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Abstract: This paper examines contractual arrangements that once governed employment relationships in two prominent entertainment industries: professional baseball and Hollywood filmmaking. The arrangements were, respectively, the player reserve system and the star system. Both were defended as necessary by the governing powers of each industry, but both were also criticized as exploitive of employees because they prevented them from negotiating as free agents with other possible employers. The argument in this paper is that these systems can be interpreted as having served a rational economic purpose; namely, to promote efficient investment in the development of would-be performers in professions where the probability of success is very low. The persistence of a limited reserve period in baseball in the presence of a strong players' union is evidence for this claim. By contrast, the demise of the star system reflects the diminished importance of talent development by studios.

Key words: Reserve system, star system, training, incentive contracts
JEL codes: J30, J41, J42, J53, L14, L82

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1 Introduction

This paper examines contractual arrangements that once governed employment relations in two prominent entertainment industries: professional baseball and Hollywood filmmaking. These arrangements were, respectively, the *player reserve system* and the *star system*. Both were defended as necessary by the governing powers of each industry, and both were also heavily criticized as being exploitive of employees. The argument in this paper is that these systems can be interpreted as having served a rational economic purpose; namely, to promote efficient investment in the development of would-be performers in professions where the probability of success was (and is) very low. By making this argument I do not mean to suggest that no exploitation of trainees occurred as a by-product of these arrangements. It almost certainly did. Rather, I will argue that the essential structure of these contracts represented an efficient response to the environment in which the parties found themselves. Thus, even if they had stood on more equal footing, I will contend that they would have negotiated some version of these contracts.

The reserve system in baseball dates back to the earliest days of the major leagues when team owners agreed not to negotiate with players from rival teams. The need for the system, the owners contended, was that it prevented the richest among them from acquiring all of the best players, but its real effect was to sustain the owners' monopsony power. Despite numerous challenges, the system remained intact for a hundred years, finally being struck down by courts in the mid-1970s.[1] Player contracts are now negotiated under a collective bargaining agreement

[1] See Ward and Burns (1994) for a thorough history of the game, including the origins and evolution of the reserve system.

between the players' union and owners, which tellingly continues to include a limited period of reserve.

The star system in filmmaking likewise dates from the earliest years of the film industry, particularly following the advent of sound, when large production studios identified potential star material and signed them to long term contracts, usually on terms very unfavorable to the actor. The studio then invested heavily in developing that star's persona so as to maximize the return on its investment. The system persisted for decades, eventually collapsing, along with the studio system that had created it, as a result of various legal and economic factors and changing tastes among moviegoers, the combination of which greatly curtailed the role of studios in developing stars.[2]

The similarity between the two systems revolves around the need to invest in the training and development of prospective performers, which constitute the central assets in both industries. It is not the need for training *per se* that is the critical factor, however; many professions require personnel to serve a period of apprenticeship in order to acquire necessary knowledge and skills. What distinguishes sports and entertainment is the very low probability of success; only a small percentage of "trainees" reach the highest level of achievement, despite significant investments in training. This is due to the large role of unpredictable factors that determine success in both sports and entertainment.[3]

From a theoretical perspective, the analysis in this paper contributes to the literature on incentive contracts and transaction-specific investments.[4] As for its particular applications, the

[2] See Basinger (2007) for a history of the star system, or the "star machine," as she calls it.
[3] As Basinger (2007, p. 77) colorfully puts it with respect to the development of a star: "There's mathematics there, but also moonlight."
[4] For a thorough treatment of this area of study, see Bolton and Dewatipont (2005).

paper furthers the economic analysis of the baseball reserve system by more fully characterizing the optimal contract between owners and players.[5] It also extends the analysis to the Hollywood star system which, to my knowledge, has not been previously studied from this perspective.[6]

The remainder of the paper is organized as follows. Section 2 motivates the analysis by providing further historical background on the two systems. Section 3 then develops the formal analysis. Finally, Section 4 discusses the results and draws conclusions.

2 Historical Background

2.1 The Reserve System in Baseball

The reserve system in professional baseball dates back to the earliest days of the major leagues.[7] When the National League first formed in 1876, the owners agreed to insert a clause into the contracts of the best players on their teams which reserved those players' services for their current teams in perpetuity. In other words, the designated players could not negotiate with other teams, even after their contracts had expired. Their only alternative to negotiating with their current teams was to leave baseball altogether. The rationale for this rule, according to the owners, was that free movement of players (free agency) would result in the richest teams

[5] The approach here is closest to that in Miceli (2004), but the current paper extends that model by more fully characterizing the optimal contract between players and owners. Also see Daly (1992) and Bradbury (2007, pp. 195-197) for similar, though informal, interpretations of the reserve system.

[6] Hanssen (2010) studies the Hollywood studio system from an economic perspective, but he focuses on a different aspect of the industry, namely, the vertical integration of film production and distribution, a practice that became commonplace but was banned by a series of antitrust cases in the late 1940's. Nathanson (2017) studies the star system but focuses on legal aspects of the contracts that tied stars to studios under unfavorable terms. This practice was also limited by legal action in 1944 based on a California statute that limited the length of personal service contracts to seven years. Nathanson also draws a link between the star system and baseball's reserve system, though again primarily from a legal perspective.

[7] Rottenberg (1956) is the seminal paper on this topic. See Szymanski (2009, pp. 73-84) for a concise history of the origin and demise of the reserve system in professional baseball. Also see Scully (1989, Chapter 1), Zimbalist (1992, Chapter 1) and Quirk and Fort (1992, Chapter 5). For an insider's view, see Miller (1991).

acquiring all the best players.[8] Eventually, owners expanded this provision to include every player on their rosters.

In 1889 the players collectively organized a rival league, called the Players' League, with the intent of overturning the owners' monopsonistic control of their employment options, but the league quickly folded for financial reasons. Another new league emerged in 1901, and this one, called the American League, did achieve financial success, resulting in the signing of a peace treaty between the American and National Leagues in 1903. This so-called "National Agreement" established the current structure of two separate but equal major leagues,[9] but, importantly, it retained the reserve clause as a component of all player contracts (Ward and Burns, 1994, p. 65).

The next challenge to the reserve system came with the formation of anther insurgent league, called the Federal League, in 1914. Because the new league promised free agency, it lured away some of the game's best players, but it nevertheless failed after only two years. A federal lawsuit filed by the owners of one team, however, challenged the existing structure of baseball under federal antitrust laws, and by 1922 that case made it to the U.S. Supreme Court. In a decision that does not represent one of its shining moments, the Court ruled unanimously in favor of major league baseball. Writing for the Court, Oliver Wendell Holmes, Jr., said that, even though baseball was a business, it was "not trade or commerce in the commonly accepted use of those words." And although staging games required personnel to cross state lines, thus bringing baseball under the jurisdiction of federal antitrust laws, Holmes argued that "the

[8] Rottenberg (1956), however, showed that this claim is not correct using an argument that anticipated the Coase Theorem (Coase, 1960). Specifically, he observed that as long as player contracts could be sold by owners, players would end up with the teams that valued them the most regardless of their initial affiliation.

[9] New franchises have entered since then during times of expansion, but under the umbrella of the two-league structure.

transport is a mere incident, not the essential thing."[10] The Court thus granted baseball an antitrust exemption that continues to this day.

The demise of the reserve system would have to await another half century. It was precipitated by a lawsuit filed by Curt Flood following the 1969 season in which he challenged the right of his current team to trade him to another team without his consent. Flood eventually lost his case, but the impetus for change was in the air. And when an arbitration panel ruled in favor of players in 1975, the reserve clause as a default provision of all contracts was dead. Thereafter, the provisions of player contracts would be decided by collective bargaining between owners and the players' union.

It is notable that the current agreement grants free agency to players only after they have completed six years of major league service. Thus, a limited reserve system remains in place by mutual consent of players and owners. A similar situation exists in other professional sports. This provides some evidence for the claim, to be demonstrated below, that a limit on free agency actually serves the players' interests.

2.2 The Star System in Hollywood

In the earliest days of the cinema, actors were mostly uncredited, partly because studios wanted to keep their wages low. But eventually, fans wanted to know about the actors they were seeing on the screen, and this created another asset that studios could capitalize on.[11] From about 1930 to 1960, the so-called "golden era" of the studio system, the development of talent therefore became an important investment by studios, giving rise to the "star system" (Basinger, 2007, p. 16).

[10] *Federal Base Ball Club of Baltimore v. National League*, 259 U.S. 200 (1922).
[11] See Basinger (2007, p. 18) and Thompson and Bordwell (2010, pp. 30-31).

The way the system worked was that studios scouted for talent across the country in much the same way that scouts seek budding sports stars. Promising individuals were then signed to exclusive contracts, and subjected to rigorous testing and training to determine their potential star power. As Nathanson (2017, p. 26) notes, however, "most of these contracts came to nothing given the elusiveness of fame." Prospects who showed real promise, however, were signed to seven-year exclusive contracts which bound them to the studio during that time under very unfavorable terms.[12] As Basinger notes, "the hard legal facts of star contracts were clear. Movie stars could not do anything except work for the studio that had signed them for seven years." Further, the studio could loan the star out to other studios if doing so suited their joint interests. "Such negotiations reflect the practical nature of the business, which traded stars back and forth according to any studio's need, and which reveal how studios cooperated with one another when something was in the interests of both parties" (Basinger, 2007, p. 131).

The studio bosses, like major league owners, argued that this arrangement was essential because the "failure rate was high, and unpopular films and actors abounded. As such a studio's survival depended upon its capacity to capitalize on its relatively few successes" (Nathanson, p. 26). It was ultimately a question of numbers, for "one truly successful star who thrived at the box office could easily pay for fifteen or twenty failures" (Basinger, 2007, p. 126).

The star system eventually succumbed to a variety of factors, the most important being the downfall of its driving force, the studio system. A series of court cases in the late 1940s forced studios to divest themselves of various vertical practices in the production and distribution of movies, thus weakening their market power.[13] However, changes on the demand side also

[12] Seven years was the longest allowable duration for personal service contracts under California law. See Nathanson (2017).
[13] See Hanssen (2010) for an analysis of these cases, which posits an efficiency rationale for the vertical practices.

contributed to a decline in the importance of the traditional method of star "creation." These included competition from television and foreign films, and the fact that movie fans were no longer so much attracted by the stars themselves as by the vehicles in which they appeared. Further, most modern-day actors come to Hollywood with already-developed acting skills. Thus, in contrast to the situation in sports, developing talent was no longer a top priority in the moviemaking business.[14]

3 Theoretical Analysis

Against this backdrop, consider the following simple model of employee training, whether applied to aspiring athletes or actors. Let

V = value of a successful trainee;

x = dollar investment in training;

$p(x)$ = probability of success, where $p'>0$ and $p''<0$;

w_1 = salary paid to a successful trainee;

w_0 = salary paid during training.

We assume that the value of the trainee during the training phase is zero. The efficient level of training, which is the level the trainee would choose if he or she were self-financing the training cost, would therefore maximize $p(x)V-x$. This yields the first-order condition

$$p'(x)V = 1 \tag{1}$$

where the left-hand side is the marginal benefit of training and the right-hand side is the marginal cost. Let x^* denote the solution to (1).

[14] See Basinger (2007, pp. 523-553) for a discussion of the current situation in Hollywood moviemaking.

We suppose, however, that would-be professional athletes or actors lack the resources to finance their own training. And, because the success rate in both cases is very low,[15] third-party lenders would be unwilling to provide loans for this expense. Thus, the employers have to foot the cost, which includes both the training expense and the salary of trainees during the training phase. Under this arrangement, the expected return to the employer for each trainee is equal to

$$\pi = p(x)(V - w_1) - w_0 - x \quad (2)$$

while the return to the trainee is

$$U = w_0 + p(x)w_1 \quad (3)$$

For now, we will treat both the employer and the trainee as risk-neutral.

The sequence of decisions is as follows. First, the employer offers the trainee a contract consisting of the wage profile (w_0, w_1), which the latter will accept if it satisfies the following participation constraint:

$$w_0 + p(x)w_1 \geq \overline{U} \quad (4)$$

where $\overline{U}$ is the utility from his or her next-best option. Once the trainee accepts the contract, the employer chooses x to maximize (2). The resulting investment level, $\hat{x}$, will therefore solve the following first-order condition

$$p'(x)(V - w_1) = 1 \quad (5)$$

This incentive compatibility condition reflects the incentives of the employer *once the wage structure is in place*.

[15] A back-of-the-envelope calculation puts this probability at about one in nine for the average minor league player. This was computed as follows. As of 2019 there were 256 minor league teams and 30 major league teams. If we assume equal roster sizes for all teams (25 players) and an equal probability of advancement, we get 30/256=.117. A comparable calculation is not possible for aspiring actors. However, Basinger (2007, p. 17) notes that "There were approximately two thousand performers floating around Hollywood by the end of the 1930s, but experts say only about five hundred of these were actually even under contract to one of the seven major studios. A studio like MGM—the biggest—could carry between fifty to one hundred names on its regular payroll, out of which no more than thirty might actually be considered 'movie stars.' "

Note that this situation inverts the traditional agency problem in the sense that the employer effectively becomes the "agent" of the trainees. Condition (5) therefore captures the inability of the employer to pre-commit to a particular level of investment that the trainees would be able to enforce in court.[16]

Two implications follow immediately from (5); first, it must be true that $V>w_1$ for the employer to make a positive investment; and second, the level of investment, $\hat{x}$, is decreasing in w_1, with a slope equal to

$$\frac{\partial \hat{x}}{\partial w_1} = \frac{p'}{p''(V - w_1)} < 0 \tag{6}$$

and with $\hat{x}=x^*$ if and only if $w_1=0$. Thus, the higher the salary that must be paid to successful trainees, the lower will be the amount that the employer would be willing to invest in training in the first place. This depicts a fundamental trade-off between x and w_1 from the perspective of trainees.[17]

[Figure 1 here]

Given the above set-up, the optimal wage profile from the employer's perspective will maximize (2) subject to the trainee's participation constraint in (4), and the employer's incentive compatibility constraint in (5). The solution can be derived graphically as follows.[18] Figure 1 shows $\hat{x}(w_1)$ as a downward-sloping line in (x, w_1) space with a vertical intercept at x^*, given that $\hat{x}(0) = x^*$. The employer's iso-profit lines are also shown, with profits increasing to the left along the $\hat{x}$ locus. The slope of these lines is given by

[16] In the current model, therefore, the participation constraint and the incentive compatibility constraint apply to different individuals, whereas in the traditional principal-agent set-up, both would apply to the same individual, the agent.

[17] If the parties could contract on x, there would be a degree of freedom in choosing w_0 and w_1, provided that the combination satisfies the trainee's participation constraint.

[18] See Appendix A for details.

$$\frac{\partial x}{\partial w_1}|_{\bar{\pi}} = \frac{p}{p'(V - w_1) - 1} \tag{7}$$

Now consider the participation constraint of trainees. From (3), we compute the slope of their indifference curves in (x, w_1) space to be

$$\frac{\partial x}{\partial w_1}|_{\bar{U}} = \frac{-p}{p'w_1} < 0 \tag{8}$$

They are thus negatively-sloped curves that are convex to the origin given $p''<0$, and utility is increasing to the upper right (i.e., as both x and w_1 increase).

To derive the optimal contract, we initially take w_0, the wage paid during training, as given. The participation constraint in (5) then locates the combinations of w_1 and x that are acceptable to trainees as those points on or above the indifference curve labeled $\bar{U} - w_0$ in Figure 2. The employer's incentive compatibility constraint limits the feasible points to those along the $\hat{x}$ locus within this acceptable set.[19] The employer's profit-maximizing point along this segment is therefore the point that is furthest to the left, given that we showed above that profit is rising in that direction along the $\hat{x}$ locus. Thus, the optimum is given by the point labeled (w_1^*, $\hat{x}(w_1^*)$).

[Figure 2 here]

This optimum was derived for a particular value of w_0, but that wage is also a choice variable. To determine the optimal value of w_0, note first from (5) that it has no effect on $\hat{x}$. Thus, given (2) and (3), it is purely a transfer payment from the employer to the trainee. Suppose, therefore, that, starting from the initial value for which the above optimum was derived, we increase w_0. Given (4), this will cause the indifference curve defining the trainee's

[19] We assume that this set is non-empty, for otherwise, a mutually beneficial contract is not feasible. This will be true as long as $\bar{U}$ is small enough.

minimum acceptable combination of w_1 and x in Figure 2 to shift inward (toward the axes). In effect, by paying the trainee more during his or her training phase, the employer can expand the combinations of w_1 and x that will satisfy the participation constraint to include lower values of both. This effect is shown by the dashed indifference curve in Figure 2.

Note that this change shifts the left-most point of the $\hat{x}$ locus within this feasible set further to the left, thereby allowing the employer to increase its profit by tracking this point leftward along that locus. The new optimum is therefore at a lower value of w_1 and a higher value x. This is indicated by the arrows in the graph. And because this adjustment increases the employer's profit without lowering the expected return of trainees (by construction), the parties will both assent to this adjustment. Notice further that this exercise can be repeated by continually raising w_0, and correspondingly lowering w_1, until w_1=0, which I assume is its lowest feasible value. At this point, (4) implies that $w_0=\bar{U}$. Additionally, (5) implies that the employer will make the efficient level of investment; i.e., $\hat{x} = x^*$. Thus, this limiting contract has $w_0=\bar{U}$ and w_1=0, and is also first-best. (Thus, even if we allowed w_1 to be lowered further, the employer would not choose to do so.)

The interpretation of this contract is that the employer pays the trainee a fixed wage up-front (i.e., during training) in an amount that is just enough to induce him or her to sign onto the agreement. Then, those trainees who "make it" *are obliged to perform for zero additional pay*.[20] The excess return that these lucky few generates for the employer then serves to repay the latter

[20] This solution corresponds to the optimal contract in standard principal-agent models when the agent is risk-neutral. In those models, the agent in effect "buys out" the principal and retains all of the output, as under a fixed rental contract in agriculture. Here, the employer also effectively buys out trainees up front, which requires the latter in effect to work for free in the event that they "make it." The impractically of such first-best contracts is captured in traditional models by the need for a resource constraint on the agent, sometimes called a "limited liability" constraint, which limits what they are able to pay up-front (see Bolton and Dewatripont (2005, pp. 132-133) and Sappington (1983)). The corresponding constraint here is that "stars" must receive some positive pay once they make it.

for the investment in training that it made for *all* trainees, including for those who didn't make it.[21]

Under this arrangement, trainees collectively pay one another's training costs knowing that only a fraction $p(x^*)$ will in fact make it to the highest level. And the fact that employers are induced to spend x^* on each trainee actually benefits the latter because it results in the maximum probability that they will make it, $p(x^*)$. In this sense, trainees benefit from the arrangement, though the employer ends up extracting all of the surplus by offering the lowest acceptable value of w_0.

If a particular trainee has a better outside option in the form of a higher value of $\overline{U}$, the structure of the optimal contract would not change in principle; it would only result in a higher value of w_0 for that individual. The same would be true if $p(x)$ were higher for some trainees by virtue of their possessing more innate ability or star appeal. In baseball, this usually manifests itself in the form of signing bonuses for highly touted draftees. In the movie business, more polished prospects were inserted more quickly into starring roles, thus allowing them to jump to a higher pay scale sooner.[22]

The other point to note about this contract is that it fully insures trainees against income risk because they are paid a fixed income up front. This result therefore differs from that in a standard principal-agent model in which there is a fundamental conflict between optimal risk-sharing and incentives when the agent is risk averse and the principal is risk neutral.[23] Risk

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[21] From (2), the minimum wage discount per trainee that allows the employer to cover its overall costs is $V - w_1 = \frac{w_0+x}{p(x)}$. Thus, even in the most favorable setting for trainees, they would have to pay back their own training expenses, w_0+x, multiplied by the factor $1/p(x)$.

[22] Basinger (2007, p. 144) notes, for example, that "Tyrone Power did not need the usual detailed star preparation the studio machine provided."

[23] The optimality of the above contract when the trainee is risk averse is proved in Appendix B.

aversion on the part of trainees would only reinforce the attractiveness of the above contract to signees because it insures them against any income variability due to the risk of failure (i.e., all trainees get a fixed up-front payment of w_0).[24]

However, to those few who make it, the fact that $w_1^*=0$ would look grossly unfair (talk about exploitation!). For this reason, it is clear that the optimal contract as just derived would not be acceptable, and perhaps not legal. In reality, therefore, there will be strictly positive lower bounds on both w_0 and w_1 based on minimum wage requirements and other practical considerations. To address this issue, we add the additional constraint that[25]

$$w_1 \geq \overline{w}_1 > 0 \tag{9}$$

It should be clear from the above analysis that this constraint will be binding, in which case the optimal contract (now second-best) will have $w_1^*=\overline{w}_1$ and $x=\hat{x}(\overline{w}_1)<x^*$. (See Appendix A for details.) The corresponding value of w_0 will then be determined by the binding participation constraint:

$$w_0 = \overline{U} - p(\hat{x}(\overline{w}_1))\overline{w}_1 \tag{10}$$

which I am assuming is positive.[26] This outcome looks like the interior solution illustrated in Figure 2. Note that the cost trainees bear as a result of (9) is that $p(\hat{x}(\overline{w}_1))<p(x^*)$. Thus, they

[24] This claim is true in the sense that a trainee's "lifetime" income under the contract, given by w_0, is independent of risk. Obviously, those trainees who "make it" will receive no further compensation given $w_1=0$ under the optimal contract. Thus, it will appear that the income of successful trainees does vary over their lifetimes. But remember that w_0 should be interpreted as a one-time payment that covers the duration of the contract rather than being payment only for the training period. (Payment could, for example, take the form of an annuity with present value equal to w_0.) Obviously, those who make it would like to be paid more based on their value *from that point forward*, but that is purely an *ex post* point of view.

[25] The minimum yearly salary for a major league player in 2021 will be $570,500, which over the six-year reserve period amounts to $3.423 million. This is not necessarily $\overline{w}_1$, however, as it depends on the average career length of a major league player. The difference $V-w_1$ is the net gain to the team over the career of an average player, conditional on his making the majors.

[26] A negative value implies that trainees would have to pay for the right to sign the contract, which we are ruling out.

implicitly trade a positive salary in the post-training phase of their careers for a lower probability of ever making it to that phase.

4 Discussion

The preceding analysis has provided an efficiency rationale for a certain contractual structure whose aim is to promote investment in talent development in a setting where the success rate is inherently very low. As we saw, the optimal contract involves a cross-subsidization whereby those prospects who “make it” pay back their own training costs along with the costs of those who don’t make it. Because the success rate is so low, however, the optimal structure looks, in hindsight, to be exploitive of those who actually achieve star status because they appear to be grossly underpaid. This was in fact the criticism leveled against the reserve system in baseball and the star system in Hollywood, both of which arose during eras in which employers had considerable bargaining power in their dealings with employees. Legal action in both industries, however, eventually curtailed that power. It would seem to follow, therefore, that if the practices in question were truly exploitive, they should have disappeared as well. This turned out to be true in the movie industry, but not in baseball. The difference is instructive.

As previously noted, a series of court cases in the 1970s ended the reserve system as a default provision of all player contracts in professional baseball. Since then, labor issues have been decided by negotiation between owners and the players’ union, which is very strong. It is therefore noteworthy that a limited reserve system remains in place in professional baseball: under the current collective bargaining agreement, a player cannot attain free agency until he has served at least six years of major league service. This reflects a recognition by players that investment in training continues to be an essential ingredient in their success, and the only way that teams would be willing to make such an investment is if they were able to recover their investment from that small percentage of players who actually make it big in the major leagues. The six-year reserve period, during which players are paid less than their marginal revenue products, provides that opportunity. As long as minor-league training remains crucial for a baseball player' success, full free agency will probably not become the norm.[27]

The situation has evolved very differently in the movie industry, where the collapse of the studio system *did* spell the end of the star system. Aspiring actors truly became free agents who, if they wanted to become stars, "would have to operate the star machine for themselves" (Basinger, 2007, p. 525). Large talent agencies have taken on much of that function on their behalf. The key difference is that the process of talent development that had arisen as part of the star system was no longer critical to the success of the movie business. This seems to have been a consequence of two factors, both attributable to changing consumer preferences. The first was that moviegoers came to value a "natural" style of acting rather than the "manufactured persona," and so there was less need for stars to be "created" by the studios. And acting talent was something that aspiring stars could acquire on their own.

Second, the movie itself rather than the actors became the chief attraction to fans, and hence production values became the studio's most important investment. Basinger (2007, p. 525), for example, describes moviemaking in the late 1960s and early 1970s—the decade after the star system collapsed—as "the dawn of a new era in which the *movie* is the star, and the actor rides *its* coattails. In old Hollywood, the success of the movie had largely depended on the star.

[27] Baseball, unlike other sports, does not yet seem to be able to rely on participation at the collegiate level for training, as is the case in football and basketball.

Now the success of the star would become dependent on the movie." No such inversion has occurred in sports, where the athletes themselves are still the main attraction.

Appendix

A.

This appendix provides details of the derivation of the optimal contract when the trainee is risk-neutral. The initial version of the problem is to choose the wage contract (w_0, w_1) to maximize (2) subject to (4) and (5). The Lagrangian for this problem is

$$\mathscr{L} = p(V - w_1) - w_0 - x + \lambda(w_0 + p(x)w_1 - \overline{U}) + \mu[p'(x)(V - w_1) - 1] \quad \text{(A1)}$$

where λ is the multiplier on the participation constraint, and μ is the multiplier on the incentive compatibility constraint. The first-order condition for w_0 and w_1 are

$$-1 + \lambda = 0 \quad \text{(A2)}$$

$$-p + \lambda p - \mu p' = 0 \quad \text{(A3)}$$

(A2) gives λ=1, which shows that the participation constraint is binding. Substituting this into (A3) gives μ=0, which shows that the incentive compatibility constraint is not binding. Finally, the derivative of (A1) with respect to x gives

$$p'(V - w_1) - 1 + \lambda p' w_1 + \mu p''(V - w_1) = 0 \quad \text{(A4)}$$

Substituting λ=1 and μ=0 into this equation gives (1), which shows that the employer makes the efficient investment, x^*. Finally, equations (1) and (5) establish that w_1=0, which, together with the binding participation constraint, gives $w_0^* = \overline{U}$.

Now suppose that we add $w_1 \geq \overline{w}_1 > 0$ as an additional constraint with the multiplier γ. Condition (A2) is unaffected, but (A3) becomes

$$-p + \lambda p - \mu p' + \gamma = 0 \quad \text{(A5)}$$

which, with $\lambda = 1$, becomes

$$\gamma = \mu p' \quad \text{(A6)}$$

Thus, μ and γ are both positive or both zero. The condition for x in this problem, after using λ=1, is

$$p'V - 1 + \mu p''(V - w_1) = 0 \quad \text{(A7)}$$

After substituting from (5), this becomes

$$p' w_1 + \mu p''(V - w_1) = 0 \quad \text{(A8)}$$

Now if $\overline{w}_1 > 0$, as we are supposing, $w_1 > 0$ at the optimum. And, assuming that $w_1 < V$ (for otherwise a mutually beneficial contract would not be possible), equation (A8) implies that $\mu > 0$

given $p''<0$ for finite x. Hence, $\gamma>0$. It follows that $w_1^*=\overline{w}_1$. Finally, from the participation constraint we compute

$$w_0^* = \overline{U} - p(\hat{x}(w_1^*))w_1^* \tag{A9}$$

B.

This appendix shows that when the trainee is risk-averse, the optimal contract is qualitatively identical to that just derived for the risk-neutral case (specifically, the version where w_1 is unconstrained). The key difference is the trainee's participation constraint in (4), which is now written

$$p(x)U(w_0 + w_1) + (1 - p(x)U(w_0) \geq \overline{U} \tag{B1}$$

where $U'>0$ and $U''<0$. The Lagrangian for the employer's problem therefore becomes

$$\mathscr{L} = p(V-w_1) - w_0 - x + \lambda[p(x)U(w_0+w_1)+(1-p(x))U(w_0) - \overline{U}] + \mu[p'(x)(V-w_1) - 1] \tag{B2}$$

The first-order conditions for w_0 and w_1 are

$$-1 + \lambda[p(x)U'(w_0+w_1)+(1-p(x))U'(w_0)] = 0 \tag{B3}$$

$$-p(x) + \lambda p(x)U'(w_0+w_1) - \mu p'(x) = 0 \tag{B4}$$

Solving (B3) for λ gives

$$\lambda = \frac{1}{p(x)U'(w_0 + w_1) + \big(1 - p(x)\big)U'(w_0)} \tag{B5}$$

which is positive. Thus, the participation constraint is binding. Substituting (B5) into (B4) and rearranging gives

$$p(x)\left[-1 + \frac{p(x)U'(w_0 + w_1)}{p(x)U'(w_0 + w_1) + \big(1 - p(x)\big)U'(w_0)}\right] = \mu p'(x) \tag{B6}$$

Risk aversion (i.e., $U''<0$) implies that $U'(w_0+w_1) \leq U'(w_0)$ as $w_1 \geq 0$. Thus, the expression in square brackets is negative if $w_1>0$ and zero if $w_1=0$. Either way, it follows that $\mu=0$ given $p'>0$.

The first-order condition for x in this problem is

$$p'(V-w_1) - 1 + \lambda p'[U(w_0+w_1) - U(w_0)] + \mu p''(V-w_1) = 0 \tag{B7}$$

Now, since $p'(V-w_1) - 1=0$ by the employer's incentive compatibility constraint, and with $\mu=0$, this condition becomes

$$\lambda p'[U(w_0+w_1) - U(w_0)] = 0 \tag{B8}$$

Since $\lambda>0$, $U(w_0+w_1)=U(w_0)$, which implies that $w_1^*=0$, as was true in the model with a risk-neutral trainee. It then follows from the employer's incentive compatibility constraint that $x=x^*$. Finally, from the trainee's binding participation constraint, w_0^* implicitly solves

$$U(w_0^*) = \overline{U} \qquad \text{(B9)}$$

Thus, the optimal contract is both efficient and fully insures trainees against risk. It only differs from the risk-neutral version in the specific value of w_0^*.

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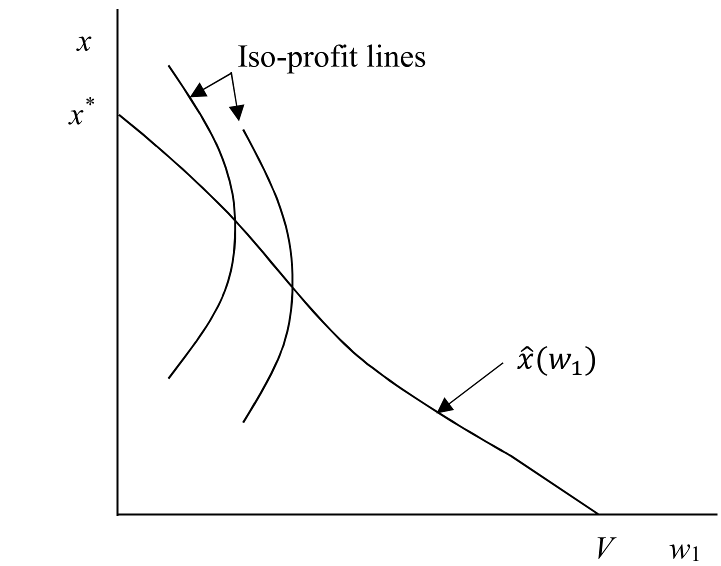

Figure 1. The incentive compatibility constraint of the employer.

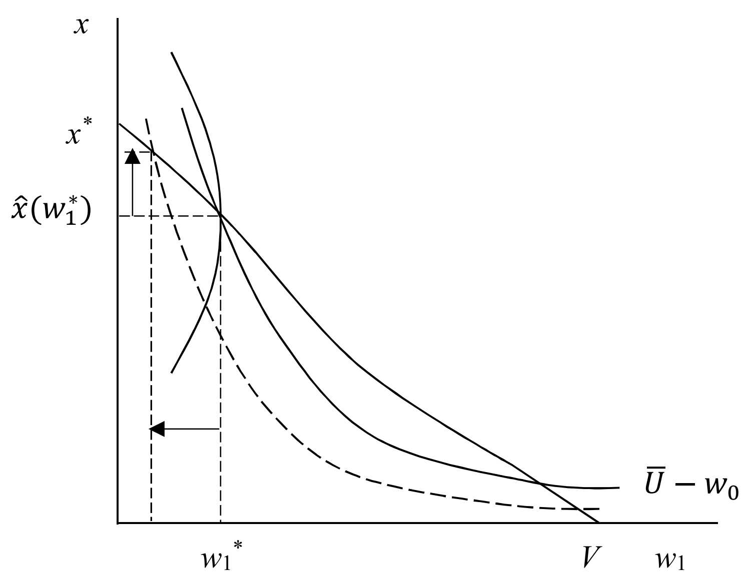

Figure 2. The optimal contract, showing the impact of increasing w_0.