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The Effect of Luxury Taxes on Competitive Balance, Club Profits, and Social Welfare in Sports Leagues

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Abstract

This paper presents a model of a professional sports league and analyzes the effect of luxury taxes on competitive balance, club profits, and social welfare. It shows that a luxury tax increases aggregate salary payments in the league and produces a more balanced league. Moreover, a higher tax rate increases the profits of large-market clubs, whereas the profits of small-market clubs only increase if the tax rate is not set inadequately high. Finally, we show that social welfare increases with a luxury tax.

Keywords: sports league, luxury tax, social welfare, competitive balance

Introduction

A "luxury tax," or competitive balance tax, is a surcharge on the aggregate payroll of a sports team that exceeds a predetermined limit set by the corresponding sports league. The luxury tax was essentially designed to slow the growth of salaries and to prevent large-market teams from signing all of the top players within a league. The money derived from this tax is distributed among the financially weaker teams. The luxury tax thus aims to create a more balanced league, because redistribution among clubs counteracts financial imbalances.

In North America, the National Basketball Association (NBA) and Major League Baseball (MLB) operate with a luxury tax system. In 1984, the NBA became the first league to introduce salary cap provisions.[1] The NBA's salary cap is a so-called "soft cap," meaning that there are several exceptions that allow teams to exceed the salary cap in order to sign players. These exceptions are mainly designed to enable teams to retain popular players. In 1999, the NBA also introduced a luxury tax system for those teams with an average team payroll exceeding the salary cap by a predefined amount. These teams have to pay a 100% tax to the league for each dollar their payroll exceeds the tax level.

The first luxury tax in professional sports was introduced in 1996 by MLB as part of its Collective Bargaining Agreement (CBA). This agreement imposed a luxury tax of 35% for the first two years and 34% for the third year on the teams with the top five payrolls during the 1997, 1998, and 1999 seasons. Between 2000 and 2002, the luxury tax system was replaced by a revenue-sharing system. MLB reintroduced a luxury tax system in 2003 and set fixed limits on payrolls for every year. For instance, the limit was $137 million in 2006, $148 million in 2007, and $155 million in 2008. The excess payroll is taxed at 22.5% for first-time offenders, 30% for the second offense and 40% for three or more offenses. Table 1 shows recent luxury tax payments in the NBA and MLB.

Table 1: Luxury Tax Payments in the NBA and MLB

		Luxury Tax Payments (in US$)	
League	**Club**	**Season 2006-07**	**Season 2007-08**
NBA	New York Knicks	45’100’000	19’700’000
	Dalas Mavericks	7’200’000	19’600’000
	Cleveland Cavaliers	-	14’000’000
	Denver Nuggets	2’000’000	13’600’000
	Miami Heat	-	8’300’000
	Boston Celtics	-	8’200’000
	Minnesota Timberwolves	1’000’000	-
	LA Lakers	-	5’100’000
	Phoenix Suns	-	3’900’000
	San Antonio Spurs	200’000	-
League	**Club**	**Season 2006**	**Season 2007**
MLB	New York Yankees	26’000’000	23’880’000
	Boston Red Soxs	498’000	6’060’000

The welfare effect of luxury taxes has not yet been studied in the sports economic literature. There are, however, some studies that analyze the effect of luxury taxes on competitive balance and player salaries. Gustafson and Hadley (1996) find that a luxury tax will depress the demand curve for star players on high-payroll teams and will not alter the demand for star players by low-payroll teams, resulting in a lower equilibrium salary for star players. The new equilibrium is further characterized by a higher level of competitive balance, because the high-payroll teams will hire fewer star players and the low-payroll teams will hire more star players as compared to the period prior the introduction of the luxury tax.

Marburger (1997) develops a model with two profit-maximizing clubs, including one large-market club and one small-market club, and a fixed talent supply. He shows that luxury taxes that are uniformly imposed as a linear function of a club’s payroll and that are not redistributed to other clubs do not affect club profitability because the decline in salaries equals the increase in taxes. Luxury taxes that are redistributed according to a linear subsidy function result in lower salaries and higher profits, but they do not affect competitive balance. In order to reward small-market clubs and improve competitive balance, the proceeds of luxury taxes must be distributed uniformly among all clubs.

Ajilore and Hendrickson (2005) analyze the effect of luxury taxes on competitive balance in MLB by empirically estimating the impact of luxury taxes on team competitiveness. Their results show that the introduction of a luxury tax in MLB has reduced the competitive inequality of teams. Most of their results, however, are driven by a single team, the New York Yankees. Finally, Van der Burg and Prinz (2005) propose a progressive tax on either the revenues or the payroll of sports clubs as a means to enhance competitive balance in team sports league. Their theoretical analysis shows that both types of tax will create asymmetric changes in the marginal revenues or the marginal costs of the clubs and thus yield a more balanced league.

In the present paper, we add to the literature by providing a welfare analysis of luxury taxes in a professional team sports league. In particular, we analyze the effect of luxury taxes on competitive balance, club profits, and social welfare. We show that a luxury tax increases aggregate player salaries in the league and produces a more balanced league. Moreover, a higher tax rate increases the profits of large-market clubs, whereas the profits of small-market clubs only increase if the tax rate is not set inadequately high. Finally, we show that social welfare increases with a luxury tax.

Model

The following model describes the impact of luxury taxes on social welfare in a professional team sports league consisting of an even number of profit-maximizing clubs. The league generates total revenues according to a league demand function. League revenues are then split among the clubs that differ with respect to their market share. We assume that there are two types of clubs, namely, large-market clubs and small-market clubs. In order to maximize profits, each club independently invests in playing talent.

League demand depends on the quality of the league, q, and is derived as follows.[2] 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 fans θ_k are assumed to be uniformly distributed in [0,1], that is, 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 $\theta^* = p/q$. Hence, the measure of fans that purchase at price p is $\theta^* = (q - p)/q$. The league demand function is therefore given by $d(p,q) = 1 - p/q$. Note that league demand increases in quality, albeit with a decreasing rate; that is, $\partial d/\partial q > 0$ and $\partial^2 d/\partial q^2 <$. By normalizing all other costs (e.g., stadium and broadcasting costs) to zero, league revenues are simply $LR = p \cdot d(p,q)$. Then, the league will choose the profit-maximizing price $p^* = q/2$.[3] Given this profit-maximizing price, league revenues depend solely on the quality of the league as follows:

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

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 potential suspense associated with a close competition (competitive balance). Moreover, we assume that the supply of talent is perfectly elastic. As a consequence, the unit cost/price of talent is exogenously given and constant. Without loss of generality, we normalize the unit cost/price of talent to one, which means that talent investments of club i, denoted by

x_i, are equal to their salary payments. In the subsequent analysis, we use the terms "player salaries" and "talent investments" interchangeably.

The level of competition is measured by the aggregate talent within the n-club league. We assume that the marginal effect of player salaries (talent investments) x_i on the level of the competition, T, is positive but decreasing:

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

This is guaranteed in our model if $\partial T / \partial x_i > 0 \Leftrightarrow \sum_{j=1}^{n} x_j < \alpha / 2$, and $\partial^2 T / \partial x_i^2 < 0$, which will always be satisfied in equilibrium.

Competitive balance, CB, is measured by minus the variance of player salaries and yields:[4]

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

Note that a lower variance of player salaries among the n clubs implies closer competition and, therefore, a higher degree of competitive balance. If all clubs invest the same amount in talent, then the measure for competitive balance attains its maximum and equals zero.

League quality is now defined as:

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

with $\mu \in (0,1)$. The parameter μ represents the relative weight that fans place on aggregate talent and competitive balance. Given aggregate player salaries of the other (n-1) clubs, league quality increases with club i's player salaries x_i until a threshold value $x_i(\mu)$. Since fans have at least some preference for $\sum_{j=1, j \neq i}^{n} x_j$ competitive balance, excessive dominance by one club causes quality to decrease.

League revenues are split between the two types of clubs according to their market shares. For the sake of simplicity, we assume that half of the n clubs are large-market clubs which receive a bigger share of league revenues than the small-market clubs.[5] Each of the large-market clubs receives a fraction $\frac{m_l}{n/2}$ of league revenues, and each of the small-market clubs receives a fraction $\frac{m_l}{n/2}$ of league revenues, with

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

We denote J_l and J_s as the set of large-market and small-market clubs, respectively, i.e., $J = \{1,..,n\} = J_l \cup J_s$.

Furthermore, our league features a luxury tax system with an endogenously determined luxury tax and subsidy.[6] A club must pay a luxury tax if its player salaries lie above the league's average salary level. The club with player salaries below the league's average salary level then receives this tax as a subsidy. We model the endogenously determined tax or subsidy, $\theta_i(x_1,..,x_n)$, as follows

$$\theta_i(x_1,..,x_n) = -r \cdot \left(x_i - \frac{1}{n} \sum_{j=1}^{n} x_j \right);$$

where the parameter $r \in [0,1]$ represents the tax rate. Note that if club i spends more than the league's average salary level, then this club has to pay a luxury tax, whereas it receives a subsidy if it spends less than the average level in the league, i.e., $\theta_i > 0 \Leftrightarrow x_i < \frac{1}{n}\sum_{j=1}^{n} x_j$. Moreover, note that the luxury tax or subsidy involves a pure redistribution among clubs because $\sum_{i=1}^{n}\theta_i = 0$.

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

$$\Pi_i(x_1,..,x_n) = \frac{m_\delta}{2n} q(x_1,..,x_n) - x_i + \theta_i(x_1,..,x_n),$$

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

with $\delta = l$ for $i \in J_l$ and $\delta = s$ for $i \in J_s$.

Social welfare is given by the sum of the aggregate consumer (or fan) surplus, the aggregate club profit and the 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 maximum price $\bar{p} = q$, which is the maximum price fans are willing to pay for quality *q*, that is,

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

The summation of aggregate consumer surplus, aggregate club profits and aggregate player salaries produces social welfare as

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

Note that neither aggregate player salaries, taxes, nor subsidies directly influence social welfare, because salaries merely represent a transfer from clubs to players, and the tax or subsidy involves a pure redistribution among clubs.

As mentioned above, clubs are assumed to be profit-maximizing and thus, each club $i \in J$ aims to solve the following maximization problem:[7]

$$\max_{x_i \geq 0} \Pi_i(x_1,..,x_n).$$

The solution to the maximization problem is given in the next lemma:

Lemma 1

The equilibrium player salaries (talent investments) for club $i \in J$ are given by

$$x_i^* = \frac{\alpha}{2n} - \frac{v_1 w_2 - v_2 w_1}{2m_l m_s n(1-\mu)\mu} \equiv x_l^* \;\; \forall i \in J_l,$$

$$x_j^* = \frac{\alpha}{2n} - \frac{v_1 w_1 - v_2 w_2}{2m_l m_s n(1-\mu)\mu} \equiv x_s^* \;\; \forall j \in J_s, \quad (3)$$

with $v_1 \equiv m_s(r(n-1)+n)$, $v_2 \equiv m_l(r(n-1)-n)$, $w_1 \equiv 1-\mu(n^2+1)$, *and* $w_2 \equiv 1+\mu(n^2-1)$

Proof: See Appendix A.1.

The lemma shows that all large-market (small-market) clubs choose the same salary level, x_l (x_s). Moreover, the large-market clubs spend more on player salaries than the small-market clubs because the marginal revenue of talent investments is higher for the former type of clubs. As a consequence, each large-market club has to pay a luxury tax, and each small-market club receives a subsidy, which is financed by the large-market clubs.

We see that a higher tax rate r induces small-market clubs to increase their talent investments, i.e., $\frac{\partial x_s^*}{\partial r} > 0$. This result is intuitively clear: a higher tax rate increases the subsidies to small-market clubs, which are financed by large-market clubs, such that the investment costs of small-market clubs decrease.

The effect of a higher tax rate on the talent investments of large-market clubs, however, is ambiguous and depends on the fans' preference parameter μ. Note that

$$\frac{\partial x_l^*}{\partial r} = -\frac{(n-1)(m_s - m_l + \mu(m_l - m_s + n^2))}{2m_l m_s (1-\mu)\mu} \begin{cases} > 0 \text{ if } \mu \in (0, \mu'), \\ = 0 \text{ if } \mu = \mu', \\ < 0 \text{ if } \mu \in (\mu', 1). \end{cases}$$

with $\mu' = \frac{m_l - m_s}{m_l - m_s + n^2}$. A higher tax rate thus induces large-market clubs to increase their investment level if fans have a high preference for competitive balance, i.e., $\mu < \mu'$, and to decrease their investment level if fans have a high preference for aggregate talent, i.e., $\mu < \mu'$.

The rationale for this result is as follows. If μ is relatively low, fans have a high preference for competitive balance and the equilibrium (3) is already characterized by a high level of competitive balance and a low level of aggregate talent. At these equilibrium levels, the marginal benefit of a higher level of aggregate talent, which translates into higher revenues, is larger than the higher investment costs due to a higher tax. As a consequence, large-market clubs will increase their investment level.

In contrast, if μ is relatively high, the equilibrium is already characterized by a high level of aggregate talent and a low level of competitive balance. In this case, the marginal benefit of a higher level of aggregate talent is small, and cannot compensate for the higher investments costs, inducing the large-market clubs to decrease their investment level.

On aggregate, however, the investment level always increases with a higher tax rate. That is, even if large-market clubs decrease their investments (i.e., if $\mu < \mu'$), they never compensate for the increase of talent among small-market clubs.

The luxury tax paid by each large-market club, $i \in J_l$, in equilibrium is given by

$$\theta_l^* = -\frac{rn[(m_l - m_s)n - (n-1)r]}{2m_s m_l (1-\mu)} < 0.$$

Meanwhile the subsidy received by each small-market club, $i \in J_l$, is given by

$$\theta_s^* = \frac{rn[(m_l - m_s)n - (n-1)r]}{2m_s m_l (1-\mu)} > 0.$$

Note that a higher tax rate, r, increases the subsidy, θ_s^*, received by small-market clubs and decreases the luxury tax, θ_l^*, paid by large-market clubs until the maximum and minimum, respectively, is reached for $r = \frac{n(m_l - m_s)}{2(n-1)}$.

In equilibrium, the aggregate level of player salaries, $S^*(r)$, and competitive balance, $CB^*(r)$, are given by

$$S^*(r) = \sum_{j=1}^{n} x_j^* = \frac{\alpha}{2} - \frac{m_l(n(1-r)+r) + m_s(n + r(n-1))}{2m_l m_s \mu},$$

and

$$CB^*(r) = -\left(\frac{n(m_l - m_s) - r(n-1))}{2m_l m_s(1-\mu)}\right)^2.$$

We thus derive the following proposition.

Proposition 1

A higher tax rate increases the level of competition and produces a more balanced league.

Proof: See Appendix A.2.

Remember that on aggregate, the investment level increases with a higher tax rate: that is, the net effect of a higher tax rate is positive, and aggregate player salaries in the league will increase, i.e., $\partial S^*(r)/\partial r > 0$. It follows that a higher level of aggregate player salaries in the league translates through the talent function (1) into a higher level of the competition, T^*.

The proposition further shows that a higher tax rate produces a more balanced league and, thus, increases competitive balance, i.e. $\partial CB^*(r)/\partial r > 0$. The rationale for this result is that a higher tax diminishes differences among clubs. That is, even if large-market clubs increase their investment levels, small-market clubs will always respond with even higher investment levels such that $\partial x_s^*/\partial r > \partial x_l^*/\partial r$.

Since both the level of the competition, T^*, and competitive balance, CB^*, increase through a higher tax rate, it is clear that league quality, as given by $q^* = \mu T^* + (1-\mu)CB^*$, will also increase. A higher league quality will then result in higher league revenues, LR^*.

As a consequence, we are able to establish the following proposition:

Proposition 2

A higher tax rate increases social welfare in a team sports league comprised of profit-maximizing clubs.

Proof: Straightforward and therefore omitted.

The proposition posits that the introduction of a luxury tax system that redistributes revenues from large-market clubs to small-market clubs increases social welfare in a team sports league comprised of profit-maximizing clubs, and an elastic supply of talent. Since a higher tax rate increases league quality, it will also increase social welfare because welfare is directly proportional to league quality. Note that the result of the proposition is independent of the fans' preferences for aggregate talent and competitive balance.

In the following proposition, we analyze the effect of a higher tax rate on club profits.

Proposition 3

A higher tax rate always increases the profits of large-market clubs, whereas the profits of small-market clubs only increase until the profit maximum is reached for a tax rate given by $r = r^* \in (0,1]$.

Proof: See Appendix A.3.

This proposition posits that even though large-market clubs must subsidize small-market clubs, the large-market clubs always benefit from a higher tax, whereas the small-market clubs only benefit up to a certain tax level, r^*. The rationale for this result is as follows. On the revenue side, both clubs benefit from higher league revenues as a result of a higher luxury tax. Large-market clubs, however, benefit from the higher league revenues at an above-average rate because they receive a larger share of league revenues. On the cost side, small-market clubs face higher investment costs due to higher player salaries, while the investment costs for large-market clubs decrease (increase) if fans have a high preference for aggregate talent (competitive balance). For small-market clubs, the higher subsidies and higher revenues compensate for the higher player salaries only until the tax rate attains r^*. For large-market clubs, however, the higher revenues always compensate for the higher costs, and thus, profits increase with a higher tax rate.

Conclusion

Luxury taxes are an important way to increase competitive balance in professional sports leagues. In this paper, we analyze the effects of a luxury tax on competitive balance, club profits, and social welfare under the assumption that the supply of talent is elastic and clubs maximize profits. We develop a game-theoretic model of an n-club league consisting of small-market and large-market clubs and derive fan demand from a general utility function by assuming that a fan's willingness to pay depends on the quality of the league. Our league features the combination of an endogenously determined luxury tax and subsidy. Clubs with payroll exceeding the average salary level must pay a luxury tax on the excess amount. These proceeds are then redistributed proportionally to those clubs with a payroll below the league average.

Our analysis shows that a higher luxury tax induces small-market clubs to increase their player salaries. If fans have a high preference for aggregate talent, however, large-market clubs will respond by decreasing their player salaries. Aggregate payrolls will increase with a higher tax rate, as the increase in player salaries by small-market clubs is always larger than the decrease in player salaries by large-market clubs. As a consequence, both competitive balance and aggregate player salaries in the league will increase. The effect of luxury taxes on social welfare is positive, because league quality will always increase as a result of the combination of luxury taxes and its resulting subsidies. Finally, our model shows that a luxury tax will increase the profits of large-market clubs, whereas the profits of small-market clubs only increase if the tax rate is not set inadequately high. This result holds despite the fact that large-market clubs must finance the subsidies for small-market clubs.

Further research is necessary, for example, to model the bargaining game among clubs and league authorities in the distribution of league revenues. Moreover, luxury taxes have not yet been analyzed in the context of open league with promotion and relegation, or so-called mixed leagues, that is, in leagues in which some clubs maximize profits, while others aim to maximize wins.[8] Finally, an interesting avenue for further research is the analysis of luxury taxes in the context of a league with a fixed supply of talent and an endogenously determined cost/price per unit of talent.

References

Ajilore, O., & Hendrickson, J. (2005). *The impact of the luxury tax on competitive balance in Major League Baseball.* IASE Working Paper Series, Paper No. 07-27.

Buraimo, B., Forrest, D., & Simmons, R. (2007). Freedom of entry, market size, and competitive outcome: Evidence from English soccer. *Southern Economic Journal 74*(1), 204-213.

Buraimo, B., & Simmons, R. (2008). Competitive balance and attendance in Major League Baseball: An empirical test of the uncertainty of outcome hypothesis. *International Journal of Sport Finance 3*, 146-155.

Dietl, H., Franck, E., & Lang, M. (2008). Overinvestment in team sports leagues: A contest theory model. *Scottish Journal of Political Economy 55*, 353-368.

Dietl, H., & Lang, M. (2008). The effect of gate revenue sharing on social welfare. *Contemporary Economic Policy 26*, 448.459.

Dietl, H., Lang, M., & Rathke, A. (2009). The effect of salary caps in professional team sports on social welfare. *The B.E. Journal of Economic Analysis and Policy, 9*, Article 17.

Dietl, H., Lang, M., & Werner, S. (2009). Social welfare in sports leagues with profit-maximizing and/or win-maximizing clubs. *Southern Economic Journal, 76*, 375-396.

Falconieri, S., Palomino, F., & Sákovics, J. (2004). Collective versus individual sale of television rights in league sports. *Journal of the European Economic Association 5*, 833-862.

Fort, R., & Quirk, J. (1995). Cross-subsidization, incentives, and outcomes in professional team sports leagues. *Journal of Economic Literature, 33*, 1265-1299.

Fort, R., & Quirk, J. (2004). Owner objectives and competitive balance. *Journal of Sports Economics, 5*, 20-32.

Frick, B., Prinz, J., & Winkelmann, K. (2003). Pay inequalities and team performance: Empirical evidence from the North American major leagues. *International Journal of Manpower, 24*, 472-488.

Gustafson, E., & Hadley, L. (1996). The luxury tax proposal for Major League Baseball: A partial equilibrium analysis. In J. Fizel, E. Gustafson, & L. Hadley (Eds.), *Baseball economics: Current research*, pp. 145-159. Westport, CT: Praeger.

Hoehn, T., & Szymanski, S. (1999). The Americanization of European football. *Economic Policy, 14*, 204-240.

Humphreys, B. (2002). Alternative measures of competitive balance in sports leagues. *Journal of Sports Economics, 3*(2), 133.

Késenne, S. (2000a). The impact of salary caps in professional team sports. *Scottish Journal of Political Economy, 47*, 422-430.

Késenne, S. (2000b). Revenue sharing and competitive balance in professional team sports. *Journal of Sports Economics, 1*, 56-65.

Késenne, S. (2007). The economic theory of professional team sports – An analytical treatment. Cheltenham, UK: Edward Elgar.

Marburger, D. (1997). Gate revenue sharing and luxury taxes in professional sports. *Contemporary Economic Policy, 15*, 114-123.

Sloane, P. (1971). The economics of professional football: The football club as a utility maximizer. *Scottish Journal of Political Economy, 17*, 121-146.

Szymanski, S. (2003). The economic design of sporting contests. *Journal of Economic Literature, 41*, 1137-1187.

Van der Burg, T., & Prinz, A. (2005). Progressive taxation as a means for improving competitive balance. *Scottish Journal of Political Economy, 52*, 65-74.

Vrooman, J. (1995). A general theory of professional sports leagues. *Southern Economic Journal, 61*, 971-990.

Vrooman, J. (2000). The economics of American sports leagues. *Scottish Journal of Political Economy, 47*, 364-398.

Endnotes

[1] 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 a club's investment in playing talent. For a more detailed analysis, see e.g., Fort and Quirk (1995), Késenne (2000a), Szymanski (2003), Vrooman (1995, 2000), and Dietl, Lang, and Rathke (2009).

[2] Our approach is similar to Falconieri et al. (2004), but we use a different quality function. The quality function q in Falconieri et al. always increases with a club's own talent investments, i.e., $\partial q / \partial x_i > 0$, regardless of how unbalanced the league becomes. In contrast, in our model, quality decreases if the league becomes too unbalanced. Also see Dietl and Lang (2008) who derive league demand as in the present paper.

[3] Note that the optimal price increase with quality, i.e., $\partial p^* / \partial q > 0$.

[4] For an analysis of competitive balance in sports leagues, see e.g., Humphreys (2002), Buraimo et al. (2007), and Buraimo and Simmons (2008). Moreover, see Frick et al. (2003), who investigate the consequences of wage disparities on team performance.

[5]An interesting avenue for further research is to generalize the results by implementing a parameter that characterizes the fraction of large-market and small-market clubs, respectively.

[6] See also Marburger (1997).

[7] For a discussion of the club objective function, see e.g., Sloane (1971), Hoehn and Szymanski (1999), Fort and Quirk (2004), Késenne (2000b, 2007), and Dietl, Lang, and Werner (2009).

[8] See, e.g., Dietl, Franck, and Lang (2008), who investigate the overinvestment problem in open leagues and Dietl, Lang, and Werner (2009), who analyze social welfare in mixed leagues.

[9] It is easy to show that the corresponding second-order conditions for a maximum are satisfied.

[10] This parameterization allows us to derive closed-form solutions. The results remain qualitatively the same for other parameter configurations.

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Appendix A

A.1 Proof of Lemma 1

The first-order conditions of equation (2) are given by[9]

$$\frac{m_\delta}{2n}\left(\mu\left(\alpha - 2\sum_{j=1}^{n} x_j^*\right) - \frac{2(1-\mu)}{n}\left(x_i^* - \frac{1}{n}\sum_{j=1}^{n} x_j^*\right)\right) - 1 - r\cdot\left(1-\frac{1}{n}\right),$$

if $x_i^* > \frac{1}{n}\sum_{j=1}^{n} x_j^*$, and

$$\frac{m_\delta}{2n}\left(\mu\left(\alpha - 2\sum_{j=1}^{n} x_j^*\right) - \frac{2(1-\mu)}{n}\left(x_i^* - \frac{1}{n}\sum_{j=1}^{n} x_j^*\right)\right) - 1 + r\cdot\left(1-\frac{1}{n}\right),$$

if $x_i^* < \frac{1}{n}\sum_{j=1}^{n} x_j^*$. Note that $\delta = l$ for $i \in J_l$ and $\delta = s$ for $i \in J_s$. Solving the system of first-order conditions yields the following equilibrium investment levels:

$$x_i^* = \frac{\alpha}{2n} - \frac{v_1 w_2 - v_2 w_1}{2m_l m_s n(1-\mu)\mu} \equiv x_l^* \;\; \forall i \in J_l,$$

$$x_j^* = \frac{\alpha}{2n} - \frac{v_1 w_1 - v_2 w_2}{2m_l m_s n(1-\mu)\mu} \equiv x_s^* \;\; \forall j \in J_s,$$

with, $v_1 \equiv m_s(r(n-1)+n)$, $v_2 \equiv m_l(r(n-1)-n)$, $w_1 \equiv 1-\mu(n^2+1)$, and $w_2 \equiv 1+\mu(n^2-1)$.

In order to guarantee positive equilibrium investments, we assume that α is sufficiently large. Moreover, in order to guarantee that large-market clubs always invest more than small-market clubs, we assume that $m_l > m' \equiv \frac{m_s(n+(n-1)r)}{n(1-r)+r}$.

A.2 Proof of Proposition 1

First, we prove that a higher tax rate increases the level of competition. Substituting the equilibrium talent investments (3) in the talent function, *T*, given by (1) and computing the derivative with respect to *r* yields

$$\frac{\partial T^*(r)}{\partial r} = \frac{(m_l - m_s)(n-1)(n - r(m_l - m_s)(n-1))}{2(m_l m_s \mu)^2}.$$

We derive that $\frac{\partial T^*(r)}{\partial r} > 0$ for all $n > 2$, $1 > m_l > m_s > 0$, $1 \geq r \geq 0$ and $1 > \mu > 0$.

Second, we show that competitive balance increases with a higher tax rate. We find that

$$\frac{\partial CB^*(r)}{\partial r} = \frac{n^2(n-1)(m_l n + r - n(m_s + r))}{2(m_l m_s(1-\mu))^2}$$

Since $m_l > m'$, it holds that $\frac{\partial CB^*(r)}{\partial r} > 0$, which completes the proof.

A.3 Proof of Proposition 3

In order to analyze the effect of a luxury tax on club profits, we consider a two-club league with $n = 2$ and set the fan preference parameter to $\mu = 1/2$.[10] Substituting the equilibrium talent investments (3) into the profit function (2) and maximizing it with respect to the tax rate, *r*, yields the following profit-maximizing tax rate for large-market clubs

$$r_l^* = \frac{10m_l - 10m_s(m_l+1) + 26m_s^2}{4 + m_l^2 - 2m_s(m_l+8) + m_s^2},$$

and for small-market clubs

$$r_s^* = r^* \equiv \frac{2m_l(5+3m_l) - 2m_s(11m_l+5)}{4 + m_l^2 - 2m_l(m_s-8) + m_s^2}.$$

We can show that $r_l^* \geq 2$, i.e., that the maximum profit for large-market clubs is not within the interval of feasible tax rates. As a consequence, profits for large-market clubs increase for all $r \in [0,1]$. In contrast, for small-market clubs, the profit-maximizing tax rate, $r_s^* = r^*$, is in the interval $(0,1]$. It follows that the profits of small-market clubs increase when $r < r^*$ and decrease when $r > r^*$.