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Abstract

Professional sports leagues that feature teams in different countries with different currencies are exposed to exchange rate uncertainty and risk. This is particularly evident for three professional sports leagues that feature teams in the United States and Canada. We construct a simple model of a profit-maximizing team that earns its revenue in one currency and meets its payroll obligations in a second currency and participates in a league-imposed revenue sharing plan. Team profit can increase or decrease due to movements in the exchange rate based on a simple condition. Revenue sharing reduces the exposure to exchange rate uncertainty and risk. Hedging is possible for a single team by adjusting its payroll, but not likely. Some elementary calculations suggest this previously unrecognized benefit of revenue sharing is substantial for baseball's Toronto Blue Jays.

Key words: Exchange rate, risk, revenue sharing, profit

INTRODUCTION

Most professional sport leagues in North America find themselves in the position of operating leagues that span an international border. The National Hockey League (NHL) operates 23 teams in the United States (US) and 7 teams in Canada, while Major League Soccer (MLS) operates 19 teams in the US and 3 teams in Canada. The National Basketball Association (NBA) and Major League Baseball (MLB) each feature only one team in Canada. One is hard-pressed to find any other professional sports league in the world that spans an international border.[1] The member federations of FIFA, world football's governing body, operate annual tournaments that feature the top private professional teams in each federation, most notably the Champion's League in the European federation (UEFA). Although marketed as leagues, these are not leagues in the usual sense that teams play a regular season schedule, agree to common business practices (revenue sharing of local revenues, rules regarding player contracts, and so on) and compete within the same talent market.

Teams that operate in different countries in the same league are subject to exchange rate risk since the bulk of their revenues are typically in local currency but their payroll costs are in another currency. This is the case in the four North American leagues studied here. Their collective bargaining agreements stipulate that all player salaries are to be paid in U.S. Dollars (US$). NHL teams that operate in Canada are particularly vocal about exchange rate risk. Maple Leaf Sports and Entertainment (MLSE), owner of the Toronto Maple Leafs (NHL), Toronto Raptors (NBA) and Toronto FC (MLS), calls the exchange rate "one of the toughest risk factors for the company".[2] The NHL maintained an exchange rate stabilization fund during the 1990's to compensate Canadian teams when negotiating salaries for free agents, however it now relies on teams to hedge their payroll costs in the futures market.[3] The depreciation in the Canadian Dollar (CAD$) amounted to a CAD$32 million increase in payroll costs for the company in 2014. MLSE hedged a total of US$100 million in 2014, just over half of the payroll costs for its three teams, incurring CAD$350,000 in transactions costs.[4] The remaining payroll was left exposed to exchange risk. The Toronto Blue Jays (MLB) suffered an increase in payroll costs of CAD$25 million in 2014 due to the falling CAD$. The team does not comment on whether it hedges it payroll costs.

The purpose of this paper is to construct a simple model of a professional sports team that faces this mismatch in currencies and show how its profit is affected by exchange rate exposure. We derive a simple condition that contains local revenue in domestic currency, national revenue and team payroll in another currency, and revenue sharing. Revenue sharing can serve the purpose of at least partially insulating a domestic team from exchange rate exposure. In fact, it is possible for a domestic team to use revenue sharing and the setting of its payroll to construct a hedge against exchange rate movements, but it is not likely to be practical since it would require the team to achieve two objectives with only one tool. We close the paper by using some basic financial data for Canadian teams to assess their exchange rate exposure.

LOCAL REVENUES, NATIONAL REVENUES AND EXCHANGE RATE EXPOSURE

The collective bargaining agreements of the four North American leagues that feature teams in Canada stipulate that all player compensation is to be paid in US$. The largest portion of revenue for these teams is earned in CAD$, composed primarily of gate revenue, concessions, parking and local TV and media. Revenue from national TV, licensing, logos, apparel and so on is collected in a central fund in US$ and distributed evenly to each team in the league. The currency composition of team revenue is critical in determining the exchange risk exposure of the team: the greater the share of revenue collected in CAD$, the greater the exposure. For example, through 2021 each MLB team receives US$50 million in national TV revenue alone[5], but gate revenue for the Toronto Blue Jays was estimated to be CAD$79 million (US$59 million) excluding other local revenue for the 2015 season.[6] This leaves the Blue Jays in a partially exposed position with respect to exchange rate risk, but not as much as it would be without the national revenue. The Toronto Raptors (NBA) earned an estimated CAD$54 million (US$48 million) in gate revenue, excluding other local revenue, for the 2014-15 season. National TV revenue will total approximately US$87 million per year for the Raptors through to the 2024-25 season, so the team is well, but not fully insulated from exchange rate risk.

Canadian NHL and MLS teams receive far less in national revenues and are less insulated from exchange rate risk. Forbes estimates that three of the top six total revenue generating NHL teams in 2014-15 operate in Canada: the Montreal Canadiens, Toronto Maple Leafs and Vancouver Canucks.[7] These teams earned an estimated CAD$98 million (US$86 million), CAD$87.5 million (US$77 million) and CAD$81 million (US$71 million) respectively in gate revenue, excluding other local revenue. Each team will receive approximately US$6.7 million in national TV revenue (NBC) until 2021-22. The NHL sold the Canadian TV rights for CAD$5.2 billion until the 2025-26 season, but this revenue is fully subject to exchange rate risk. Clearly Canadian NHL teams are very exposed to exchange rate risk, much more so than their MLB and NBA cousins. This mismatch in currencies leaves Canadian teams open to exchange rate risk, particularly if a depreciation in the CAD$/US$ exchange rate increases the number of CAD$ needed to service the payroll. Many NHL teams have noted this repeatedly in the popular press[8] and have argued for more league and government intervention in the support of the Canadian teams.[9] MLS uses a unique system to mitigate exchange rate risk that will be discussed later in the paper.

Professional sports teams in Canada have had to weather large movements in the CAD$/US$ nominal exchange rate, as demonstrated in Figure 1. The exchange rate stood at $0.8866 US$ for each CAD$ in October 1991 and fell to $0.6249 by January 2002. This is the lowest value for the CAD$ in its history and was a 29.5% depreciation over a roughly 11 year period. The CAD$ subsequently began a long period of appreciation, topping out at $1.0348 in November 2007, an appreciation of 65.6%. The 2008 economic crash saw the CAD$ fall to $0.7911 by March 2009, but a strong economic recovery in Canada pushed the CAD$ to an all-time high of $1.0469 by July 2011, a 32.3% appreciation. Since that peak, the CAD$ has suffered a rapid decline in value to $0.7803 by March 2016, a 25.5% depreciation. The volatility of the exchange rate has increased significantly. The standard deviation of the annual exchange rate during the 1990-2002 period was $0.0762 and rose to $0.0992 during the 2003-2015 period. Hence exchange rate risk has increased for Canadian teams making it more difficult to form expectations of the exchange rate.

REVENUE SHARING

Under the 2012-16 CBA, each MLB team contributes 34% of its net local revenue from the previous year, net of any postseason revenue, to a central fund.[10] This revenue pool is then split evenly among all 30 MLB teams. Net local revenue includes mostly gate revenue and excludes revenue from luxury suites and local television and radio.

MLS uses a similar system to MLB in its centralized ownership structure.[11] Each team contributes 30% of gate revenue only into a central fund. The league then pays up to $3.49 million of each team's payroll and uses the remainder to finance league operations. The only difference between MLS and MLB is that MLS teams can only use the payment received towards payroll, whereas MLB teams can use the payment received for any purpose they choose.

The NBA first adopted revenue sharing in 2005. NBA teams contribute 50% of net local revenue (gross local revenue less allowable expenses) to a central fund that is allocated to the smaller market teams using a formula based on television viewership.[12] The NBA revenue sharing plan has since been reworked since it was believed that the largest market teams were not contributing enough to the fund. In the new plan, in markets with less than 1 million television viewers, the team contributes only 15% of its net local revenue and receives a full share from the fund (1/30th of the revenue in the fund). In markets with more than 2.5 million television viewers, the team does not receive any share. Teams that fall between 2.5 million and 2 million, receive partial shares. In addition, teams that earn more than $10 million profit before receiving a share, do not receive a share.

The NHL uses the most complicated revenue sharing system of the four leagues and was first adopted in the 2012-22 CBA. Each season, the league revenue sharing pool is established to be

6% of total league revenue.[13] The top ten revenue teams in the NHL, after deducting certain costs, evenly contribute 50% of the revenue sharing pool, the remainder is financed from playoff (35%) and other league revenues. The pool is paid out to the bottom 15 revenue teams using a formula based on attendance and revenue.

Each of the four leagues has designed its revenue sharing system to redistributed revenue from large market teams to small market teams. Small market teams receive much more money than they contribute, while the large market teams contribute much more than what they receive, which in many cases is nothing.

THE EXCHANGE RATE AND LEAGUE EQUILIBRIUM

Revenue sharing has been an important feature of models of professional sports leagues since Fort and Quirk (1995). For the most part, a large amount of research has focused on the effects of revenue sharing on league parity with little research on team profitability. Examples include Kesenne (2015), Vrooman (2009) and Szymanski and Kesenne (2004) with the parity issue still seemingly unsettled. Easton and Rockerbie (2005) considered the effect on team profitability of different revenue sharing systems with different conjectures about talent supply. Kesenne (2007) explored the relationship between profitability and the extent of revenue sharing and determined that greater revenue sharing reduced profits under a simple gate sharing system. Rockerbie (2009) examined how different revenue sharing systems affect the league distribution of revenues after sharing, but did not explore profitability.

We augment the simple two-league model developed in Kesenne (2015) by allowing one team to operate in a foreign country, hereafter referred to as Team 1. For clarity, we specify that Team 1 operates in Canada and Team 2 in the United States. Team 1 receives its local revenues, R_1, in CAD$, but must meet its payroll obligations, B_1, in US$. We define the nominal exchange rate as $e = CAD\$/US\$$. Team 2 conducts all of its business in US$. Let $a = m_{US}/m_C$ as the relative market size. Winning percentages are the usual logistic functions, $w_{US} = \frac{t_{US}}{t_{US}+t_C}$ and $w_{US} = \frac{t_C}{t_{US}+t_C}$ where t_C and t_{US} are the talent stocks of each team respectively. Talent costs are linear in talent stocks, $C_{US} = ct_{US}$ and $C_C = ct_C$, where *c* is the marginal cost in US$. The team revenue functions are the simplest possible to allow for an easy solution to the model: $R_{US} = aw_{US}$ (in US$) and $R_C = w_C$ (in CAD$). Revenue sharing is the simple gate sharing plan, so $R_C^* = \frac{\alpha R_C}{e} + (1-\alpha)R_{US}$ and $R_{US}^* = \alpha R_{US} + (1-\alpha)\frac{R_C}{e}$ where α is the share of local revenue retained by each team. All revenues after sharing are denominated in US$.

Each team maximizes its profit after revenue sharing by choosing an optimal stock of talent. The necessary derivatives are given below in (1) and (2). These set the marginal revenue product (*MRP*) after sharing for each team equal to the common marginal cost (*c*) of talent.

$$\frac{\partial R_C^*}{\partial t_C} = \frac{\alpha}{e}\left[\frac{t_{US}}{(t_{US}+t_C)^2}\right] - a(1-\alpha)\left[\frac{t_{US}}{(t_{US}+t_C)^2}\right] = c \quad (1)$$

$$\frac{\partial R_{US}^*}{\partial t_{US}} = a\alpha\left[\frac{t_C}{(t_{US}+t_C)^2}\right] - \frac{(1-\alpha)}{e}\left[\frac{t_C}{(t_{US}+t_C)^2}\right] = c \quad (2)$$

Setting the *MRP*'s equal and simplifying gives (the Kesenne (2015) model assumes Cournot talent conjectures)

$$MRP_C = t_{US}\left[\frac{\alpha}{e} - a(1-\alpha)\right] = t_C\left[a\alpha - \left(\frac{1-\alpha}{e}\right)\right] = MRP_{US} \tag{3}$$

This can be simplified to give a necessary condition for joint profit maximization in the league equilibrium.

$$\frac{t_{US}}{t_C} = \frac{a\alpha-(1-\alpha)/e}{\alpha/e-a(1-\alpha)} = \gamma \tag{4}$$

A necessary condition is that the denominator of (4) be positive, or $\alpha/[e(1-\alpha)] > a$, so a cannot be too large. Greater revenue sharing (smaller α) worsens parity since $\partial(t_{US}/t_C)/\partial\alpha < 0$ if $ae > 1$, that is, the exchange adjusted value of the relative market sizes must favor Team 2.[14] Parity is decreasing in the exchange rate since it can be shown that $\partial(t_{US}/t_C)/\partial e = (t_{US}/t_C)(1-\alpha)+\alpha > 0$. The winning percentages are $w_{US} = \gamma/(1+\gamma)$ and $w_C = 1/(1+\gamma)$. Team payrolls at the equilibrium can be found by computing the area below the marginal cost line.

$$ct_{US} = w_{US}MRP_{US}^{*} = [\gamma/(1+\gamma)]\left[t_C\left[a\alpha - \left(\frac{1-\alpha}{e}\right)\right]\right] = [\gamma/(1+\gamma)]\left[w_C\left[a\alpha - \left(\frac{1-\alpha}{e}\right)\right]\right] =$$

$$[\gamma/(1+\gamma)][1/(1+\gamma)]\left[a\alpha - \left(\frac{1-\alpha}{e}\right)\right] = \gamma/(1+\gamma)^2\left[a\alpha - \left(\frac{1-\alpha}{e}\right)\right] \tag{5}$$

$$ct_C = w_C MRP_C^* = [1/(1+\gamma)]\left[t_{US}\left[\frac{\alpha}{e} - a(1-\alpha)\right]\right] = [1/(1+\gamma)]\left[w_{US}\left[\frac{\alpha}{e} - a(1-\alpha)\right]\right] =$$

$$[1/(1+\gamma)][\gamma/(1+\gamma)]\left[\frac{\alpha}{e} - a(1-\alpha)\right] = \gamma/(1+\gamma)^2\left[\frac{\alpha}{e} - a(1-\alpha)\right] \quad (6)$$

With $a = 1.5$, $e = 1$ and $\alpha = 1$, an initial league equilibrium is established at $w_{US} = 0.6, w_C = 0.4, ct_{US} = 0.36, ct_C = 0.24, \pi_{US} = 0.54$ and $\pi_C = 0.16$ (CAD$). Table 1 summarizes the new equilibrium values with a depreciation in the CAD$ to *e* = 1.4 and/or a revenue sharing of α = 0.7. With the exchange rate at parity, greater revenue sharing worsens parity, reduces payrolls and increases profitability for both teams. For the Canadian team, lower revenue is more than offset by a lower payroll. These results agree with those found in Kesenne (2015). Depreciating the exchange rate without any revenue sharing also worsens parity and reduces the payroll for both teams. Profits diverge with the U.S. team experiencing higher profit and the Canadian team lower profit (in CAD$). In this case, the reduction in payroll is not sufficient to offset the loss in revenue for the Canadian team.

An exchange rate depreciation hurts profitability for the Canadian team, but greater revenue sharing increases its profitability in the two-team league model. The last column in Table 1 introduces revenue sharing (α = 0.7) and an exchange rate depreciation (*e* = 1.4). The result is an *increase* in profit. Parity moves against the Canadian team, however the Canadian team shares in the increased revenue for the U.S. team that results. Both teams reduce their payrolls. Revenue sharing has more than offset the effect of the exchange rate depreciation for the Canadian team. However this is not a general result. In our simple model, it only takes a small amount of revenue sharing ($\alpha = 0.96$) to offset the negative effects on profit of the exchange rate depreciation, but our simple model cannot be trusted to measure the effects using real world data. Nevertheless revenue sharing can at least reduce the loss in profit from exchange rate risk and that makes revenue sharing an effective league policy to assist Canadian teams beyond just the small market assistance the policy provides. We explore this effectiveness more thoroughly in the next section with the use of a partial equilibrium approach.

PROFIT IN THE SHORT-RUN

In this section, we build a simple model of a single team in a sports league that features a somewhat more complex and realistic revenue sharing system than in the previous section, and then determine how movements in an exchange rate affect profitability. Consider a professional sports league composed of *N* teams with *J* ($J \leq N$) teams that operate in a second country. For the purpose of clarity, we will assume that the *J* teams operate in Canada and the remaining *N-J* teams operate in the United States. As before, we will focus our attention on one of the Canadian teams we will designate as Team 1. Team 1 receives its local revenues, R_1, in CAD$, but must meet its payroll obligations, B_1, in US$. All other costs the team faces are in CAD$. Each of the *N* teams receives an equal share of national revenues (television and so on) in US$. These national revenues are independent of the operations of any single team and are treated as exogenous. We now define the nominal exchange rate as $e = US\$/CAD\$$ since we can analyze profit for the Canadian team in CAD$ with our partial equilibrium approach.

The league uses a central pool revenue sharing system where each team contributes a share, $1 - \alpha$, of its local revenue to the pool each season and retains a share, α $(0 \leq \alpha \leq 1)$. We denote the number of shares paid to the ith team from the pool as γ_i with the adding-up constraint $\sum_{i=1}^{N} \gamma_i = N$. This term broadly captures the unequal sharing of the revenue pool found in the NBA, NHL and MLB. For the large market, top revenue teams, $\gamma_i = 0$ in the NHL, NBA and MLB. For the small market teams with low revenues, $\gamma_i > 1$. With the equal revenue sharing system in MLS, $\gamma_i = 1$ for every team. We define $\theta_i = \gamma_i / N$ as the "effective share" received from the revenue sharing pool in which $0 \leq \theta_i \leq 1$ and $\sum \theta_i = 1$.

Profit after revenue sharing for Team 1 in CAD$ is given by (where a superscript A denotes after revenue sharing, a superscript C denotes CAD$ and a superscript US denotes US$)

$$\pi_1^A = \alpha R_1^C + \theta_1(1-\alpha)\left(R_1^C + \sum_{i=2}^{J} R_i^C + \frac{1}{e}\sum_{i=J+1}^{N} R_i^{US}\right) + \frac{R_{CF}^{US}}{eN} - \frac{B_1^{US}}{e} \tag{7}$$

In the event that the league has a salary cap, the team's payroll defined in US dollars is assumed to be a simplified version of the one used in the NFL, NBA, and NHL where the total league payroll is constrained to be 50 percent of anticipated league revenues divided equally among N teams. The team's payroll (indeed every team) in US dollars is defined as $B_1^{US} = \frac{e\sum_{i=1}^{J} R_i^C + \sum_{i=J+1}^{N} R_i^{US}}{2N}$.

Team 1 contributes a portion of its local revenue, $(1-\alpha)R_1^C$, into the revenue sharing pool. The other *J*-1 Canadian teams contribute a share of their local revenues, $(1-\alpha)\sum_{i=2}^{J} R_i^C$ into the revenue sharing pool, as do the *N*-*J* US teams.[15] Team 1 receives a share of the revenue sharing pool converted in CAD$ given by the second term in (7). Central fund revenue is denoted as R_{CF}^{US} with Team 1 receiving an equal share converted to CAD$. Collecting some terms, (7) can be rewritten as

$$\pi_1^A = \big(\alpha + \theta_1(1-\alpha)\big)R_1^C + \theta_1(1-\alpha)\left(\sum_{i=2}^{J} R_i^C + \frac{1}{e}\sum_{i=J+1}^{N} R_i^{US}\right) + \frac{R_{CF}}{eN} - \frac{B_1^{US}}{e} \tag{8}$$

To determine how profit for the Canadian team will change given a change in the exchange rate, we take the derivative below.[16]

$$\frac{\partial \pi_1^A}{\partial e} = -\frac{\theta_1(1-\alpha)R_{ROL}^{US}}{e^2} - \frac{\frac{R_{CF}}{N}}{e^2} + \frac{B_1^{US}}{e^2} \tag{9}$$

In the event that there is a salary cap, substituting for B_1^{US}, (9) becomes:

$$\frac{\partial \pi_1^A}{\partial e} = -\frac{\theta_1(1-\alpha)R_{ROL}^{US}}{e^2} - \frac{\frac{R_{CF}}{N}}{e^2} + \frac{R_{ROL}^{US}}{2Ne^2} \tag{9'}$$

We have denoted $\sum_{i=J+1}^{N} R_i^{US}$ as R_{ROL}^{US} for simplicity (ROL = rest of league in the US). Since the exchange rate is US$ per Canadian $, a depreciation in the Canadian $ is a negative value of de. In 9', when the Canadian dollar depreciates ($de < 0$) the first term identifies the improvement in marginal revenue measured in Canadian $ from the revenue sharing pool measured in US $. The second term reflects the increase in revenue from the Canadian share of the central fund (converted from US $ to Canadian $), while the final term is the loss associated with the increase in Canadian $ required to meet the new US $ salary cap resulting from the depreciation. That is the Canadian team gains on the revenue side and loses even though US $ salary cap falls since it is converted to Canadian $. The first terms reflect Canadian $ value of the marginal value of the revenue fund. The last term is the Canadian $ value of the marginal change in the revenue cap.

Equation (10) follows from (9) (without a salary cap), and solves for a condition for Team 1 profit to increase in CAD$ given a depreciation in the exchange rate (recognizing that $de < 0$ for a depreciation of the Canadian dollar). Equation (10') gives the condition with a cap.

$$\theta_1(1-\alpha)R_{ROL} + \frac{R_{CF}}{N} > B_1^{US} \tag{10}$$

$$\theta_1(1-\alpha)R_{ROL} + \frac{1}{N}[\bar{R}^c + R_{CF}] > B_1^{US} \tag{10'}$$

In (10') $\bar{R}^c$ is the average revenue of the other J-1Canadian teams.

To increase Team 1's profit, the US$ value of the local revenue pool received from the rest of the league, added to the share of the US$ central fund revenue, must be greater than the US$ liability of the team payroll. Less revenue sharing (larger α) or an increase in market size (smaller γ_1, and therefore smaller θ_1) makes the condition less likely to hold. The result is indeterminate with a greater number of teams (larger N) since total local revenue for the league will increase as well.[17] Larger central fund revenues makes the condition more likely, as does a smaller payroll for the Canadian team. A greater share of league revenue made up of CAD$ reduces R_{ROL}^{US} and makes the condition less likely. These all make sense. Revenue sharing partially insulates the Canadian team from adverse depreciations in the CAD$ exchange rate since receipts from the plan are denominated in US$. Receipts from the central fund are also in US$. However profit will decrease with an appreciation in CAD$ if (10) holds since the sign of the condition will be reversed. Team 1 is still subject to exchange risk. The appeal of the short-run condition in (10) is that it is not difficult to operationalize as the variables and parameters can be measured.

In the salary cap case (10') it is clear that the likelihood of the condition being satisfied is greater than without a salary cap in (10). This is because of the presence of $\bar{R}^c$ in (10'). Without the salary cap the payroll is unaffected in the short run by the exchange rate depreciation. However, with a cap the payroll is reduced by a fraction of the depreciation of the exchange rate which helps to offset the decrease in revenue received from the revenue sharing plan and helps profitability.

Whether or not there is a salary cap, for the U.S. team's revenue after sharing will decrease since the US$ value of the contributions of the Canadian teams are reduced. Essentially all U.S. teams will share in the loss of the US$ value of Canadian revenues. This will reduce the demand for talent and lower salaries for players. To explore this issue, one would need to construct best response functions for all teams and solve for their Nash equilibrium talent stocks. Without explicitly solving for the Nash equilibrium the effects on the distribution of league talent is nonetheless predictable. Talent demand drops for every team and lowers the league's stock of talent and reduces the wage paid per unit of talent. The Canadian team's talent stock will decline by relatively more than that experienced by US teams further reducing the Canadian team's winning percentage.

Hedging

Investors can manage exchange risk on a day to day basis by constructing hedges in futures markets. A nominal exchange rate is just the price of one currency in terms of another and futures markets can be used to hedge price risk for many different types of commodities. In the case of a Canadian team, the management wants to seek protection against a depreciation in the CAD$ in the future since it must meet its payroll in US$. Since it must purchase US$ in the future, it buys a contract to purchase US$ and closes its position by selling a contract to sell CAD$ at the same time. Neither a profit nor a loss can be made on the hedge and the cost is the transactions costs to write the two contracts.

Canadian NHL teams do construct hedges in the futures market.[18] However, they admit that hedges are hard to construct since the opening and closing positions must be the same for the number of contracts and the delivery month. The management of the team must know its future payroll with certainty to construct a perfect hedge, otherwise it will be exposed to some exchange rate risk. It must also know the number of years remaining in its player contracts so as to time the termination of the hedge positions correctly. In addition, the number of participants in the futures markets willing to write two to four year contracts on exchange rates is very small.[19]

The Canadian team could effectively construct a hedge that eliminates exchange risk by setting its payroll in US$ just equal to the left hand side of (10). The payroll is then determined by largely exogenous variables that can be measured and forecast. The difficulty is that such a hedging strategy would not allow for profit-maximization. Professional sports league models typically assume that a team maximizes its profit with respect to its own stock of talent, t_i. The revenue function is $R_i = R_i(w_i)$ in its most general form, with the team winning percentage determined by $w_i = w_i(t_i, T)$. The form of the payroll function is assumed to be $B_1^{US} = ct_i$ where c is the marginal cost of talent. The solution to the profit-maximization problem is an optimal team stock of talent, t_i^*, which determines team revenue and payroll. It is very unlikely that the optimal payroll for the Canadian team, $B_1^{US*} = ct_1^*$, would just satisfy the equality necessary in (10).

PROFIT IN THE LONG-RUN

One can think of (10) and (10') as short-run conditions since we have assumed that local revenue and payroll are not functions of the exchange rate. Over the course of a season or two, the Canadian team might not able to adjust its talent stock in response to changes in the exchange rate due to player contracts that are a fixed length longer than one season. The median contract length is three years in the NHL and the NBA[20], and only one season in MLB. No information on contract lengths could be obtained for MLS. Of course, a team must also deal with constantly overlapping contracts that might provide more flexibility in moving talent.

A team can purchase and release talent freely in the long-run. Hence, after maximizing profit, the Canadian team determines $R_1^* = R_1^*(e)$ and $B_1^{US*} = B_1^{US*}(e)$. The exchange rate enters as a shift parameter in the optimized local revenue and payroll functions and the team profit for the case without or with a salary cap are given by (11)[21]

$$\pi_1^{*A} = \big(\alpha + \theta_1(1-\alpha)\big)R_1^{C*} + \theta_1(1-\alpha)\left[\sum_{i=2}^{J} R_i^C + \frac{1}{e}R_{ROL}^{US}\right] + \frac{R_{CF}^{US}}{eN} - \frac{B_1^{US*}}{e} \tag{11}$$

The required derivative without a salary cap is given in (12).[22]

$$\frac{\partial \pi_1^{*A}}{\partial e} = \big(\alpha + \theta_1(1-\alpha)\big)\frac{\partial R_1^*}{\partial e} - \frac{\theta_1(1-\alpha)}{e^2}R_{ROL}^{US} - \frac{1}{N^2e^2}R_{CF}^{US} - \frac{e\frac{\partial B_1^*}{\partial e} - B_1^{US*}}{e^2} \tag{12}$$

The case of a salary cap is displayed in (6').

$$\frac{\partial \pi_1^{*A}}{\partial e} = \left(\alpha + \theta_1(1-\alpha)\right)\frac{\partial R_1^*}{\partial e} - \frac{\theta_1(1-\alpha)}{e^2} R_{ROL}^{US} - \frac{1}{N^2 e^2} R_{CF}^{US} + \frac{R_{ROL}^{US}}{4N^2 e^2} \tag{12'}$$

There is only a single term that differs between (12) and (12'). Taking the difference between (12') and (12) gives

$$\left.\frac{\partial \pi_1^{*A}}{\partial e}\right]_{(6)} - \left.\frac{\partial \pi_1^{*A}}{\partial e}\right]_{(6')} = \left(\frac{R_{ROL}^{US}}{4N^2 e^2} + \frac{e\frac{\partial B_1^*}{\partial e} - B_1^{US*}}{e^2}\right) \tag{13}$$

Noting that $\frac{e \partial B_1^{US*}}{B_1^{US*} \partial e} \equiv \eta_e^{B_1^{US*}}$, yields a simplified expression

$$\left.\frac{\partial \pi_1^{*A}}{\partial e}\right]_{(6)} - \left.\frac{\partial \pi_1^{*A}}{\partial e}\right]_{(6')} = \left(\frac{\bar{R}_{ROL}^{US}}{4N} + B_1^{US}\left[\eta_e^{B_1^{US*}} - 1\right]\right)\frac{1}{e^2} \tag{14}$$

With a salary cap it is clear that the depreciation of the exchange rate reduces the likelihood of a decrease in profit since the first term is unambiguously positive. A sufficient condition to ensure that a depreciation of the exchange rate does not reduce profit is that $\eta_e^{B_1^{US*}} > 1$. Without a salary cap, the decrease in payroll may be sufficiently large to offset the drop in revenue from the revenue sharing program. Unfortunately these long run conditions are particularly difficult to evaluate empirically. Consequently, the next section explores the short run effects on profitability of movements in the exchange rate.

SOME CALCULATIONS

To evaluate the short-run condition in (10), we require values for the average local revenue shared by the *N*-*J* US teams ($\bar{R}_{ROL} = \frac{1}{N} R_{CF}^{US}$) in US$, the payroll for one of the Canadian teams (our Team 1) in US$, central fund revenue received by the Canadian team in US$ ($\bar{R}_{CF} = \frac{1}{N} R_{CF}^{US}$), the share of local revenues that are not shared in the revenue sharing plan ($1-\alpha$), and the adjustment factor for the Canadian team (γ_1). The necessary revenue data are available from Forbes estimates for the NHL, NBA and MLB, however revenue data for MLS could not be obtained. One must assume that the Forbes' estimates are accurate. League reported revenue figures for MLB are available for the 1995 through 2001 seasons (Levin et al. (2000) and MLB (2001)), however in this period, MLB did not use the pooled revenue sharing system adopted in 2002 that we model in this paper. Accounting statements (Deadspin leaks) for the 2008 Anaheim Angels, Florida (Miami) Marlins, Pittsburgh Pirates and Tampa Bay Rays (all MLB) contain detailed revenues, but no statements are available for Canada's Toronto Blue Jays. Rockerbie (2011) found a correlation coefficient of 0.973 between the local revenue figures reported in Levin et al (2000) and Forbes estimates for the same seasons. The standard error of an OLS regression between the two was half the magnitude of similar regressions performed for actual and estimated payroll data (Fort (2010)) and estimated payrolls are often used without question. So we will use the Forbes estimates for local revenue and central fund revenue and live with the inevitable criticisms. For our payroll data, we use the USA Today payroll database.

Table 1 presents the evaluation of the condition in (10) for MLB's Toronto Blue Jays for the 2003 through 2012 seasons. Local revenue estimates are net of revenue sharing, however the total local revenue for MLB is unaffected by revenue sharing. Estimates of central fund revenues include national TV deals but do not include revenues from apparel, licensing, logos and so on, so they are an underestimate of the actual central fund revenues received by the Blue Jays. An estimate for monies received from the supplemental revenue sharing fund by the Blue Jays for 2012 is also included. All revenues and payrolls are deflated by the US consumer price index. The share of local revenue contributed to the revenue sharing pool changed from 34% to 31% in the 2007 season, then increased back to 34% in the 2012 season. The US$/CAD$ nominal exchange rate is the average of monthly values over each season. It was multiplied by the ratio of the consumer price indices (2002 = 100), CPI_{CAD}/CPI_{US}, to calculate the real exchange rate.

According to the figures in Table 1, with positive and negative differences for condition (10), the Blue Jays found its profit exposed to real exchange rate movements over the 2003-12 seasons. But how large does the difference need to be to impose a real financial burden or benefit for the Blue Jays? With the real exchange rate appreciating by US$ 0.0483 between 2003 and 2004, the Blue Jays profit is estimated to have changed by (US$ -0.923 million x [(1/0.7677) – (1/0.7194)] = CAD$ 0.081 million, ceteris paribus. This is an increase in profit since the CAD$ appreciated and the Jays found themselves with a negative difference for condition (10). The next two seasons, a strong appreciation in the CAD$ resulted in reductions in profit of CAD$ 0.338 million and CAD$ 0.829 million since the difference in condition (10) was positive. Of course, these calculations assume the short-run only. In the long-run, the Blue Jays can adjust their payroll and other business operations to adapt to the exchange rate appreciation. However in practical terms, the losses in profit were not large considering that revenues from all sources for the Blue Jays were estimated to be CAD$ 139 million, CAD$ 167 million and CAD$ 183 million for the 2004-06 seasons. The loss or gain in profit by not satisfying condition (10) was much less than 1% of total revenue for any of the 2003-11 seasons.

The figures in Table 1 reveal that revenue sharing does not eliminate the uncertainty from movements in the real exchange rate for the Toronto Blue Jays. A computed difference equal to zero for condition (10) would be necessary for such a hedge. Revenue sharing does provide the benefit of reducing the profit risk for the Blue Jays. The standard deviation of the gain or loss in profit is just CAD$ 0.726 million with revenue sharing, but increases to CAD$ 2.659 million without revenue sharing ($\alpha = 1$ in condition (10)). This is, perhaps, an unexpected benefit for the Blue Jays from the central pool revenue sharing plan. Unfortunately the plan changed drastically in 2013 and the Blue Jays probably lost this valuable feature of the earlier revenue sharing plan.

Canadian MLS teams find themselves with condition (10) satisfied not by choice, but instead by the structure of the league's revenue sharing plan. As already noted, each team contributes 30% of its gate revenue into a central pool that is then used to meet each team's payroll up to a maximum of US$ 3.5 million, which is also the league imposed team salary cap. Teams can exceed their salary cap by signing no more than two designated players that are typically high profile international players. However only a few teams choose to do this and none of the three Canadian teams currently do. In terms of condition (10), if the monies received from the revenue sharing plan just equal the team budget for players, this leaves the central fund TV revenue as the difference. Each MLS team receives approximately US$ 4.5 million from the central fund from US and international television rights (the value of Canadian television rights is not known), not including any apparel and other licensing revenue. Like the Blue Jays, the positive difference for condition (10) is not large when translated to swings in team revenues as a result of exchange rate movements. Condition (10) might be closer to the long-run condition (14) since MLS teams face a league imposed payroll and thus have a limited ability to make talent choices.

The same calculations for the NBA's Toronto Raptors cannot be performed without knowing the size of the team's TV audience so as to determine the share of its local revenues the team pays into the revenue sharing pool. Teams with small TV audiences pay only 15% of local revenue into the pool and receive back a full share. We do not know if the Raptors construct hedges in futures markets, but we could not find any evidence that they do. This suggests that the Raptors are not concerned with depreciations in the value of the Canadian Dollar and that condition (10) might be satisfied for the team.

Calculations for Canada's NHL teams are also difficult to compute. Only the top ten revenue teams in the NHL pay into the revenue sharing pool and they receive nothing back. For the Toronto Maple Leafs, Montreal Canadiens and Vancouver Canucks, the revenue sharing plan offers no protection from movements in the exchange rate. An executive for the Maple Leafs recently stated that a one cent depreciation in the Canadian Dollar increases expenses by CAD$ 1 million.[23] That figure is roughly consistent with a payroll of US$ 65 million, well within the narrow range of payrolls in the NHL. The Canadian teams that contribute no revenue into the revenue sharing pool definitely benefit from the plan, but we cannot estimate how much since the pool is not split evenly among the qualifying teams.

CONCLUSIONS

The US$-CAD$ nominal (or real) exchange rate has demonstrated significantly volatility over the last two decades. NHL, NBA and MLB teams operating in Canada are exposed to exchange rate risk if they do not construct hedges to protect current and future CAD$ profits. This is because player contracts stipulate payment in US$, while at least a portion of revenues are received in CAD$. This results in a currency mismatch that becomes a problem when the exchange rate is volatile and difficult to predict. The higher revenue Canadian NHL teams do use the futures market to construct hedges against exchange risk, however because they require long maturities these hedges are expensive. One can only conclude that these costs are smaller than the potential losses in profit if the exchange rate moves adversely.

This paper demonstrates that revenue sharing can cushion the blow to profit for Canadian teams if the team's payrolls are properly positioned. This is determined by condition (10), which if satisfied, increases CAD$ profit for a Canadian team in the face of a depreciation in the Canadian Dollar (with the U.S. Dollar), but leaves the team open to lower CAD$ profit if the Canadian Dollar appreciates in value. A Canadian team could hedge itself against any exchange rate movement by adjusting its US$ payroll to make condition (10) an equality, however this would require abandoning the choice of a payroll to maximize profit. The need to hedge could be reduced by increasing the share Canadian teams receive from the revenue sharing pool. Of course, this would come at the expense of the other teams. The revenue sharing plan is determined in the CBA and requires equal shares in MLB and unequal shares (that are not tied to the exchange rate) in the NHL and NBA. It would be possible for these leagues to tie the weights to an exchange rate aware formula. At present, we see no evidence of this.

We evaluate the condition for the Toronto Blue Jays and find that the losses to the team from adverse exchange rate movements is small, even when faced with large exchange rate fluctuations. Revenue sharing provides an effective "hedge" for the Blue Jays that negates the need for the team to hedge in futures markets. This would appear to be a, perhaps unexpected, benefit from revenue sharing to teams that operate in another country that has not been noted in the literature. In general, our model demonstrates that revenue sharing can provide a partial hedge against adverse movements in the exchange rate that create distortions in league parity that do not necessarily reflect fan preferences.

Canada's NHL teams are much more vocal about exchange rate risk than their MLB, NBA and MLS counterparts for two reasons identified in this paper. First, under the NHL revenue sharing plan only the top ten revenue teams contribute to the revenue sharing pool. The Montreal Canadiens, Toronto Maple Leafs and Vancouver Canucks appear consistently in the top ten list, with the occasional appearances of the Edmonton Oilers and Calgary Flames – at five of the seven Canadian teams in the NHL. These teams receive no payment from the revenue sharing pool thus there is no insulating effect from exchange rate risk for these teams. Canada's MLB, NBA and MLS are eligible to receive payments from their revenue sharing pools and can benefit from the hedging effect. Second, our model demonstrated that the greater the number of teams contributing Canadian Dollars into the revenue sharing pool, the less the insulating effect for the Canadian teams receiving payments from the pool.

Endnotes

[1] The Caribbean Professional Football League featured teams in 8 countries during its short existence from 1992 to 1995.

[2] Mirtle, J. (2016, January 19). NHL players cheer for loonie's recovery as reduced revenues sink salaries. Retrieved October 3, 2016, from http://www.theglobeandmail.com/sports/hockey/nhl-players-cheer-for-loonies-recovery-as-reduced-revenues-sink-salaries/article28253008/

[3] Hobson, W. (2015, September 7). NHL's bottom line, expansion plans at risk Canadian currency struggles. Retrieved on October 3, 2016 from https://www.washingtonpost.com/news/sports/wp/2015/09/07/nhls-expansion-plans-imperiled-by-a-drop-in-canadas-currency/

[4] Rubin, J. (2015, January 25). MLSE, Blue Jays deal with dollar dive. Retrieved on October 3, 2016 from https://www.thestar.com/sports/leafs/2015/01/25/mlse-blue-jays-deal-with-dollar-dive.html

[5] We may think of 'national' revenue as being primarily international in origin for the Blue Jays.

[6] https://umich.app.box.com/s/41707f0b2619c0107b8b/1/320021709/58988534861/1. Retrieved on May 16, 2016.

[7] https://umich.app.box.com/s/41707f0b2619c0107b8b/1/320029263/48837028157/1. Retrieved on May 16, 2016.

[8] Just a few recent references are Mirtle, J. (2015, January 23). Loonie's free fall is bad news for the NHL. Retrieved May 16, 2016, from http://www.theglobeandmail.com/sports/hockey/loonies-free-fall-is-bad-news-for-the-nhl/article22616925/ and Mirtle, J. (January 18). NHL players cheer for loonie's recovery as reduced revenues sink salaries. Retrieved May 16, 2016, from http://www.theglobeandmail.com/sports/hockey/nhl-players-cheer-for-loonies-recovery-as-reduced-revenues-sink-salaries/article28253008/

[9] The National Hockey League in Canada, Public Policy Forum, October 1999. Retrieved May 16, 2016, from https://www.ppforum.ca/sites/default/files/NHL.pdf.

[10] http://www.fangraphs.com/blogs/marlins-mlb-revenue-sharing-syste/. Retrieved on May 17, 2016.

[11] http://www.linkdein.com/pulse/2015-mls-collective-bargaining-agreement-moving-right-luca-ferrrar?forceNoSplash=true. Retrieved on May 12, 2016.

[12] http://www.cbafaq.com/salarycap.htm. Retrieved on May 12, 2016.

[13] Mirtle, J. (2012, November 08). How much revenue sharing should the NHL have? Retrieved May 12, 2016, from http://www.theglobeandmail.com/sports/hockey/globe-on-hockey/how-much-revenue-sharing-should-the-nhl-have/article5103058.

[14] This result can also be shown by the derivatives $\partial MRP^*_{US}/\partial\alpha = (w_C/(t_C + t_{US}))(1 + a)$ and $\partial MRP^*_C/\partial\alpha = (w_{US}/(t_C + t_{US}))(1 + a)$. As long as $w_{US} > w_C$, the downward shift in MRP^*_C is greater than that for MRP^*_{US} and parity is worsened.

[15] We implicitly assume that the growth rates of income in Canada and the U.S are zero which is our short-run model.

[16] Since the exchange rate is exogenous to the choice the team is making, our short run holds the level of talent and other revenue choices constant. We assume that local revenue and payroll are not functions of the exchange rate. The more general case is discussed below.

[17] If the average stays the same, there is no change, but if the best markets have been exploited first, then we might imagine that the average would tend to fall. Expansion would tend to reduce the likelihood that the condition is met.

[18] Constantineau, B. (2014, May 29). It's fight or flight with the loonie for Canadian NHL teams. Retrieved July 05, 2016, from http://o.canada.com/sports/hockey/nhl/its-fight-or-flight-with-the-loonie-for-canadian-nhl-teams

[19] On June 8, 2016, futures contracts for delivery of Canadian Dollars showed no volume (no outstanding contracts) beyond June 2017, although contracts available to buy or sell were listed up to March 2021. See http://www.cmegroup.com/trading/fx/g10/canadian-dollar.html.

[20] http://www.sportrac.com/. Retrieved on May 18, 2016.

[21] We do not explicitly treat the team owner's optimization of the expected future path of the exchange rate. Equation (5) reflects the expectation that results from this optimization although not a part of our notation.

[22] We are assuming away any effect of the exchange rate on local revenue for the rest of the league. In a Nash equilibrium, the choices of talent stocks by the US teams can change due to the change in the talent stock of the Canadian team. This would require solving for the best response functions for all N teams and solving them for the N talent choices simultaneously.

[23] Freeman, S. (2016, January 13). Falling loonie bad news for Canadian sports fans | Toronto Star. Retrieved June 06, 2016, from https://www.thestar.com/business/2016/01/13/falling-loonie-bad-news-for-canadian-sports-fans.html

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Table 1. Equilibrium Values for Two-Team League Model

	α = 1, e = 1, a = 1.5	α = 1, e = 1.4, a = 1.5	α = 0.7, e = 1, a = 1.5	α = 0.7, e = 1.4, a = 1.5
γ	1.500	2.100	3.000	16.720
w_{US}	0.600	0.677	0.750	0.944
w_C	0.400	0.323	0.250	0.056
ct_{US}	0.360	0.328	0.141	0.045
ct_C	0.240	0.156	0.047	0.004
π_{US}	0.540	0.688	0.722	0.958
π_C (CAD$)	0.160	0.104	0.438	0.628

Table 2. Evaluation of Condition (4) for Toronto Blue Jays, 2003-12

								Condition 4			
	Alp ha (1)	Average Revenue ROL (2)	TV Revenue (3)	Blue Jays Payroll (4)	Jays Total Revenue (5)	Jays Local Revenue (6)	Real Exchange Rate (7)	Annual Change With Revenue Sharing (8)	Profit gain (with revenue sharing) (9)	Annual Change Without Revenue Sharing (10)	Profit gain (without revenue sharing) (11)
2003	0.66	109.50	18.19	50.16	96.79	72.1	0.7194	-0.923	0.081	-31.971	2.792
2004	0.66	119.04	17.71	47.62	101.90	75.4	0.7677	4.548	-0.338	-29.904	2.222
2005	0.66	128.96	17.13	42.10	125.28	106.2	0.8141	13.058	-0.829	-24.963	1.584
2006	0.66	135.64	16.60	64.16	140.10	125.8	0.8585	-7.089	0.424	-47.563	2.843
2007	0.69	136.22	23.51	71.06	138.82	116.5	0.9049	-12.608	-0.087	-47.547	-0.328
2008	0.69	140.38	22.64	81.72	143.72	122.6	0.8993	-22.578	-1.637	-59.075	-4.283
2009	0.69	143.39	22.72	67.50	136.68	110.9	0.8443	-7.372	0.833	-44.779	5.062
2010	0.69	147.68	22.36	51.32	138.60	112.2	0.9334	9.891	-0.400	-28.958	1.170
2011	0.69	148.76	21.67	50.07	150.36	129.4	0.9700	11.004	0.184	-28.392	-0.476
2012	0.66	157.49	21.23	59.16	159.06	138.6	0.9544	8.404		-37.924	
								Std Dev =	0.726		2.659

All US$ millions (2002 = 100)

Jays local revenue estimated using (6) = [(5) - ((1-(1))*(2)) - (3)]/(1)

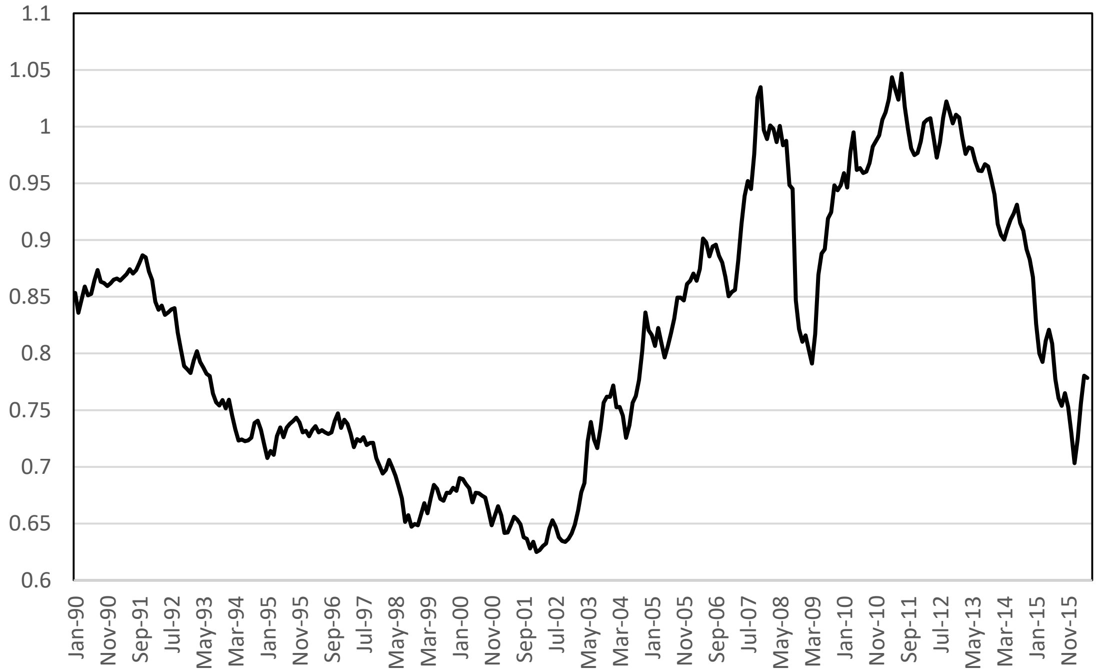
Difference with sharing computed using (8) = [(1-(1))*((2)-(3))] + (3) - (4)

Profit gain computed using (9) = (8)*[(1/(7(t+1))-(1/(7(t))]

Difference without sharing computed using (10) = (3) - (4)

Profit gain computed using (11) = (10)*[(1/(7(t+1))-(1/(7(t))]

Figure 1. US$/CAD$ Nominal Exchange Rate: 1990-2015



Source: Pacific Exchange Rate Service. http://fx.sauder.ubc.ca/