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Abstract

Increasing financial disparity and spiraling wages in European football have triggered a debate about the introduction of salary caps. This paper provides a theoretical model of a team sports leagues and studies the welfare effect of salary caps. It shows that salary caps will increase competitive balance and decrease overall salary payments within the league. The resulting effect on social welfare is counter-intuitive and depends on the preference of fans for aggregate talent and for competitive balance. A salary cap that binds only for large market clubs will increase social welfare if fans prefer aggregate talent despite the fact that the salary cap will result in lower aggregate talent. If fans prefer competitive balance, on the other hand, any binding salary cap will reduce social welfare.

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1 Introduction

A salary cap is a limit on the amount of money a club can spend on player salaries. The cap is usually defined as a percentage of average annual revenues and limits the club's investment in playing talent. Since most leagues compute their caps on the basis of the revenues of the preceding season, the cap is actually a fixed sum. In 2006, for example, the National Football League (NFL) had a salary cap of approximately 102 million US dollars per team.

The North-American National Basketball Association (NBA) was the first league to introduce a salary cap for the 1984-85 season.[1] Today, salary caps are in effect in professional team sports all around the world. In North America, the National Hockey League,[2] the Canadian Football League, the National Football League, the National Basketball Association and the Arena Football League have installed salary caps. In Australia, the Australian Football League, the National Rugby League and A-League Soccer have implemented salary caps to regulate their labor markets. In Europe, salary caps are in effect in the Guiness Premiership in rugby union and the Super League in rugby league. In European soccer, there are currently intensive discussions to introduce salary caps. The leading clubs, organized as the so-called G-14, planned to limit annual team salaries to 70% of revenues.[3]

From an economic perspective, salary caps are often regarded as a collusive agreement of wealthy owners to use their monopoly power to transfer player rents back to ownership.[4] Nevertheless, salary caps are not illegal in the US because they are the result of a freely negotiated collective bargaining agreement between the players' union and the league, represented by their governing body. The stated rationale for salary caps focuses on two main objectives: increasing competitive balance and maintaining financial stability. The concern for competitive balance describes one of the most important peculiarities of professional team sports:[5] It is a wideheld belief that a certain degree of uncertainty about the outcome is necessary to ensure an entertaining competition.[6] Salary caps prevent large-market clubs from becoming too dominant by helping small-market clubs to keep

[1] See Staudohar (1998, 1999).

[2] A lockout in 2004-05 resulted, for the first time, in the loss of an entire season in the National Hockey League. The main point of contention was that club owner insisted on the introduction of a salary cap to have cost certainty (Staudohar, 2005).

[3] See Késenne (2003) for an analysis.

[4] See e.g. Vrooman (1995, 2000).

[5] Going back to Rottenberg (1956) and Neale (1964).

[6] For a survey and discussion, see Szymanski (2003) and Borland and MacDonald (2003).

star players who would otherwise be attracted by higher salary offers from large-market clubs. Fort and Quirk (1995) consider an enforceable salary cap as the only effective device to maintain "financial viability" and improve competitive balance.

In Europe, the leading football clubs cited the protection of the financial future of the game as the main reason for their attempts to introduce a salary cap. Many clubs are facing financial ruin after gambling on spiralling wages. Owing to its structure, professional team sport carries the risks that its clubs over-invest in playing talent (see Dietl et al., 2008). Salary caps prevent clubs from overinvesting in playing talent.

Both arguments have been discussed in the economic literature. According to Rottenberg (1956) clubs would not voluntarily bid themselves into bankruptcy and diminishing returns to talent will guarantee at least some level of competitive talent. Whitney (1993), on the other hand, shows that the market for star athletes in professional team sports is subject to destructive competition - a process which drives some clubs into bankruptcy. According to Whitney (1993), club managers will, on average, overspend on talent that turns their team into a contender, i.e. they will overinvest in star players. The recent development of club finances in European soccer supports Whitney's hypothesis.

Késenne (2000a) develops a two-team model consisting of a large- and a small-market club and shows that a payroll cap, defined as a fixed percentage of league revenue divided by the number of teams, will improve competitive balance as well as the distribution of player salary within the league. Moreover, he shows that profits of both the small- and the large-market club will increase.

The effect of salary caps on consumers (fans) has not been analyzed in the literature. This paper tries to fill this gap. We present a complete analysis of social welfare incorporating the effect of salary caps on clubs, players and fans. Based on a game-theoretical model of a league consisting of both small- and large-market clubs, we show that salary caps will increase competitive balance and decrease the aggregate level of talent within the league. The resulting effect on social welfare is counter-intuitive and depends on the relative preference of fans for aggregate talent and for competitive balance. A salary cap that binds only for large-market clubs will increase social welfare if fans prefer aggregate talent despite the fact that the salary cap will result in lower aggregate talent. If fans prefer competitive balance, on the other hand, any binding salary cap will reduce social welfare.

The remainder of the paper is organized as follows. Section 2 outlines the basic model.

In section 3, we introduce salary caps into the model and distinguish different regimes depending on whether the salary cap is binding or not. Section 4 compares the aggregate salary payments, competitive balance and social welfare between the regimes. Finally, section 5 concludes.

2 Model specification

The following model describes the impact of a salary cap on social welfare in a professional team sports league consisting of n (an even number) profit-maximizing clubs. The league generates total revenues according to a league demand function. The league revenue is then split among the clubs that differ with respect to their bargaining power. We assume that there are two types of clubs, large-market clubs with strong bargaining power and small-market clubs with weak bargaining power. In order to maximize profits each club independently invests in playing talent. We regard the salary payment of each club as an investment in talent where the maximum amount that each club can invest in playing talent is defined by the salary cap.

League demand depends on the quality of the league q and is derived as follows:[7] We assume a continuum of fans that differ in their willingness-to-pay for a league with quality q. Every fan k has a certain preference for quality that is measured by θ_k. The fan θ_k are assumed to be uniformly distributed in $[0, 1]$, i.e. the measure of potential fans is one. The net-utility of fan θ_k is specified as $\max\{\theta_k q - p, 0\}$. At price p the fan that is indifferent between consuming the league product or not is given by $\theta^* = \frac{p}{q}$.[8] Hence, the measure of fans that purchase at price p is $1 - \theta^* = \frac{q-p}{q}$. The league demand function is therefore given by $d(p, q) := 1 - \frac{p}{q}$. Note that league demand increases in quality, albeit with a decreasing rate, i.e. $\frac{\partial d}{\partial q} > 0$ and $\frac{\partial^2 d}{\partial q^2} < 0$. By normalizing all other costs (e.g. stadium and broadcasting costs) to zero, league revenue is simply $LR = pd(p, q)$. Then, the league will choose the profit-maximizing price $p^* = \frac{q}{2}$.[9] Given this profit-maximizing price, league revenue depends solely on the quality of the league

$$LR = \frac{q}{4}.$$

[7] Our approach is similar to Falconieri et al. (2004) but we use a different quality function. The quality function q in Falconieri et al. (2004) is always increasing in own talent invetsments, i.e. $\frac{\partial q}{\partial x_i} > 0$, no matter how unbalanced the league becomes. In contrast, in our model quality decreases if the league becomes too unbalanced (see also Dietl and Lang, 2008).

[8] The price p can e.g. be interpreted as the subscription fee for TV coverage of the league.

[9] Note that the optimal price is increasing in quality, i.e. $\frac{\partial p^*}{\partial q} > 0$.

Following the sports economic literature (e.g. Szymanski, 2003) we assume that league quality depends on the level of the competition, as well as the suspense associated with a close competition (competitive balance).[10] The level of the competition is measured by the aggregate talent within the n club league. We assume that the marginal effect of the salary payment (talent investment) on the level of the competition T is positive but decreasing,

$$T(x_1,..,x_n) = \alpha \sum_{j=1}^{n} x_j - \left(\sum_{j=1}^{n} x_j \right)^2 .$$

This is guaranteed in our model if $\frac{\partial T}{\partial x_i} > 0 \Leftrightarrow \sum_{j=1}^{n} x_j < \frac{\alpha}{2}$ and $\frac{\partial^2 T}{\partial x_i^2} < 0$ which will always be satisfied in equilibrium. Competitive balance CB is measured as minus the variance of salary payments

$$CB(x_1,..,x_n) = -\frac{1}{n} \sum_{j=1}^{n} (x_j - \overline{x}_n)^2 \text{ with } \overline{x}_n = \frac{1}{n} \sum_{j=1}^{n} x_j.$$

Note that a lower variance of salary payments by the n clubs implies a closer competition and therefore a higher degree of competitive balance. League quality is now defined as

$$q(x_1,..,x_n) = \mu T(x_1,..,x_n) + (1-\mu) CB(x_1,..,x_n). \tag{1}$$

The parameter $\mu \in (0,1)$ represents how much the fans weight aggregate talent and competitive balance. Given aggregate salaries $\sum_{j=1, j\neq i}^{n} x_j$ of the other $(n-1)$ clubs, league quality increases in club i's salary payment x_i until a threshold value $x_i^*(\mu)$, i.e. $\frac{\partial q}{\partial x_i} > 0 \Leftrightarrow x_i < x_i^*(\mu)$. Since fans have at least some preference for competitive balance excessive dominance by one club causes the quality to decrease.[11]

League revenues are split between the two types of clubs according to their bargaining power. For the sake of simplicity, we assume that half of the n clubs have strong bargaining power and half of them have weak bargaining power. Each of the strong clubs receives a fraction $\frac{m_s}{n/2}$ of league revenues and each of the weak clubs receives a fraction $\frac{m_w}{n/2}$ of

[10] According to Szymanski (2003) fan demand depends not only on the level of the competition and competitive balance but also on the "likelihood of the home team's success." Taking home team winning into consideration would result in an asymmetric quality function but would not alter our basic findings. For the sake of simplicity, we abstract from home team winning.

[11] Note that the threshold value $x_i^*(\mu)$ beyond which league quality decreases in club i's salary payments is an increasing function of the preference parameter μ because an increase in μ implies an increase in the preference for aggregate talent.

league revenues, with

$$m_s > m_w \text{ and } m_s + m_w = 1.$$

We denote J_s and J_w as the set of strong and weak clubs, respectively, i.e. $J = \{1, .., n\} = J_s \cup J_w$.

The profit function $\Pi_i(x_1, .., x_n)$ of club $i \in J$ is given by revenue minus salary payments,

$$\Pi_i(x_1, .., x_n) = \frac{m_\delta}{2n}\left(\mu\alpha\sum_{j=1}^{n} x_j - \mu\left(\sum_{j=1}^{n} x_j\right)^2 - \frac{1-\mu}{n}\sum_{j=1}^{n}(x_j - \overline{x}_n)^2\right) - x_i, \quad (2)$$

with $\delta = s$ for $i \in J_s$ and $\delta = w$ for $i \in J_w$.

Social welfare is given by the sum of aggregate consumer (fan) surplus, aggregate club profit and aggregate player salaries. Aggregate consumer surplus CS corresponds to the integral of the demand function $d(p, q)$ from the equilibrium price $p^* = \frac{q}{2}$ to the maximal price $\overline{p} = q$ which fans are willing to pay for quality q,

$$CS = \int_{p^*}^{\overline{p}} d(p, q)dp = \int_{\frac{q}{2}}^{q} \frac{q-p}{q} dp = \frac{q}{8}.$$

Summing up aggregate consumer surplus, aggregate club profit and aggregate salary payments, social welfare is derived as

$$W(x_1, .., x_n) = \frac{3}{8} q(x_1, .., x_n). \quad (3)$$

Note that salary payments do not directly influence social welfare because salaries merely represent a transfer from clubs to players. As a consequence, social welfare depends only on the quality of the league.

3 Salary caps in a profit-maximizing league

Following Késenne (2000*a*), we introduce a salary cap into our model, which limits the total amount a club can spend on player salaries. The size of the salary cap, which is the same for each club, is based on the total league revenue in the previous season, divided by the number of clubs in the league. Therefore, the salary cap *cap* is exogenously given in the current season.

Clubs choose salary levels such that profits (2) are maximized subject to the salary cap constraint.[12] That is, salary payments x_i must not exceed the threshold *cap* given by the salary cap. The maximization problem for club $i \in J$ is

$$\max_{x_i} \left\{ \frac{m_\delta}{2n} \left(\mu\alpha \sum_{j=1}^{n} x_j - \mu \left(\sum_{j=1}^{n} x_j \right)^2 - \frac{1-\mu}{n} \sum_{j=1}^{n} (x_j - \overline{x}_n)^2 \right) - x_i \right\},$$

$$\text{subject to } 0 \leq x_i \leq cap,$$

with $\delta = s$ for $i \in J_s$ and $\delta = w$ for $i \in J_w$.

The corresponding first-order conditions are

$$\begin{aligned} \frac{m_\delta}{2n} \left(\mu \left(\alpha - 2\sum_{j=1}^{n} x_j \right) - \frac{2(1-\mu)}{n} \left(x_i - \frac{1}{n} \sum_{j=1}^{n} x_j \right) \right) - (1+\lambda_i) \geq 0, \\ x_i - cap \leq 0, \\ \lambda_i (x_i - cap) = 0, \end{aligned} \tag{4}$$

where λ_i denotes the Lagrange multiplier for club $i \in J$ with $\delta = s$ for $i \in J_s$ and $\delta = w$ for $i \in J_w$.[13] To characterize the equilibrium, we have to distinguish different regimes depending on whether the salary cap is binding or not.

3.1 Regime A: Salary cap is ineffective for all clubs

In this section, we assume that the salary cap is ineffective for all clubs, i.e. we consider the benchmark case that no (effective) salary cap exists.

In regime A, the equilibrium salary payments (talent investments) are computed from (4) as[14]

$$\begin{aligned} x_i^A &= \frac{\alpha}{2n} - \frac{m_s(1-\mu(1+n^2)) + m_w(1+\mu(n^2-1))}{2m_s m_w (1-\mu)\mu} =: x_s^A \ \forall i \in J_s, \\ x_j^A &= \frac{\alpha}{2n} - \frac{m_s(1+\mu(n^2-1)) + m_w(1-\mu(1+n^2))}{2m_s m_w (1-\mu)\mu} =: x_w^A \ \forall j \in J_w. \end{aligned} \tag{5}$$

[12] For a discussion about the clubs' objective function see e.g. Sloane (1971) and Késenne (2000*b*).
[13] It is easy to show that the second-order conditions for a maximum are satisfied.
[14] We denote the salary payments of club $i \in J$ in regime A with x_i^A. Analogous for regime B and C.

For (5) to hold, in the following we restrict μ to $(\underline{\mu}, \overline{\mu})$.[15] The equilibrium salary payments show that all strong (weak) clubs choose the same salary level x_s^A (x_w^A). Note that without a binding salary cap the strong clubs invest more in playing talent in equilibrium than the weak clubs because the marginal revenue of talent investments is higher for these clubs. Thus, we are in regime A if in equilibrium the salary cap does not bind for the strong clubs, i.e. if $cap \in I^A = [x_s^A, \infty)$.

In regime A, the aggregate level of salary payments $X^A = \sum_{j=1}^n x_j^A$ and competitive balance CB^A are given by

$$X^A = \frac{\alpha}{2} - \frac{n}{2\mu m_s m_w} \quad \text{and} \quad CB^A = -\left(\frac{n^2(m_s - m_w)}{2(1-\mu)m_s m_w}\right)^2. \tag{6}$$

Note that X^A (CB^A) is increasing (decreasing) in μ. That is, the higher the preference of fans for aggregate talent is, the higher are aggregate salaries and the more unbalanced is the league. The opposite holds if fans have a high preference for competitive balance.

Plugging the equilibrium salary payments (5) into equation (3) for social welfare yields the following level of total welfare in regime A

$$W^A = \frac{3}{32}\left(\mu\alpha^2 - \left(\frac{1}{\mu}\left(\frac{n}{m_s m_w}\right)^2 + \frac{1}{(1-\mu)}\left(\frac{n^2(m_s - m_w)}{m_s m_w}\right)^2\right)\right).$$

3.2 Regime B: Salary cap is only effective for the strong clubs

In this section, we assume that the salary cap is only effective for the strong clubs. That is, the salary cap constraint is only binding for club i with $i \in J_s$.

In regime B, the equilibrium salary payments (talent investments) are computed from (4) as

$$\begin{aligned} x_i^B &= cap =: x_s^B \ \forall i \in J_s, \\ x_j^B &= \frac{n(\alpha\mu m_w - 2n)}{m_w(1 + \mu(n^2 - 1))} + cap\frac{1 - \mu(n^2 + 1)}{1 + \mu(n^2 - 1)} =: x_w^B \ \forall j \in J_w. \end{aligned} \tag{7}$$

Thus, we are in regime B if $cap \in I^B = (cap', x_s^A)$ with $cap' := \frac{\alpha}{2n} - \frac{1}{\mu m_w}$. This condition guarantees that in equilibrium the weak clubs invest less than cap. Otherwise the salary

[15] For μ very close to zero or one the optimal choice for some clubs is zero. Since we are not interested in a situation where clubs are not participating, we choose to restrict the range of μ to ensure positive equilibrium investments. Formally, we compute $(\underline{\mu}, \overline{\mu})$ as $\underline{\mu} = \frac{1}{2} - \frac{n^3(m_w - m_s) - n + ((n^3(m_s - m_w) + n + \alpha m_s m_w)^2 - 4n\alpha m_s m_w)^{1/2}}{2\alpha m_s m_w}$ and $\overline{\mu} = \frac{1}{2} + \frac{n^3(m_w - m_s) + n + ((n^3(m_w - m_s) + n + \alpha m_s m_w)^2 - 4n\alpha m_s m_w)^{1/2}}{2\alpha m_s m_w}$.

cap constraint would be binding for all clubs and regime C would be effective.

We now analyze how variations of the salary cap affect the clubs' optimal choice of salary payments. A more restrictive salary cap, i.e. a lower value of *cap* induces the strong clubs to decrease their salary payments in equilibrium, i.e. $\frac{\partial x_s^B}{\partial cap} > 0$. However, the effect on the weak clubs' investment level is ambiguous since

$$\frac{\partial x_w^B}{\partial cap} = \frac{1-\mu(n^2+1)}{1+\mu(n^2-1)} \begin{cases} > 0 \text{ if } \mu \in \left(\underline{\mu}, \frac{1}{n^2+1}\right), \\ = 0 \text{ if } \mu = \frac{1}{n^2+1}, \\ < 0 \text{ if } \mu \in \left(\frac{1}{n^2+1}, \overline{\mu}\right). \end{cases}$$

Hence, a more restrictive salary cap induces the weak clubs to decrease their salary payments in equilibrium if $\mu \in \left(\underline{\mu}, \frac{1}{n^2+1}\right)$ and to increase their salary payments in equilibrium if $\mu \in \left(\frac{1}{n^2+1}, \overline{\mu}\right)$.[16] As a consequence, the higher the fans' preference for aggregate talent, the less talent is lost through a more restrictive salary cap.

What is the intuition for the result? The tightening of the salary cap has two effects on the investment incentives of the weak clubs. On the one hand a more restrictive cap lowers the salary payments by the strong clubs and therefore enhances the incentive of the small clubs to pay higher salaries in order to "compensate" for the decrease in aggregate talent.[17] On the other hand the incentive to improve competitive balance is weakened. If μ is relatively high, i.e. fans have a high preference for aggregate talent, then the first effect dominates the second effect and the weak clubs increase their salary payments in equilibrium. If μ is relatively low, i.e. the fans have a high preference for competitive balance, then the incentive to improve competitive balance is lowered by the salary cap restriction so much that the weak clubs will lower their salary payments in equilibrium. Finally, if $\mu = \frac{1}{n^2+1}$ then both effects exactly balance each other out.

The level of aggregate salary payments and competitive balance in regime B are given by

$$\begin{aligned} X^B(cap) =& \frac{n(1-\mu)}{1+\mu(n^2-1)} cap + \frac{n^2(\alpha\mu m_w - 2n)}{2m_w(1+\mu(n^2-1))} \quad \text{and} \\ CB^B(cap) =& -\left(\frac{n(2n+\mu m_w(2n \cdot cap - \alpha)}{2m_w(1+\mu(n^2-1))}\right)^2. \end{aligned} \tag{8}$$

[16] Note that in equilibrium the weak clubs never compensate the reduction of talent by the strong clubs due to the salary constraint.

[17] Remember that quality is concave in aggregate talent.

Since $\frac{\partial x_s^B}{\partial cap} > \frac{\partial x_w^B}{\partial cap}$ a more restrictive salary cap will increase competitive balance and decrease aggregate salaries in regime B.

Social welfare in regime B is given by

$$W^B(cap) = \frac{3n(-n\mu(1-\mu)cap^2 + \alpha\mu(1-\mu)cap)}{8(1+\mu(n^2-1))} + \frac{3n(n\alpha^2\mu^2 m_w^2 - 4n^3)}{32m_w^2(1+\mu(n^2-1))}.$$

and is maximized if the salary cap is fixed at

$$cap_{\max}^B = \frac{\alpha}{2n}. \tag{9}$$

In this case, social welfare is

$$W^B\left(\frac{\alpha}{2n}\right) = \frac{3\alpha^2\mu}{32} - \frac{3n^4}{8m_w^2(1+\mu(n^2-1))}.$$

Note that the welfare maximizing level of the salary cap $cap_{\max}^B$ need not necessarily lie within the interval of feasible salary caps I^B. If $\mu \in (\underline{\mu}, \mu']$ with

$$\mu' := \frac{1}{1+n^2(m_s - m_w)} \tag{10}$$

then the welfare maximizing level of the salary cap is not an element of the interval of feasible salary caps, i.e. $cap_{\max}^B \notin I^B$. Whereas if $\mu \in (\mu', \overline{\mu})$ then $cap_{\max}^B \in I^B$.[18] We defer the discussion of the implications to section 4.

3.3 Regime C: Salary cap is effective for all clubs

In this section, we assume that the salary cap is binding for the strong and the weak clubs. In this case, the equilibrium salary payments are simply given by

$$x_i^C = cap \text{ for all } i \in J. \tag{11}$$

We are in regime C if $cap \in I^C = (0, cap']$. Total salary payments $X^C(cap)$ are equal to $n \cdot cap$ and the competition is completely balanced with $CB^C = 0$. Social welfare in regime C is given by

$$W^C(cap) = \frac{3n}{8}\mu(-n \cdot cap^2 + \alpha cap).$$

[18] See appendix A.1 for a derivation of condition (9) and (10).

4 Comparison of the regimes

By comparing the aggregate salary payments and competitive balance in regime A, B and C, we derive the following proposition:

Proposition 1

(i) The level of competitive balance is decreasing in cap, i.e. $CB^C \geq CB^B(cap) \geq CB^A$.

(ii) The level of aggregate salaries is increasing in cap, i.e. $X^A \geq X^B(cap) \geq X^C(cap)$.

Proof. This result follows directly from (6), (8) and (11) and the definitions of I^k, $k \in \{A, B, C\}$. ■

This proposition shows that the introduction of a salary cap has the expected effect of increasing competitive balance and decreasing aggregate salaries.

By comparing social welfare in regime A, B and C, we establish the following proposition:

Proposition 2

(i) If $\mu \in (\underline{\mu}, \mu']$, *i.e. fans prefer competitive balance, then an effective salary cap is always detrimental to social welfare.*

(ii) If $\mu \in (\mu', \overline{\mu})$, *i.e. fans prefer aggregate talent, then social welfare is maximized in regime* B.

Proof. See Appendix A.2. ■

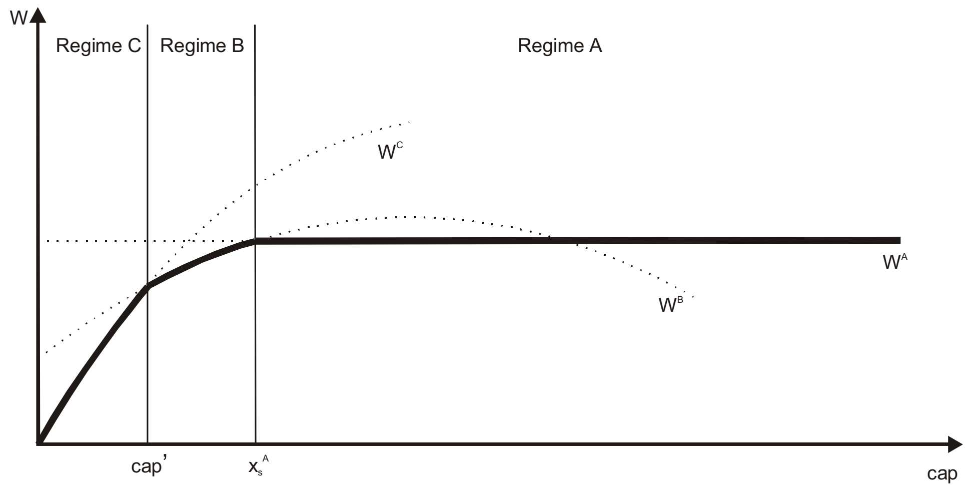
To see the intuition behind proposition 2 consider Figure 1. The figure plots social welfare as a function of the salary cap for the case that fans prefer competitive balance (Figure 1a) and the case that fans prefer aggregate talent (Figure 1b). Remember that regime A is only effective for $cap \geq x_s^A$, regime B for $cap' < cap < x_s^A$ and regime C for $cap \leq cap'$. Also remember that a salary cap decreases aggregate talent in favor of a more even competition.

Figure 1a shows the case in which fans prefer competitive balance, i.e. $\mu \in (\underline{\mu}, \mu')$. The figure shows that the introduction of a binding salary cap decreases social welfare in regime B compared to regime A. This counter-intuitive result is due to the fact that the unrestricted equilibrium in case of a high preference for competitive balance is already characterized by a high level of competitive balance and a low level of aggregate talent.[19]

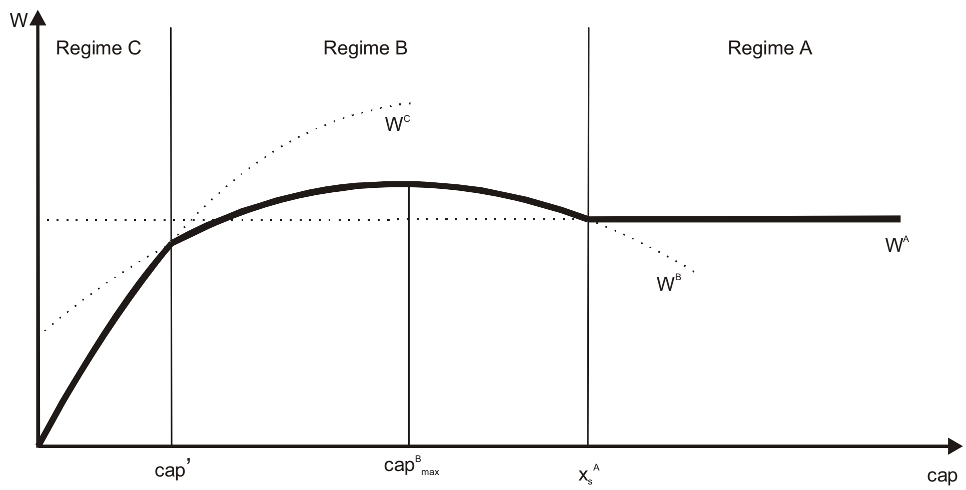
[19] Remember that X^A (CB^A) is increasing (decreasing) in μ.

Figure 1: Effect of Salary Caps on Social Welfare

a) Fans prefer competitive balance



b) Fans prefer aggregate talent



Notes: The dashed line shows the hypothetical levels of social welfare in the different regimes while the bold line depicts the actual attainable levels of social welfare.

At these equilibrium levels, the marginal benefit of increased competitive balance through the salary cap is small, while the marginal loss due to a decrease in aggregate talent is high (remember that for low μ less talent is lost through a more restrictive salary cap). In other words, there is no need to additionally increase competitive balance since the loss in aggregate talent outweighs the gains from a more even competition.

However, this changes as μ increases to $\mu > \mu'$, i.e. fans prefer aggregate talent. Figure 1b depicts this situation. Here, the unrestricted equilibrium is characterized by a relatively high level of aggregate talent and a low level of competitive balance. In this case, a binding salary cap for the strong clubs will increase social welfare in regime B compared to regime A because the marginal benefit of increased competitive balance overcompensates the marginal loss due to a decrease in aggregate talent. This is true until the welfare maximum is attained at $cap = \frac{\alpha}{2n}$. Beyond that threshold, social welfare starts to decrease again, as the loss in talent cannot be overcompensated by the increase in competitive balance.

Imposing a stricter salary cap than cap' (implementing regime C) can never be optimal from a social point of view because the resulting loss in aggregate talent is not compensated by a positive effect on competitive balance, as the competition is already perfectly balanced.[20]

5 Conclusion

Salary caps are employed within professional team sports leagues all over the world. Conventional wisdom suggests that they are a collusive effort of club owners to control labor costs. Based on this assumption most economists would predict that salary caps decrease social welfare. Based on a game-theoretical model of a league consisting of small- and large-market clubs, we show that a salary cap may increase or decrease social welfare depending upon the fans' valuation of competitive balance and aggregate talent. A salary cap that binds only for large-market clubs will increase social welfare if fans prefer aggregate talent despite the fact that the salary cap will result in lower aggregate talent. If fans prefer competitive balance, on the other hand, any binding salary cap will reduce social welfare. In any case, a binding cap will increase competitive balance and will help

[20] Note that if the fans' preference for aggregate talent increases beyond another threshold $\mu'' = \frac{3m_s+m_w}{3m_s+m_w+n^2(m_s-m_w)}$, i.e. $\mu \in (\mu'', \overline{\mu})$, then social welfare can also be higher in regime C than in regime A, although the welfare maximum is also reached in regime B. See Figure 2 at the end of the appendix for a graphical illustration of this situation.

to keep salary costs under control. Moreover, we show that if salary caps are beneficial for social welfare they also increase club profits.[21] Therefore clubs will never oppose salary caps which have a positive effect on social welfare. However, caution is necessary since there exists a range of the preference parameter μ within which club profits increase and social welfare decreases through the introduction of a salary cap.[22] These results suggest that salary caps need not be a collusive effort but can be an important mechanism to increase social welfare within professional team sports leagues.

[21] The analysis of club profits is similar to the analysis of social welfare.

[22] Formally: If the fans relative preference for aggregate talent is in the interval $(\widehat{\mu}', \mu')$ with $\widehat{\mu}' := \frac{n-4m_s m_w}{n^3(m_s-m_w)+n-4m_s m_w}$ then the introduction of a salary cap will be beneficial for the clubs and detrimental to social welfare.

A Appendix

A.1 Derivation of condition (9) and (10) in regime B

We compute

$$\frac{\partial W^B(cap)}{\partial cap} = \frac{3}{8}\left(\frac{n(\alpha - 2n\cdot cap)(1-\mu)\mu}{1+\mu(n^2-1)}\right) > 0 \Leftrightarrow cap < cap^B_{\max} = \frac{\alpha}{2n}$$

However, the welfare maximizing salary cap $cap^B_{\max}$ need not necessarily be within the interval of feasible salary caps $I^B = (cap', x^A_s)$ with $cap' = \frac{\alpha}{2n} - \frac{1}{\mu m_w}$ in regime B. We derive

$$x^A_s \leq cap^B_{\max} \Leftrightarrow \mu \leq \mu' := \frac{1}{1+n^2(m_s - m_w)} \in (\underline{\mu}, \overline{\mu})$$

Hence, if $\mu \in (\underline{\mu}, \mu']$ then $cap^B_{\max} \notin I^B$ and a more restrictive salary cap, i.e. a lower variable cap, will decrease social welfare $W^B(cap)$ in regime B.

However, if $\mu \in (\mu', \overline{\mu})$ then the welfare maximizing salary cap $cap^B_{\max}$ is in the interval of feasible salary caps I^B, i.e. $cap^B_{\max} \in I^B$. In this case the effect of a more restrictive salary cap on social welfare depends crucially on the size of the salary cap. Formally, we derive

$$\frac{\partial W^B(cap)}{\partial cap} > 0 \ \forall cap \in (cap', cap^B_{\max}) \text{ and } \frac{\partial W^B(cap)}{\partial cap} < 0 \ \forall cap \in (cap^B_{\max}, x^A_s)$$

A.2 Proof of Proposition 2

This proof consists of three parts. In part (1) we compare regime A and B, in part (2) regime A and C and in part (3) regime B and C with respect to social welfare. Remember that regime A is only effective for $cap \geq x^A_s$, regime B for $cap' < cap < x^A_s$ and regime C for even tighter salary caps, $cap \leq cap'$.

(1) By comparing social welfare in regime A and B, we derive:

$$W^A \leq W^B(cap) \Leftrightarrow cap \in [cap^{AB}_1, cap^{AB}_2]$$

where

$$\begin{aligned}
cap^{AB}_1 &= \frac{\alpha}{2n} - \frac{m_s(1-\mu(1+n^2) + m_w(1+\mu(n^2-1))}{2m_s m_w(1-\mu)\mu} \\
cap^{AB}_2 &= \frac{\alpha}{2n} + \frac{m_s(1-\mu(1+n^2) + m_w(1+\mu(n^2-1))}{2m_s m_w(1-\mu)\mu}
\end{aligned}$$

Note that cap_1^{AB} is exactly the equilibrium investment level of the strong clubs in regime A, i.e. $cap_1^{AB} = x_s^A$.

We now analyze whether a salary cap from the interval $[cap_1^{AB}, cap_2^{AB}]$ for which social welfare is higher in regime B than in regime A is part of the interval I^B of feasible salary caps in regime B. We derive

$$cap_1^{AB} < cap_2^{AB} \Leftrightarrow \mu < \mu' := \frac{1}{1 + n^2(m_s - m_w)} \in (\underline{\mu}, \overline{\mu})$$

(1a) If $\mu \in (\underline{\mu}, \mu')$ then $\nexists\ cap' \in [cap_1^{AB}, cap_2^{AB}]$ such that $cap' \in I^B$. That is, we cannot find a salary cap out of the interval $[cap_1^{AB}, cap_2^{AB}]$ which is also included in the interval I^B of feasible salary caps for regime B. Hence,

$$W^A > W^B(cap)\ \forall cap \in (cap', cap_1^{AB}) = I^B$$

This shows that an effective salary cap is always detrimental to social welfare because social welfare is higher in regime A than in regime B.

(1b) If $\mu = \mu'$ then $W^A = W^B(cap) \Leftrightarrow cap = \frac{\alpha}{2n} = x_s^A$. Since $I^B = (cap', x_s^A)$ we also conclude that $W^A > W^B(cap)\ \forall cap \in I^B$.

(1c) If $\mu \in (\mu', \overline{\mu})$ then $cap_1^{AB} > cap_2^{AB}$. In this case, we have to analyze if cap_2^{AB} is in the interval of feasible salary caps I^B. We derive

$$cap_2^{AB} \leq cap' \Leftrightarrow \mu \geq \mu'' := \frac{3m_s + m_w}{3m_s + m_w + n^2(m_s - m_w)} \in (\mu', \overline{\mu})$$

i) If $\mu \in (\mu', \mu'')$ then $cap' < cap_2^{AB}$ and thus the interval $[cap_2^{AB}, cap_1^{AB}]$ is a subset of the interval I^B. In this case the size of the salary cap determines whether social welfare is higher in regime A or B. More precisely, $W^A \geq W^B(cap)\ \forall cap \in (cap', cap_2^{AB}]$ and $W^A < W^B(cap)\ \forall cap \in (cap_2^{AB}, x_s^A)$

ii) If $\mu \in [\mu'', \overline{\mu})$ then $cap' \geq cap_2^{AB}$ and thus social welfare in regime B is higher than in regime A independent of the size of the salary cap, i.e. $W^A < W^B(cap)\ \forall cap \in I^B$.

Moreover, note that social welfare is maximized in regime B if the salary cap is fixed at $cap_{\max} = \frac{\alpha}{2n}$.

(2) By comparing social welfare in regime A and C, we derive:

$$W^A \leq W^C(cap) \Leftrightarrow cap \in [cap_1^{AC}, cap_2^{AC}]$$

where

$$\begin{aligned} cap_1^{AC} &= \frac{\alpha}{2n} - \frac{((n^2\mu m_s m_w)^2(1-\mu)(1-\mu+\mu n^2(m_s-m_w)^2))^{1/2}}{2(n\mu m_s m_w)^2(1-\mu)} \\ cap_2^{AC} &= \frac{\alpha}{2n} + \frac{((n^2\mu m_s m_w)^2(1-\mu)(1-\mu+\mu n^2(m_s-m_w)^2))^{1/2}}{2(n\mu m_s m_w)^2(1-\mu)} \end{aligned}$$

We derive that $cap_1^{AC} < cap_2^{AC}$ and $cap_2^{AC} > cap'$, i.e. cap_2^{AC} is not in the interval of feasible salary caps I^C for regime C.

Analogously to (1), we analyze whether a salary cap from the interval $[cap_1^{AC}, cap_2^{AC}]$ for which social welfare is higher in regime C than in regime A is part of the interval $I^C = (0, \frac{\alpha}{2n} - \frac{1}{\mu m_w}]$ of feasible salary caps in regime C. We derive:

$$cap_1^{AC} \leq cap' \Leftrightarrow \mu \geq \mu'' := \frac{3m_s + m_w}{3m_s + m_w + n^2(m_s - m_w)}$$

(2a) If $\mu \in (\underline{\mu}, \mu'')$ then $cap_1^{AC} > cap'$. In this case cap_1^{AC} is not in the interval of feasible salary caps I^C for regime C and thus we derive that social welfare is higher in regime A than in regime C, i.e. $W^A > W^C(cap)\ \forall cap \in I^C$.

(2b) If $\mu \in [\mu'', \overline{\mu})$ then $cap_1^{AC} \leq cap'$. In this case the size of the salary cap determines whether social welfare is higher in regime A or C. More precisely, $W^A > W^C(cap)$ for all $cap \in (0, cap_1^{AC})$ and $W^A < W^C(cap)$ for all $cap \in (cap_1^{AC}, cap']$. Note that for $cap = cap'$ holds $W^A = W^C(cap)$.

Moreover, we derive that in regime C social welfare would also be maximized if the salary cap was fixed at $cap_{\max} = \frac{\alpha}{2n}$. However, this welfare maximizing salary cap is never part of the interval I^C.

(3) By comparing social welfare in regime B and C, we derive:

$$W^B(cap) \leq W^C(cap) \Leftrightarrow cap \in [cap_1^{BC}, cap_2^{BC}]$$

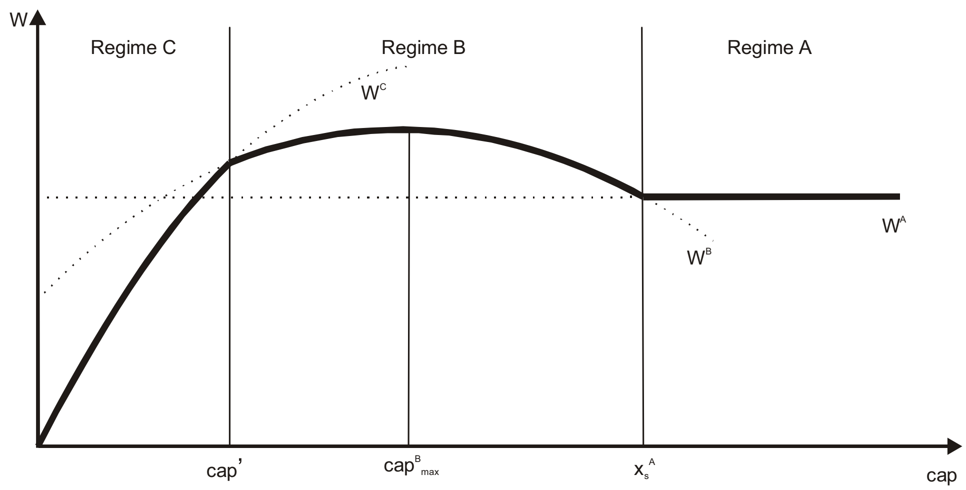
where

$$cap_1^{BC} = \frac{\alpha}{2n} - \frac{1}{\mu m_w} \text{ and } cap_2^{BC} = \frac{\alpha}{2n} + \frac{1}{\mu m_w}$$

Note that $cap_1^{BC} = cap'$. Moreover, regime C is only effective if $cap \in (0, cap']$. This directly implies that social welfare in regime C can never be higher than in regime B. As a consequence, implementing a sufficiently strict salary cap (i.e. $cap \leq cap'$) such that regime C is effective, will always decrease social welfare.

Figure 2 depicts the situation in which aggregate talent is even more important than in Figure 1b, i.e. $\mu \in (\mu'', \overline{\mu})$.

Figure 2: Effect of Salary Caps on Social Welfare for $\mu \in (\mu'', \overline{\mu})$



Notes: The dashed line shows the hypothetical levels of social welfare in the different regimes while the bold line depicts the actual attainable levels of social welfare.

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