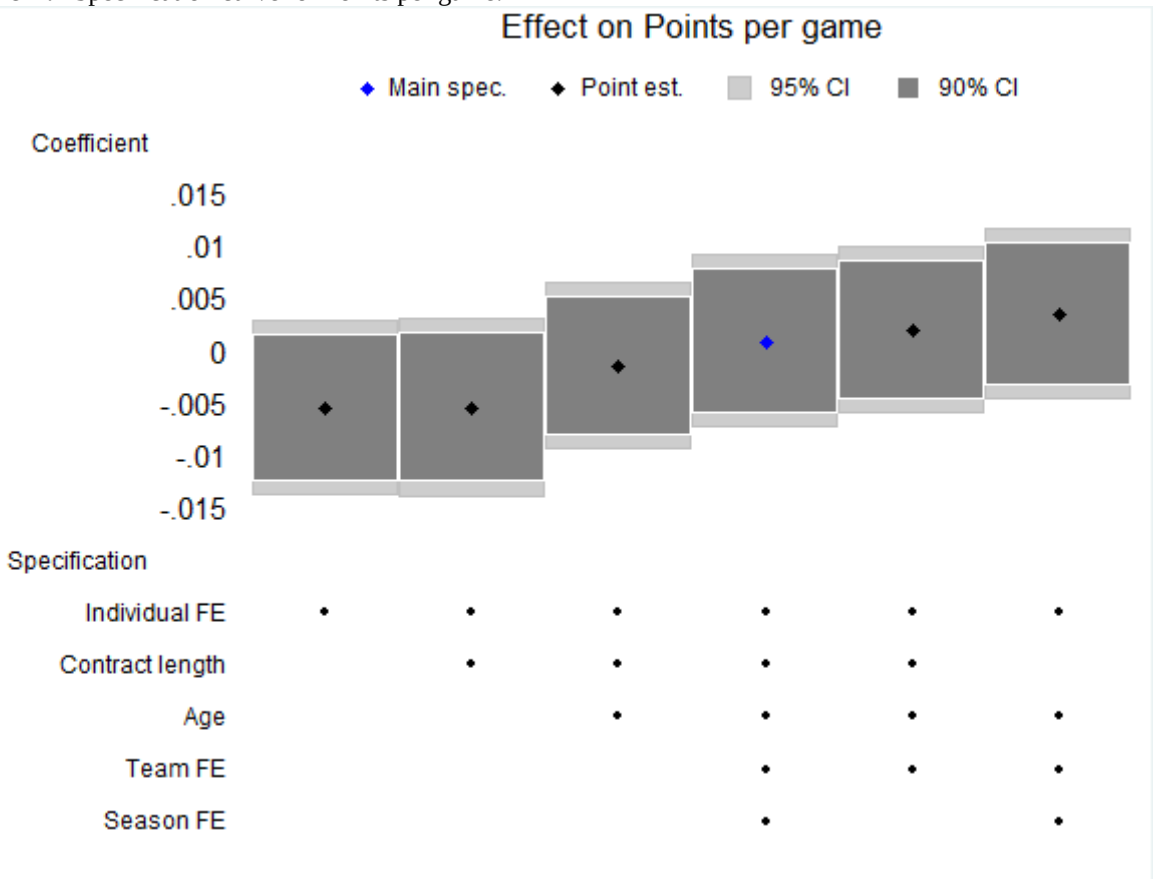


Figure A.5 Specification curve for Plus-minus per game.

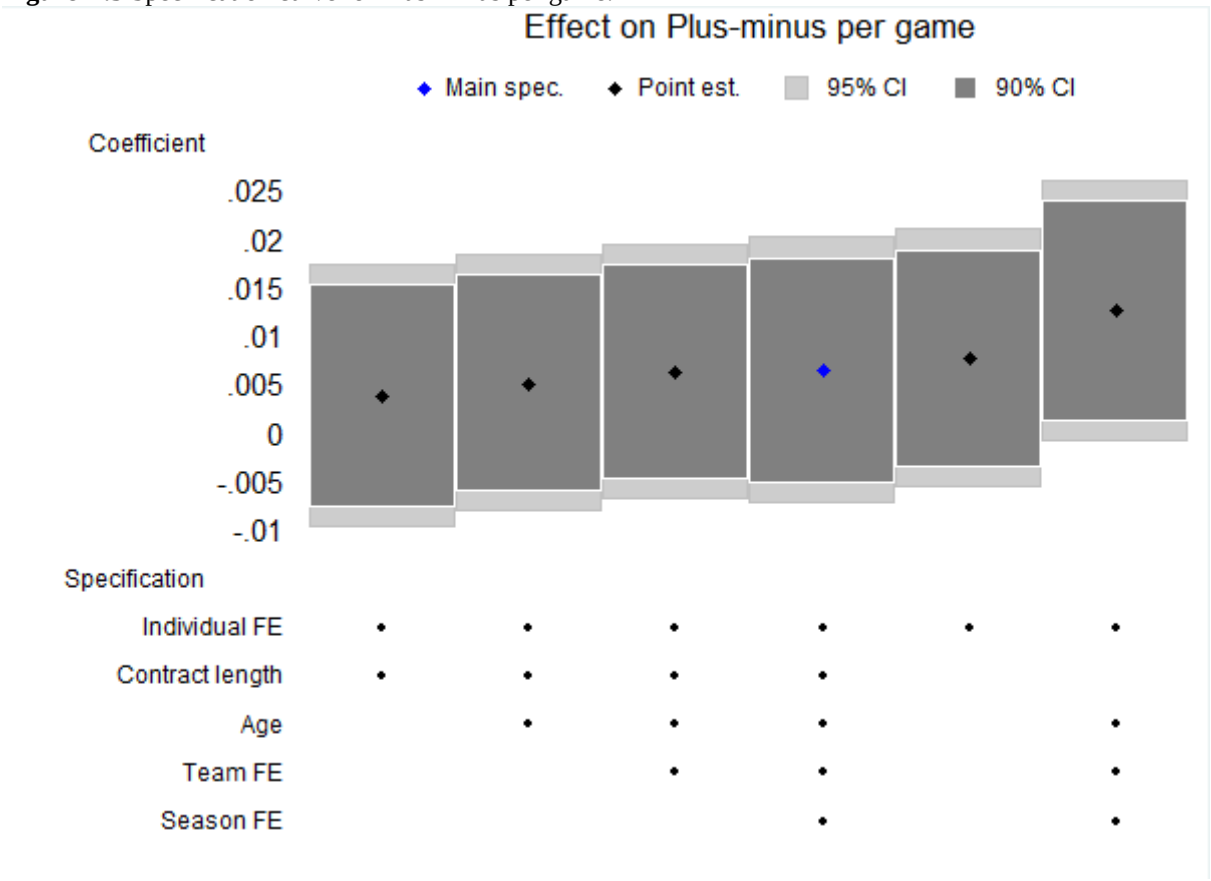


Figure A.6 Specification curve for Penalty minutes per game.