State Income Taxes and Team Performance

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Abstract

I investigate the effect of income tax rates on professional team performance using data from professional baseball, basketball, football, and hockey leagues. Using within-team variation in state top marginal income tax rates over time between 1995 and 2017, I provide evidence that higher income tax rates lower team performance with a percentage point increase in state income tax rates decreasing team win percentage between 0.77 to 0.86 points. Extending the analysis back to 1977, I show that the income tax effect did not exist prior to players gaining unrestricted free agency which allowed players to shift the income tax burden to teams. A placebo test using college team performance finds no evidence of an income tax effect on college teams.

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Introduction

Do higher state income taxes harm firms? Though income taxes are levied on households, Wallace (1993) shows that state income tax incidence depends on the mobility elasticity of capital relative to labor. While plenty of research has analyzed state income taxes effect on households, less evidence exists of the state income tax burden on firms. This paper considers a unique market, professional sports, where teams - the firms in question - are highly immobile and players - the labor - are highly mobile, to test whether higher state income tax binder team performance.

Anecdotal evidence suggests higher state income taxes disadvantage professional sports teams. In the NBA, among the ten worst teams since 1995, eight were in states among the ten highest-tax states. And across all sports, of the forty-nine franchises with long championship droughts, only four are from states that do not have an income tax while twenty are from the highest-taxed states.[1]

To test the link between state income taxes and team performance, this paper analyzes team performance in the four major US sports leagues: the National Basketball Association (NBA), the National Football League (NFL), the National Hockey League (NHL), and Major League Baseball (MLB). Using within-team variation in top state marginal income tax rates, I regress tax rates on teams' win percentages to determine whether there is a link between tax rates and team performance. Since player mobility is essential for allowing players to shift the income tax burden to teams, I focus on the period from 1995 to the present, when all four leagues allow for unrestricted free agency.

Higher income taxes may negatively affect team performance if teams must compensate players for the increased tax burden - however, this effect could be mitigated through several avenues. For instance, if higher taxes increase local amenities that players value, then higher tax rates may in fact boost team performance. Alternatively, teams could offset the effect of taxes by increasing spending on other inputs, such as coaching, scouting, or team amenities, to offset the reduction in player quality. Finally, in some markets, teams could spend more on payroll to compensate for the increased tax burden, at least to the extent that league salary cap policies allow.

This analysis finds that state income tax rates significantly influence team performance, with each percentage point increase in marginal income tax rates associated with a 0.77 to 0.86 percentage point decrease in win percentage. The tax rate effect on team performance is robust to a variety of specifications, such controlling for sales and property taxes, alternative tax rate measures, and the

[1] Nine states have no income tax. I use the nine highest taxed states for the comparison group. A long championship drought is defined as twenty-five years or longer; the analysis includes United States teams only. The list of teams with long droughts is drawn from `https://www.businessinsider.com/longest-championship-droughts-pro-sports-2017-8`.

inclusion of Canadian teams. Changing the team performance measure to championship or finals appearances yields similar results.

To address concerns that the association between team performance and income tax rates may be coincidental, I consider how the tax rate effect changed with the adoption of unrestricted free agency. Achieving unrestricted free agency has been a milestone for players' associations, paramount both for increasing player mobility across teams and for forcing teams to compete for player services without restrictions.[2] The team competition over players is crucial because it allows players to shift the income tax burden onto teams; to explore the effect of free agency, I extend the sample period back to 1977 and examine the interaction of the income tax effect with an indicator for whether the league allowed unrestricted free agency. This analysis shows that the association between income taxes and team performance only arose existed after unrestricted free agency was introduced into each league.

The estimated effect size is non-trivial. The main analysis effect size of -0.85 means that a one standard deviation increase in tax rate will result in 0.65 fewer wins over an 82 game season.[3] Using the NBA "Wins Above Replacement Player"-statistic, meant to capture player marginal productivity, shows that this standard deviation change is similar to adding $0.97 million in payroll spending. Given a 2014 average team payroll of $63.4 million, the expected difference in player income taxes is $0.59 million, suggesting that more than the full burden of higher income taxes is borne by teams rather than individual players.

Further investigating the identification concern that unobserved heterogeneity in sports enthusiasm may be correlated with income tax rates, I run a placebo test using college sports. If states without income taxes, such as Texas and Florida, have particularly strong tastes for sporting events, this could advantage teams in the same way as income or population differences. Since college athletes are unpaid, they should not respond to income taxes and team performance should not be affected by income tax rates. And, in fact, and I find no evidence of income taxes affecting college team performance.

This is the first paper examine the income tax effect on professional team performance, but it builds on several papers looking at income taxes and sports. Perhaps the most closely relate work is Kleven et al. (2013), which study soccer player mobility in response to variation in top marginal income tax rates across countries. Kleven et al. (2013) finds evidence that foreign soccer players are more responsive to national tax rates than domestic players. Similarly, Driessen and Sheffrin (2017) examine location choices of professional racecar drivers and golfers to conclude that golfers have a

[2]While all leagues currently allow unrestricted free agency, each league has its own rules governing which players are eligible for free agency. Unrestricted free agency is typically earned after several years of play.

[3]Both the NBA and the NHL play 82 game season. MLB plays a 162 game season and the NFL plays a 16 game season.

strong mobility response to variation in state income taxes, while racecar drivers benefit from agglomeration effects in high income tax states and therefore have a lower mobility elasticity. Alm et al. (2011) and Ross and Dunn (2007) both analyze the tax compensation of MLB players by comparing salaries to player metrics such as home runs and earned run average. Both find evidence that the state income tax burden is largely offset by higher salaries. Kopkin (2012) studies NBA free agent signings between 2001 and 2008 and finds that teams in low tax states sign higher quality free agents. A natural conclusion from these papers is that if teams must compensate players for income taxes - and greater spending leads to more wins, then higher taxes must lead to fewer wins.

More broadly, this paper contributes to the literature on state income tax effects. Recent work by Moretti and Wilson (2017) and Moretti and Wilson (2014) reports a high elasticity of mobility among star scientists in response to state income tax rates. Moretti and Wilson (2017) use find star scientists have a high long-run elasticity of mobility of 1.8 in relation to state top marginal income tax rates, suggesting that firms in high tax states must increase compensation to attract star talent.[4] Similarly, Bakija and Slemrod (2004) use federal estate tax returns to find evidence of wealthy elderly households avoiding high state income tax rates. However, other work, such as Young and Varner (2011) and Conway and Rork (2012), find only small migration responses to state income tax rates among high earners and the elderly respectively.

I contribute to this literature by focusing on the producer burden of state income taxes. These results may help inform similar industries where capital mobility is much lower than labor mobility such as healthcare (hospitals and physicians), academia (universities and star academics), and industrial research (large engineering firms and star scientists).

Summary of theoretical model

There is good reason to believe that state income tax rates should affect team performance. As discussed in Wallace (1993), the incidence of differential state income taxes can be investigated using a general Harberger model allowing taxes to affect the various factors of production given in McClure (1970). A main implication of the Harberger model is that the share of income tax burden borne by the labor market (in this case, the athletes) depends on the elasticity of labor mobility relative to the elasticity of capital.

[4]Technically, Moretti and Wilson (2017) utilitize the average tax rate of an earner in the 99th percentile as opposed to the top marginal tax rate, but note that these two measures well approximate each other. Similar to my empirical strategy, the main specification in Moretti and Wilson (2017) does not consider sales and propety tax burden in the location decision, although robustness checks confirm that inclusion of sales and propety tax rates do not affect results.

The professional sports market differs from traditional labor markets in a few important ways. One way is that the traditional assumptions regarding the relative mobility elasticities of capital and labor are reversed in professional sports. The labor force - the players - is highly mobile while the capital - the franchises - is highly immobile. Historically in professional sports, the player mobility was low because collective bargaining agreements gave teams monopoly power to negotiate contracts. However, in the late 1980s and early 1990s, player unions were able to successfully push for increased player leverage through unrestricted free agency, or the ability to negotiate contracts with any team.[5] Free agency greatly increased player mobility, as can be seen in Figure 1. Currently, around thirty percent of players change teams each season. Conversely, the teams can not easily switch locations and rarely do so. Since 1990, there have been sixteen official franchise relocations, making the relocation rate around 0.5 percent each year. Another difference is that the good is primarily sold on a local market through ticket sales or local television contracts instead of at a national level. This implies that team investment will depend on the local ticket prices, and in turn we expect more investment (i.e. higher team salaries) in areas with greater population and with higher incomes.

Finally, the competition between teams is to produce a zero-sum good: wins. Professional sports leagues strictly regulate both the number games played and number of players on each team. Teams can increase the quality of their labor force to generate more wins and in turn increase demand for tickets. Since the number of wins league-wide is fixed (every game must end in a win, loss, or a tie), we will consider only the relative value of input variables.

The relatively elastic mobility of athletes predicts that the state income tax burden will be borne primarily by the teams rather than the players. One implication of this prediction is that, conditional on quality, players in high income tax states should receive higher pre-tax income. Recent work has borne out this reasoning; a study by Alm et al. (2011) regresses MLB player performance and state taxes on free agent contract value to find a nearly dollar-for-dollar compensation for variation in income tax rates. Given this relationship, teams in high-tax states may face the choice of increasing payroll or wining fewer games. The ability to increase payroll may be restricted by salary caps or other factors, depending on the league. For example, in MLB, teams have no limit on team payroll, although the highest-spending teams must pay a "luxury tax." In contrast, the NFL and NHL impose spending restrictions through a "hard cap," a defined upper bound on team payrolls, while the NBA has a "soft cap" with a luxury tax, allowing teams to spend above a capped amount but penalizing them for doing so.

[5]Note that unrestricted free agency is typically only available to players after an initial, restricted rookie contract in completed.

Empirical Model

To examine the effect of income tax rates on team performance, I estimate the following equation:

$$Y_{ist} = \beta_0 + \beta_1 \tau_{ist} + \beta_2 X_{ist} + \gamma_i + \delta_{Lt} + \varepsilon_{ist} \tag{1}$$

The win percentage, Y_{ist} for team i in state s in year t is modeled as a function of the top state marginal income tax rates, τ_{ist} and other team and location characteristics, X_{ist}, including population, average income, quality-of-life estimate, and franchise age. Equation 1 also includes team, γ_i and league-by-year, δ_{Lt} fixed effects. In some specifications, β_1 is modified to allow for separate tax effects by league, β_1^L or league-by-year, β_1^{Lt}.

Identification of the income tax effect, β_1, on winning comes from within-team variation in income tax rates, τ_{it}, over time. This estimation strategy assumes that income tax rates are set exogenously relative to sports teams' interests. Bias in estimated coefficients could arise if income tax rates are set in order to influence professional team performance or if income tax rate changes are correlated with changes in other factors influencing team performance not controlled for in the regression. Given the relatively minor role of professional sports in local budgets, it is unlikely that tax rates are altered to help local teams.

Unrestricted free agency allows every team to compete on an equal footing for eligible players, a key element in the salary competition that allows players to be compensated for higher income tax rates. Hence, the income tax effect would be expected to rise as restrictions on free agency are loosened or eliminated. While many other aspects of player negotiations may also affect the tax rate effect unrestricted free agency is crucial creating player leverage in negotiations, greatly increased player mobility, and has been a major milestone in collective bargaining agreements for each players' union. I extend the sample period to include pre-free agency years back to 1977 and I modify Equation (1) to allow the income tax effect to vary depending on whether the league allows for unrestricted free-agency:

$$Y_{ist} = \beta_0 + \beta_1 \tau_{ist} + \beta_2 \tau_{ist} \mathbb{1}_{FA=1} + \beta_3 X_{ist} + \gamma_i + \delta_{Lt} + \varepsilon_{ist} \tag{2}$$

where β_1 represents the effect of income tax rate, τ_{ist}, on win percentage, β_2 represents the change in the effect of the income tax rate on win percentage after free agency is allowed. Focusing on β_2 reveals changes in the relationship between tax rates and winning over time to test if greater player autonomy shifted state tax burden onto teams.

To focus on how team performance changes in relation to the timing of tax rate changes, I also conduct an event study analysis. To run an event study on state tax rate changes, I stack observations by year relative to income tax rate change year and estimating the following equation:

$$Y_{ist} = \beta_0 + \beta_1 \Omega_t + \beta_2 X_{ist} + \gamma_i + \delta_L + \varepsilon_{ist} \tag{3}$$

where Ω_t is an indicator equal to one if a tax rate change has previously occurred, X_{ist} are covariates defined as before, γ_i are team fixed effects, and δ_L is a league fixed effect.[6] To avoid contamination, observations are excluded if other tax rate changes occur within T periods relative to each tax change. Note that tax rates are measured at the beginning of each year, however most leagues regular season overlaps across multiple seasons. This means that in the year of the tax change, $T = 0$, some teams have reduced exposure to the new tax rate.

Finally, I run a placebo test to check whether state income tax rates influence college team performance. Since college athletes are unpaid, income tax rates should have little or no influence on team performance. However, if areas with low income taxes also have a high sports demand, a negative relationship between income taxes and college team performance would be expected.[7]

Data

To determine the tax rate effect on winning, I collect top state marginal income tax rates and compare them to team performance data. This follows previous work on state mobility of high earning households, such as Kleven et al. (2013) and Moretti and Wilson (2017), which focus on top marginal income tax rates to describe state policy regimes. When included in estimation, both sales and property tax rates have a negative relationship with team performance while the income tax rate effect size remains similar in magnitude. Top state marginal income tax rate data from 1977 to 2017 come from the publication *The Book of the States* produced by the Council of State Governments since 1933. Figure 2 shows the top marginal income tax rate across states that have professional sports teams. Between 1977 and 2017, the average combined top marginal tax rate is 5.5 percent. Several states have never had a state income tax, including Florida, Tennessee, Washington, and Texas. The highest marginal income tax rates in 2017 are in California at 12.3 percent, followed by Oregon at 9.9 percent and Minnesota at 9.85 percent.

[6] Note there are not enough observations in the event study to allow league-by-year fixed effects as in Equation 1.

[7] Income taxes could still affect college coaches and administrators, but this effect is likely to be small.

I assign teams state income tax associated with the team location. Based on conversations with tax experts from the *Tax Institute at H&R Block*, this assumption seems reasonable. While calculating each players expected state income tax burden is difficult, typically players would not be able to avoid paying state income taxes on earnings from their professional sports team by residing in a different state, although some states do have reciprocity tax agreements with neighboring states. Other income, such as that from endorsements, would be subject to income tax of the athletes state of residence. Most states also currently administer a "jock tax", where players playing road games (outside their home state) must consider part of their salary earned in the road teams state, so players often must file many state income taxes each year. The effective tax rate players pay for these state is unclear though, as only a small portion of their income is subject to the tax for each state and is likely well below the top marginal rate for states with progressive income tax rates. Further, home states have the option of whether to credit out-of-state income taxes on the home state tax return, so road games may not reduce home state income tax burden. I ignore jock taxes in the income tax definition primarily due to player salience and limited cross-team variation. I am unaware of any evidence that suggests players are aware that opponent tax burden differentials exist.[8] Scheduling in professional sports leagues has also reduced regional competition, so little variation exists across teams in opponent tax rates. For example, in 2015 the standard deviation of opponent tax rates was one-tenth that of team's own tax rate.

Team performance is assessed using regular season data on wins and losses (or points, in hockey). Alternative outcome measures, such as championships or finals appearances are explored in the Appendix Table A.2. Post-season performance measures mirror the regular season findings. Historical team records for the MLB, NFL, NBA, and NHL are collected from Sports-Reference (`http://www.sports-reference.com/`). To avoid complications arising from including expansion teams, which often take several years to acquire enough talent to become competitive, the primary analysis restricts the sample to teams in existence in 1977. The year 1977 is natural starting point because it is directly after the NBA-ABA merger. I focus on regular season team win-loss records as a measure of team performance. The NHL uses a points system instead of wins and losses, so winning percentage for NHL teams is derived by taking each team's season points and dividing them by the NHL average points for the year.[9] To make winning percentage comparable across leagues, I adjust winning percentages to a mean of 50 and a standard deviation of 15.66 for each league.[10]

Since player movement and negotiation is an important requirement for shifting the income tax burden

[8] Even tax professionals admit the situation is quite complicated and little data exists describing the revenue raised from these taxes.

[9] The NHL awards two points for a win, one point for an overtime loss, and one point for a tie.

[10] The standard deviation of 15.66 sets the NBA as a benchmark.

onto teams, the regression analysis begins by considering the 1995-2017 period, during which all four leagues had unrestricted free agency. Further analysis expands the period back to 1977 to consider the evolution of the tax rate effect over time. For many years, players could only change teams through trades; teams were given large negotiating advantages in retaining players though the "reserve clause". While in theory unrestricted free agency allowed teams to compete for players, teams were resistant to free agency; in 1985, 1986, and 1988, the MLB players union filed and won grievances alleging teams were colluding to not sign free agents. Unrestricted free agency arrived in leagues during the late 1980s and 1990s, through new collective bargaining agreements NBA players won free agency in 1988, NFL players in 1994, and NHL players in 1995. As a result of free agency, player mobility and negotiating power - and, in turn, salaries - rose sharply in the 1990s and beyond. Figure 1 displays average player mobility and Figure 3 displays average player salaries by league and year. The effect of free agency can easily be seen; mobility rates increased forty percent between the 1980s and 1990s, and average NBA and MLB salaries tripled from 1988 to 1998.

This paper focuses on the effect of income tax rates on winning because in a "wins" production function, team payroll may be an important factor and higher income taxes increase the price of labor. However, other location factors may influence the price of labor or the financial return to winning, such as population, household income, and local amenities. Annual average income data comes from the Bureau of Economic Analysis, and metropolitan-area population estimates come from the US Census Bureau. Control variables are standardized by league-year for interpretability because winning is a zero-sum outcome. For example, if population growth increases a team's expected winning percentage, it must simultaneously decrease the winning percentage of other teams.

Local amenities could also matter for team performance - higher amenities may reduce labor cost. In standard labor market models such as Rosen (1979) and Roback (1982), workers consider wages, house prices, and amenity values when selecting where to reside, with wages compensating for variation in amenities across locations. When teams are competing within the limitations of a fixed salary cap, high amenity values could serve as a bargaining advantage. A player who values warm weather may absorb some sacrifice in salary to play in a place like Miami, FL, rather than, say, Buffalo, NY. While amenity values cannot be observed directly, Albouy (2015) estimates local amenity values using data on local wages, population, and home values. While this estimate provides only a static measurement of amenity values, a primary component of amenity value is local climate, which is a mostly fixed characteristic.

Finally, I consider team age. New expansion teams often perform poorly in their first few years of existence, perhaps in part because these teams begin with young players who take several years to develop. Figure A.2 displays the average win percentage of franchises originating after 1970 by team

age.[11] (Team age is determined by first year of existence, and so does not reset if a team relocates.) Expansion teams clearly do worse in their initial years. Since expansion teams may be more likely to locate in low-tax states (for a competitive advantage) I restrict the primary sample to teams already in existence in 1977. When expansion teams are included in the sample I control for a quadratic function of franchise age to resemble the pattern observed in Figure A.2.

Table 1 displays summary statistics of professional teams between the sample period of 1977 and 2017. The table is split by the pre-free agency period of 1977 to 1994 and the post-free agency period of 1995-2017, and by if the team is in an above or below median state tax rate for the time period. Though the difference in average tax rates between high tax and low tax teams is similar across time periods, at 7.08 for the early period and 5.83 percent for the later period, the difference in winning between periods changes immensely from higher tax states winning 1.44 percent more often in the early period to losing 1.79 percent more often in the later period. While teams in low tax state have lower incomes and amenities than teams in high tax states, differences in these and other covariates remains similar across time periods.

Results

This section investigates the effect of income tax rates on team performance. Since the ability to move freely between teams is crucial to players' ability to negotiate compensation for state income taxes, I begin the analysis focused on the period 1995 to 2017, when all four leagues allow unrestricted free agency. I then extend the time period back to 1977 to estimate how the relationship between taxes and winning changed from the pre- and post-free agency eras. I use an event study framework to study the time variation in the tax rate effect on winning relative to the tax change. Robustness checks are then consider which allow for alternate tax rate definitions, sample selection, and model specifications. Finally, I run a placebo test measuring the relationship between income tax rates and winning in college sports. Unless otherwise specified, the sample consists of teams in existence by 1977 to avoid complications arising from expansion team performance.

Table 2 displays regression results from estimating Equation (1), with all specifications including team and league-by-year fixed effects. Standard errors are robust and clustered at the state level as this is the level of policy variation. The income tax effect is both statistically significant and sizable in magnitude. Column (1), which include no covariates, shows the income tax effect is -0.85, meaning

[11] Prior to 1970, expansion teams may have included the founding teams of the league. Founding teams would not have been at a relative disadvantage to other teams, which is what this variable is attempting to capture.

that each one point increase in the state top marginal income tax rate decreases team performance by 0.85 percentage points. This effect size does not change when metro-area covariates are added in Column (2). Column (3) include league-specific covariates, which reduces tax rate effect to -0.77. Adding in expansion teams, along with a quadratic term for team age, in Column (4), increases the income tax magnitude slightly, to -0.86. Each of the tax rate effect estimates in these four specifications is statistically significant at the 10% level or higher. This range of estimates suggests that between 1995 and 2017, a standard deviation increase in a team's marginal tax rate decreases its expected win percentage by between 0.71 and 0.80 percentage points.[12] At its extreme, the effect implies a striking result: a team moving from a high income tax state to a no income tax state, such as the recent relocation of the Raiders from Oakland, CA to Las Vegas, NV, could expect to win 11.1 percent more of its games.

In evaluating the income tax effect size consider the NBA, which I have player salary and value data. To find the cost for a team to buy an extra win, I regress the "Wins Above Replacement" statistic on player salary data. Appendix Table A.3 shows that each win costs $1.5 million. In 2014, the average NBA payroll was $63.4 million; thus, a one percent increase in income taxes translates into $0.634 million less in spending power. Based on the cost-per-win estimate, $0.634 million should buy 0.43 wins if the full income tax burden is borne by teams, which would imply an true coefficient value of 0.52. While this suggests the estimated coefficient may overstate the income tax effect, I cannot reject the hypothesis that my estimate of 0.85 is different than 0.52.

Table 3 displays results from estimating Equation (1), allowing for separate income tax effects by league, β_1^L. In every specification for each league the estimated effect of income taxes on winning is negative.[13] The NFL has the highest and most statistically significant relationship between income taxes and team performance over this time period, while the NBA and the NHL have lower estimated tax rate effects. Further investigation of the causes of league differences may be a fruitful avenue for future research, but remain difficult for this study given the limited statistical sample power.

Free Agency Effect

As discussed earlier, for players to shift the income tax burden to teams they must have the ability to negotiate with multiple teams through free agency. Table 4 displays results from estimating Equation 2, which extended the sample period back to 1977 and allow the tax rate effect to vary by if each league allowed unrestricted free agency. Prior to free agency, the within-team changes in tax

[12] The within-team standard deviation of state top marginal income tax rates from 1995 to 2017 is 0.925.

[13] Appendix Figure A.1 displays these league-by-year tax rate coefficients.

rates were statistically insignificant across all four specifications with point estimates close to zero. Following the introduction of free agency, a within-team percentage point increase in the marginal tax rate reduced winning percentages between 0.35 to 0.61 percent. These point estimates are smaller in magnitude and less statistically significant compared to results from Table 2, however are also closer to the predicted -0.52 value if state taxes were fully borne by teams.

These results show that the effect of income tax rates on winning is only a relatively recent phenomenon and that prior to free agency there was slightly positive but near zero relationship between tax rates and winning. Viewing free agency as a policy change that enabled players to negotiate compensation for a state's income tax burden, Table 4 suggests a causal and statistically significant link between team performance and income tax rates. This analysis adds credibility to the earlier findings. One may have been concerned with Equation 1 that within-team changes in state tax rates are correlated with other unobserved factors related to demand for sports or team performance. However, as long as the relationship between tax rate changes and unobserved factors is constant over time, Table 4 confirms that increased income taxes cause a decline in team performance only when players are able to shift the income tax burden on to teams.

Event Study

Table 5 displays results from estimating the event study research design in Equation 3. Columns (1) and (2) use three- and two-year bandwidths around each tax change event, of which are there are 58 and 71 events respectively. Both specifications reveal large average estimates of the average effect of tax changes on winning of 3.44 and 3.43. Associated with these tax changes is an average rate change of -0.53 and -0.31 percentage points respectively. Figure 4 illustrates the event study finding, showing both no signs of pre-trend in winning percentage relative to tax change years and a sizable increase in average winning percentages in the three years following a tax change. Columns (3) and (4) repeat the event study estimation but replace Ω_t, which is an indicator variable for if the tax change occurred, with the continuous variable of tax rate. That is, Columns (3) and (4) mimic Equation 1 but restrict the time period to be three and two years respectively near the tax change date, and excluding observations with multiple tax changes in a short period of time. The income tax effect using this event study design yields estimates of 2.475 and 1.305 which are much larger in magnitude to estimates from Equation 1. Altogether, results from the event study framework both provide both evidence of no trend in winning percentage prior to tax rate changes and large responses to tax changes, even if the effect sizes are too large to be justified on financial grounds.

Robustness Checks

Table 6 presents tax rate effect estimates from several robustness checks. Canadian teams are excluded from the main sample due to the complexities of comparing US and Canadian tax systems. To show that this exclusion is not a main factor in my results, Column (1) of Table 6 presents results including Canadian teams. Since Canadian and US federal taxes differ substantially, I use combined federal and state, or provincial, top marginal tax rates. Including Canadian teams reduces the tax rate effect size slightly to -0.862.

Column (2) of Table 6 displays results from estimating Equation 1 without team fixed-effects. This change allows identification of the tax rate effect to come both from within-state and cross-state variation in tax rates. Since variation across states in tax rates is much greater than within state variation in tax rates, and state tax rate changes are infrequent, there is a concern that the main results may be driven by a few outlier observations. Removing team fixed effects does reduce the tax rate estimate to -0.533. While smaller than the main result, this finding is much closer to the expected maximum effect size of -0.52 if the tax burden were fully shifted to teams, and it maintains its statistical significance.

Columns (3) through (5) of Table 6 test whether alternative measures of state income tax policy yield different results. Column (3) replaces the contemporaneous state tax rate with a three-year moving average of state tax rates. Including lagged values of state tax rate could be important as players typically sign multi-year contracts, so the effects of a tax rate change may take several years to phase in. Using a three year moving average tax rate increases the tax rate effect to -1.098. Column (4) changes to tax definition to include the combined state and federal top marginal tax rates, incorporating their deductions for each other since state income taxes are deductible from federal taxes and some states allow for a deduction of federal taxes. Using this tax rate definition increases the tax rate effect to a statistically significant -1.506. Column (5) of Table 6 substitutes the statutory state top marginal income tax rate for the average marginal state income tax rate as measured by the NBER based on a the TAXSIM program which incorporates the complexities of the US tax code that can be missed by statutory rate changes alone. Using the NBER state top tax rate definition decreases the tax rate effect to a statistically insignificant -0.517. While Column (6) loses its statistical power, it is close to the expected effect size of -0.52 if the tax rate was fully borne by teams.

Lastly, Column (6) considers variation in the tax rate effect if the tax rate is above or below the median tax rate. Differential tax rate effects could occur if the cost of avoiding or mitigating taxes changes with the tax level. I find that the tax rate effect is greater for teams with tax rates above the median, although this difference is statistically insignificant. Each percentage point increase in the state tax

rate above the median reduces winning percentage by 0.140 percent in addition to the 0.651 percent decrease associated with tax rate increases below the median.

Overall, these alternative specifications provide evidence that income tax effects on team performance are robust to the inclusion of Canadian teams, removal of team fixed effects, and choice of tax rate definition.

Placebo Test: College Sports

To test the validity of the claims that state income tax rates directly influence professional sport team performance, I run a placebo test by estimating Equation 1 for college team performance during the 1995-2017 period. Since college athletes are not paid taxable income by their universities, state tax rates should not affect college athletes school choice or performance.[14] Considering college team performance should capture otherwise unobservable local variables that may affect team performance and could potentially be correlated with changes in tax rates, such as regional variation in enthusiasm for each sport. College records for 1995 through 2017 were collected for 155 football and 347 basketball teams from the Sports-Reference website. Each team was matched with its state and assigned the top state marginal income tax rates, population, income, and quality of life measures in the same manner as the professional team analysis .

Table 7 reports results from regressing income tax rates on win percentage for these college teams. Columns (1) and (2) do not include control variables while Columns (3) and (4) do include control variables. Columns (2) and (4) restrict the sample only to the five "power" conferences (Big Ten, Big 12, Pac-12, SEC, and Big East) where college sports enthusiasm is greatest.[15]. With all college teams the relationship between taxes and winning is positive. When restricting the sample to only the power conferences, the relationship between taxes and winning is small, and statistically insignificant. These results reinforce the assumption that unobserved heterogeneity in sports preference is not driving the link between state income taxes and professional team performance.

[14] State income tax rates could still affect paid employees such as coaches and administrators.

[15] The names and compositions of these leagues has changed over time

Discussion

Using within-team variation over time in top state marginal income tax rates, this paper investigated the income tax effect on team performance and finds that, over the past twenty years, higher income tax rates lower professional team performance. This finding is bolstered by considering the role of free agency in which players gained the ability to negotiate with different teams, forcing teams to pay competitive prices. Prior to free agency, the relationship between taxes and team performance was minimal, but after players could effectively bargain over salary, the effect of higher taxes on team performance became strongly negative. The tax rate effect is further verified by in an event study framework, which shows no evidence of pre-trends, and the finding is robust to several model specifications, alternative tax rate definitions, and sample selection choices.

The findings of this paper should be of interest to economists, policymakers, and sports league officials. For economists and policymakers, professional sports is one of the few markets where labor is more mobile than capital, providing a test of to the theory of state income tax incidence. My results validate this theory and lend insights into other markets where labor is more mobile than capital, including, for instance, the markets for physicians, star scientists, and CEOs. Other industries, such as healthcare and science, may be particularly burdened by increasing state income taxes. That the state income tax burden is fully shifted to producers in a market with a highly mobile workforce is a novel finding that should be explored deeper in future work.

For sports leagues, the paper shows that differential income tax rates undermine efforts to create a level playing field among teams. This is particularly true for teams in high-tax states without compensating qualities such as large populations or warm weather, such as Sacramento, CA; Minneapolis, MN; Portland, OR; Buffalo, NY; or many Canadian teams. Possible solutions include adjusting the salary cap to account for income taxes or allowing for an income tax adjustment in revenue sharing agreements.

While this study has provided clear evidence of the increasing effect of income taxes in professional sports, future research could build upon this work in a several aspects. First, I am only to indirectly measure tax burden through reduced team performance. A true accounting of state tax burden would involve more detailed accounting of team finances, which are unavailable to me, but would be important in verifying by indirect tax burden measure of team performance. Particularly interesting is the possibility that state or localities end up bearing the tax burden themselves through increased team subsidies, which often occur through stadium financing deals. Second, a deeper investigation into the mechanisms driving cross-league differences in income tax effects could reveal the extent to which

teams are able to mitigate higher income taxes by investing in higher quality team capital, such as coaches, scouting, front-office staff, or team amenities. Lastly, an interesting extension would be considering how income taxes affect teams' expansion or relocation choices, as several expansion teams have located in no income tax states.[16] A similarly interesting and plausible question is whether state income tax rates are capitalized into team value.

Overall, this paper has shown that income tax rates significantly influence team performance. Though effect sizes vary by league, if player salaries continue to increase, we should expect the impact of income taxes to rise with them. The growing differential may force leagues to confront the competitive disadvantage faced by teams in high income tax states.

[16]These now include the Las Vegas Raiders (2020), Las Vegas Knights (2017), Houston Texans (2002), Memphis Grizzlies (2000), Tampa Bay Rays (1998), Florida Marlins (1993), and Florida Panthers (1993).

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Table 1: Franchise Summary Statistics

	1977-1994		1995-2017	
	(1)	(2)	(3)	(4)
	High Tax	Low Tax	High	Low
Winning Percentage	50.61	49.17	49.43	51.22
	(15.20)	(15.24)	(14.89)	(15.47)
Tax Rate	9.91	2.83	8.33	2.50
	(2.29)	(2.22)	(1.79)	(2.15)
Population	0.01	-0.01	0.05	-0.05
	(1.19)	(0.72)	(1.19)	(0.71)
Income	0.35	-0.35	0.29	-0.29
	(1.07)	(0.73)	(1.10)	(0.74)
Local Amenities	0.45	-0.44	0.28	-0.29
	(1.03)	(0.68)	(1.10)	(0.75)
Franchise Age	19.51	19.07	36.43	32.66
	(8.33)	(8.68)	(12.94)	(15.29)
Observations	807	826	1,264	1,261

Note: High and low tax franchises defined in relation to the median state top marginal tax rate for time period, which is 6.00 percent for the 1977-1994 period and 5.95 percent for the 1995-2017 period. Log population and log income variables standardized by league-year. Tax rates are top state maringal income tax rates. Local amenities estimates come from Albouy (2015).

Table 2: Income Tax Rates and Team Performance

	(1)	(2)	(3)	(4)
Tax Rate	-0.847*	-0.848*	-0.766*	-0.859**
	(0.411)	(0.425)	(0.421)	(0.367)
Population		-11.713*	-29.862	-16.590**
		(6.822)	(17.612)	(6.854)
Income		0.974	-3.139	1.343
		(1.681)	(4.079)	(1.508)
Local Amenities		6.050	-5.628	9.300
		(4.883)	(36.490)	(5.855)
Age				1.269***
				(0.241)
Age Squared				-0.006**
				(0.002)
League Varying Coefficients	No	No	Yes	No
Team FE	Yes	Yes	Yes	Yes
Observations	1,931	1,931	1,931	2,525

* p<0.10, ** p<0.05, *** p<0.010

Note: This table displays estimates of regressing tax rates on team winning percentage between 1995 and 2017. Tax rates are top marginal state income tax rates. Sample for columns (1) through (3) exclude expansion teams since 1977, column (4) includes all teams. All specifications include league-by-year fixed effects. Column (3) includes league varying coefficients on population, income, and local amenities; only coefficients for the base league, MLB, are shown. Population and income variables standardized by league-year. Local amenities estimates come from Albouy (2015).

Table 3: Income Tax Rates and Team Performance, By League

	(1)	(2)	(3)	(4)
Tax Rate*MLB	-1.469	-1.370	-1.273	-1.321
	(0.883)	(0.924)	(0.921)	(0.823)
Tax Rate*NBA	-0.080	-0.069	-0.060	-0.143
	(1.108)	(1.323)	(1.337)	(1.284)
Tax Rate*NFL	-1.527**	-1.428**	-1.433**	-1.393**
	(0.560)	(0.573)	(0.609)	(0.557)
Tax Rate*NHL	-0.516	-0.482	-0.173	-0.639
	(0.635)	(0.636)	(0.779)	(0.618)
Covariates	No	Yes	Yes	Yes
League Varying Coefficients	No	No	Yes	No
Observations	1,931	1,931	1,931	2,525

* p<0.10, ** p<0.05, *** p<0.010

Note: This table displays estimates of regressing tax rates on team winning percentage between 1995 and 2017. Tax rates are top marginal state income tax rates. Sample for columns (1) through (3) exclude expansion teams since 1977, column (4) includes all teams. All specifications include league-by-year fixed effects. Column (3) includes league varying coefficients on population, income, and local amenities; only coefficients for the base league, MLB, are shown. Population and income variables standardized by league-year. Local amenities estimates come from Albouy (2015).

Table 4: Income Tax Rates, Team Performance, and Free Agency

	(1)	(2)	(3)	(4)
Tax Rate	-0.027	0.014	0.148	-0.005
	(0.330)	(0.336)	(0.314)	(0.315)
Free Agency × Tax Rate	-0.467*	-0.432	-0.612**	-0.348
	(0.265)	(0.259)	(0.257)	(0.251)
Population		3.333	8.768	1.793
		(3.019)	(6.136)	(3.164)
Income		-0.531	-1.423	-0.105
		(0.687)	(1.731)	(0.859)
Local Amenities		-0.434	45.160**	0.396
		(2.370)	(17.072)	(2.730)
Age				0.645*
				(0.328)
Age Squared				-0.008***
				(0.003)
League Varying Coefficients	No	No	Yes	No
Team FE	Yes	Yes	Yes	Yes
Observations	3,471	3,471	3,471	4,143

* p<0.10, ** p<0.05, *** p<0.010

Note: This table displays estimates of regressing tax rates interacted with whether the league allowed unrestricted free agency on team winning percentage between 1977 and 2017. Tax rates are combined top marginal state and federal income tax rate. Sample for columns (1) through (3) exclude expansion teams since 1977, column (4) includes all teams. First years for free agency are 1988 for MLB and NBA, 1993 for NFL and 1995 for NHL. While MLB unrestricted free agency officially began in 1976, I use 1988 due to successful collusion cases related to free agency brought by players union between 1985 and 1987. All specifications include league-by-year fixed effects. Column (3) includes league varying coefficients on population, income, and local amenities; only coefficients for the base league, MLB, are shown. Population and income variables standardized by league-year. Local amenities estimates come from Albouy (2015).

Table 5: Income Tax Rates and Team Performance, Event Study

	(1)	(2)	(3)	(4)
Tax Change Event	3.444*	3.431*		
	(1.852)	(1.729)		
Tax Rate			2.475**	1.305
			(0.938)	(1.230)
Population	18.453	-0.606	37.483*	3.503
	(29.271)	(8.317)	(19.921)	(10.558)
Local Amenities	-2.047	5.590**	-4.516	6.436*
	(17.761)	(2.584)	(11.771)	(3.322)
Income	-8.646	-4.098***	-14.218**	-4.531**
	(6.952)	(1.179)	(4.818)	(1.782)
Constant	58.196***	42.113***	56.896***	37.757***
	(11.499)	(1.825)	(6.788)	(6.814)
Observations	266	310	266	310

* p<0.10, ** p<0.05, *** p<0.010

Note: Columns (1) and (3) use three year bandwidth around tax changes and Columns (2) and (4) use a two year bandwidth around tax changes. All specifications include league and team fixed effects. The Tax Change Event variable is a dummy variable equal to one after any tax change occurs. The Tax Rate variable is equal to the top state marginal income tax rate. Population and income variables standardized by league-year. Local amenities estimates come from Albouy (2015).

Table 6: State Income Taxes Rates and Team Performance, Alternative Tax Measures and Canada

	(1)	(2)	(3)	(4)	(5)	(6)
Tax Rate	-0.862	-0.533**	-1.098**	-1.506**	-0.517	-0.651
	(0.719)	(0.204)	(0.526)	(0.560)	(0.439)	(0.852)
Above × Tax Rate						-0.140
						(0.561)
Observations	1,931	1,931	1,899	1,931	1,931	1,931

* p<0.10, ** p<0.05, *** p<0.010

Note: This table provide several robustness checks the of tax rate effect on team performance. Column (1) includes Canadian teams, and changes the tax definition to include combined federal and state (provincial) tax rates. Column (2) excludes team fixed effects. Column (3) uses a three-year moving average of top state marginal tax rate. Column (4) uses the combined state and federal statutory tax rates and incorporates the deductibility of these rates from each other. Column (5) uses the alternative NBER measure of top marginal income tax rates based on its TAXSIM prgorm. Column (6) estimates Equation 1 and adds an interaction between tax rate and an indicator for if the tax rate is above the median tax level.

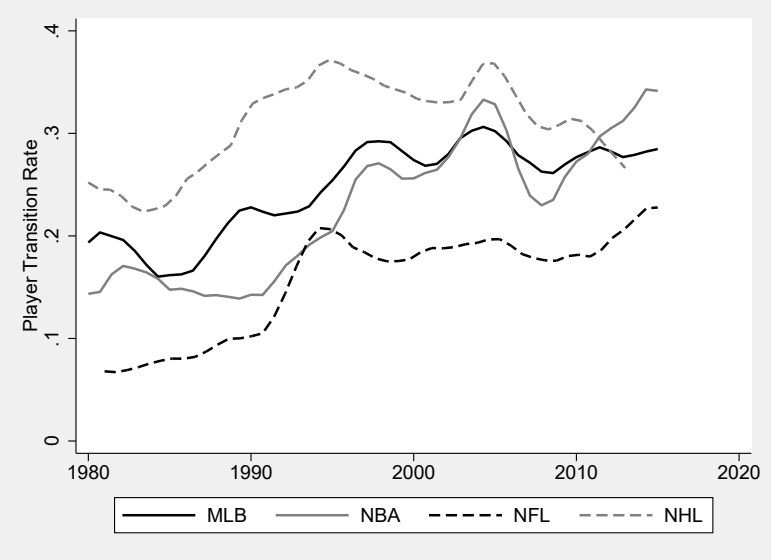
Table 7: State Income Taxes Rates and College Team Performance

	(1)	(2)	(3)	(4)
Tax Rate	0.501	-0.100	0.703*	-0.165
	(0.366)	(0.717)	(0.376)	(0.670)
Controls	No	No	Yes	Yes
Power Conferences	No	Yes	No	Yes
Observations	8,252	2,413	8,252	2,413

* p<0.10, ** p<0.05, *** p<0.010

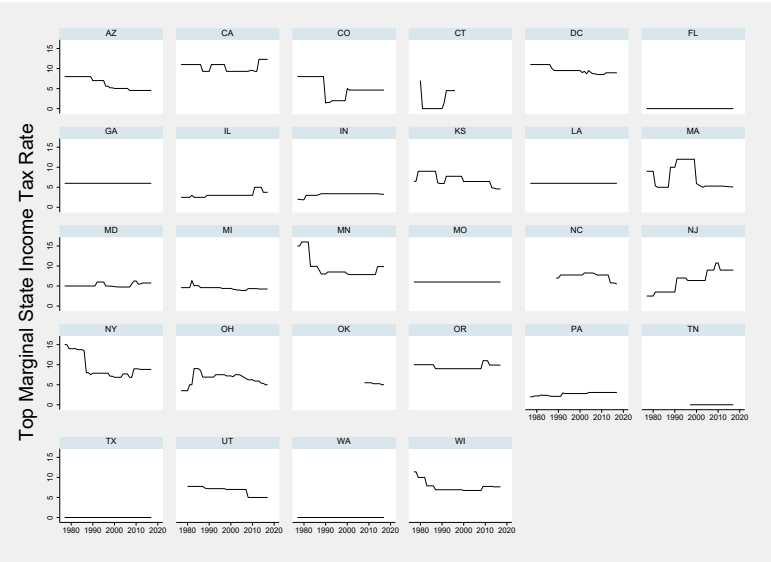
Note: This table presents results from regressing top state marginal income tax rates on team winning percentages in men's college football and basketball 1995-2017. Control variables include area population, income, and local amenities. Power conferences include the Big Ten, Big 12, Pac 12, SEC, and Big East.

Figure 1: Player Transition Rates by League



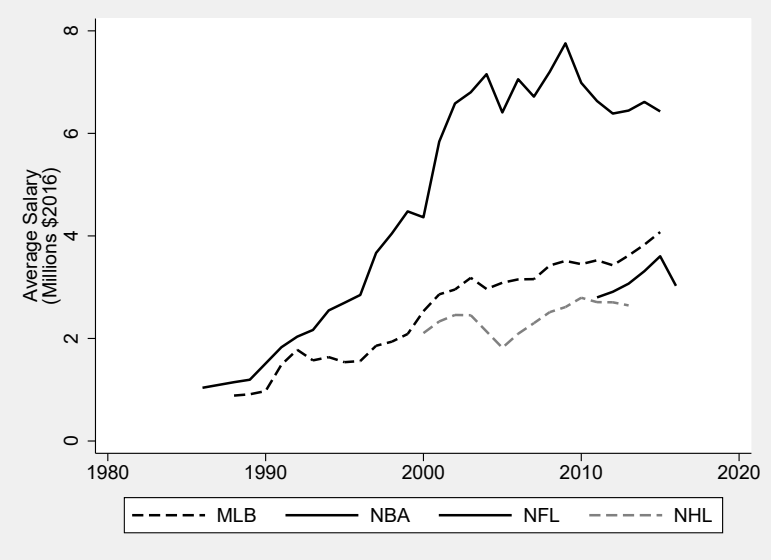
Source: Author's calculations based on data from SportsReference.com.
Note: This figure displays the rate of player movement between teams each year by league. Sample is among players with at least four years experience and on rosters in both the current and previous year, 1980-2015.

Figure 2: Top State Marginal Income Tax Rates, 1977-2017



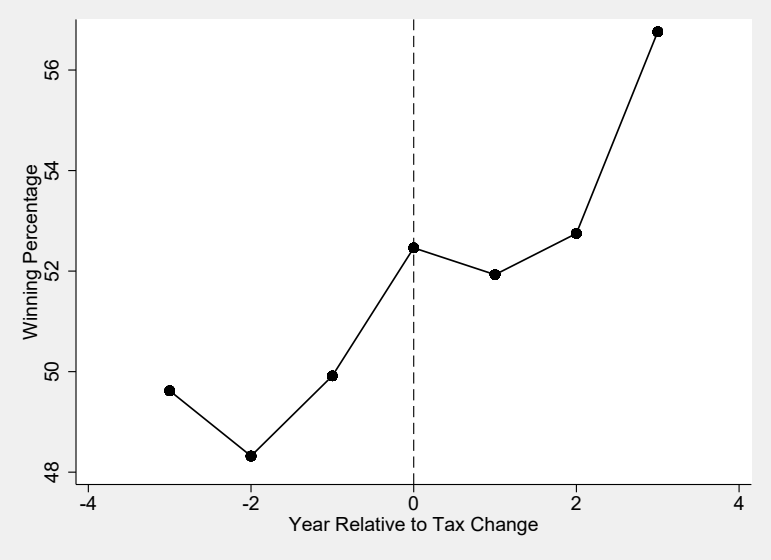
Source: The Council of State Governments: "The Book of the States", 1977 to 2017.
Notes: This figure displays the top state marginal income tax rate on earned income. Sample restricted to years in which each state had at least one professional sports team.

Figure 3: Average Veteran Player Salary by League



Sources: Salary data comes from Sean Lahman (MLB), Patricia Bender (NBA), USA Today (NHL), and SportTrac (NFL).
Note: Average player salary (in millions of 2016 dollars) among players with at least four years experience by league.

Figure 4: State Income Taxes and Team Winning Percentage, Event Study



Source: Author's calculations based on data from SportsReference.com.
Note: This figure displays average team winning percentage three years prior and following a change in top marginal income tax rates.

Appendix

Sales and Property Taxes

While income taxes may be both the most salient and progressive tax burden that high income households consider in a location choice problem, a more complete model of the location decision should include the full expected tax burden. Previous work, such as Kopkin (2012), has included income, sales, and property taxes since state and local vary substantially in their revenue sources for public goods. States without an income tax rely on higher sales and property taxes to fund similar levels government spending. Conversely, total government spending also vary significantly between states as evidenced by the two states that currently have the highest marginal tax rates in my sample, California and Minnesota, also have among the highest sales tax rates.

To examine how including a more complete measure of tax burden affects team performance, I use data on state sales tax rates published by the Council of State Governments "Book of States" which collects information on state revenue, expenditures, and policies dating back to 1935. Property tax rates are more difficult to quantify, due to the overlapping taxing districts from city, county, and state governments combined with assessment and deduction rules that often lead to differing statutory and effective rates. I utilize average effective property tax rates published in the "50-State Property Tax Comparison Study" by the Lincoln Land Institute and the Minnesota Center for Fiscal Excellence. Effective tax rates represent the average annual property tax bill as a percent of average home value in the state. Between 1995 and 2017, state sales tax range between 0 and 7.5 percent with an average of 5.76 and a standard deviation of 1.28. Effective property tax rates range between 0.51 and 2.38 percent with an average rate of 1.26 percent and a standard deviation of 1.26 percent.

Table A.1 displays results from estimating Equation 1 when sales and property tax rates are included as additional covariates. Both sales and property tax rates consistently show a negative, though not statistically significant, relationship with team performance. Across all four specifications, the inclusion of sales and property tax rates slightly changes the magnitude of the income tax rate effect, while having no affect on its statistical significance.

Table A.1: Income, Sales, and Property Tax Rates and Team Performance

	(1)	(2)	(3)	(4)
Income Tax Rate	-0.893**	-0.840*	-0.761*	-0.865**
	(0.414)	(0.424)	(0.418)	(0.354)
Sales Tax	-0.689	-1.063	-1.232	-0.314
	(0.837)	(0.945)	(0.972)	(0.824)
Property Tax	-4.855	-8.831	-9.613	-6.555
	(8.299)	(8.650)	(8.506)	(6.109)
Population		-13.696*	-31.711*	-17.782**
		(6.792)	(16.959)	(6.636)
Income		1.015	-3.231	1.349
		(1.616)	(3.903)	(1.454)
Local Amenities		10.213*	5.078	11.207*
		(5.855)	(38.316)	(5.689)
Age				-0.966
				(0.687)
Age Squared				-0.006**
				(0.002)
League Varying Coefficients	No	No	Yes	No
Team FE	Yes	Yes	Yes	Yes
Observations	1,931	1,931	1,931	2,525

* p<0.10, ** p<0.05, *** p<0.010

Note: This table displays estimates of regressing income, sales, and property tax rates on team winning percentage between 1995 and 2017. Income Tax Rates is the top state marginal income tax rate. Sample for columns (1) through (3) exclude expansion teams since 1977, column (4) includes all teams. All specifications include league-by-year fixed effects. Column (3) includes league varying coefficients on population, income, and local amenities which are not shown. Population and income variables standardized by league-year. Local amenities estimates come from Albouy (2015).

Alternative Outcome Measures

Table A.2 displays results from estimating Equation2 when the outcome measure is an indicator for a team championship or finals appearance instead of regular season winning percentage. Across all four specifications and both outcome measures the negative and mostly statistically significant relationship between income tax rates and winning remains only in the free agency period, and only a minimal relationship between championships and tax rates exists in the early period.

Table A.2: Income Tax Rates and Championships

	(1)	(2)	(3)	(4)
Championship				
Tax Rate	0.011	0.021	0.006	0.067
	(0.341)	(0.337)	(0.362)	(0.326)
Free Agency × Tax Rate	-0.349	-0.386	-0.491*	-0.390*
	(0.217)	(0.243)	(0.251)	(0.217)
Finals Appearance				
Tax Rate	-0.254	-0.263	-0.330	-0.156
	(0.463)	(0.430)	(0.471)	(0.413)
Free Agency × Tax Rate	-0.656**	-0.756**	-0.765***	-0.722**
	(0.240)	(0.280)	(0.262)	(0.264)
Controls	No	Yes	Yes	Yes
League Varying Coefficients	No	No	Yes	No
Observations	3,457	3,457	3,457	4,129

* p<0.10, ** p<0.05, *** p<0.010

Note: This table displays estimates of regressing income tax rates on team championships and finals appearances (in percentage points) between 1995 and 2017. Income Tax Rates is the top state marginal income tax rate. Sample for columns (1) through (3) exclude expansion teams since 1977, column (4) includes all teams. All specifications include league-by-year fixed effects. Column (3) includes league varying coefficients on population, income, and local amenities which are not shown. Population and income variables standardized by league-year. Local amenities estimates come from Albouy (2015).

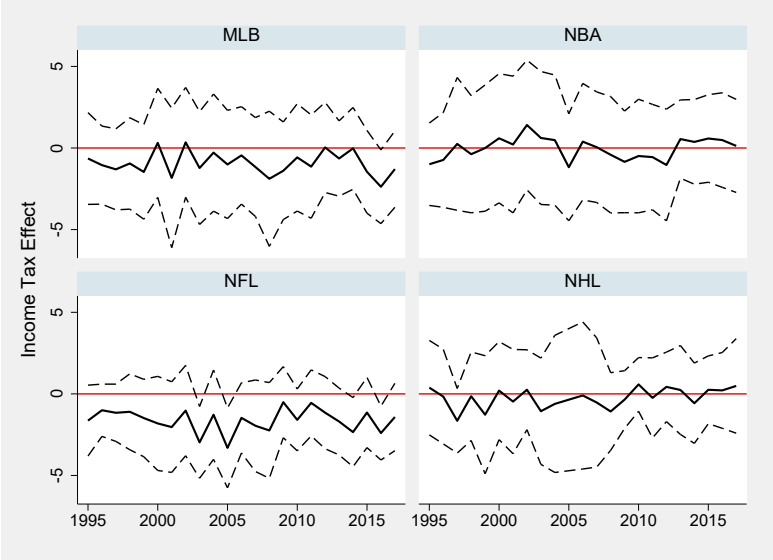
Table A.3: NBA Player Salary and Value, 1995-2017

	(1)
WAR	1,518***
	(47)
Observations	4,510

* p<0.10, ** p<0.05, *** p<0.010

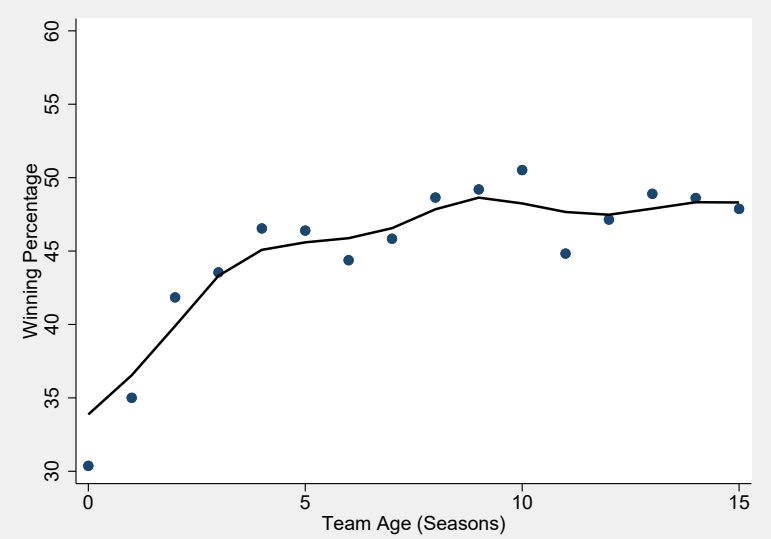
Note: This table presents results from regressing NBA player value, WAR, on salary between 1995 and 2014. Year fixed-effects not shown. Sample excludes players with less than four years experience. A guide to the definition and interpretation of the player value statistic can be found here: `http://www.sonicscentral.com/warp.html`.

Figure A.1: State Income Tax Effect On Team Winning Percentage, by League



Source: Author's calculations based on data from SportsReference.com.
Note: This figure displays point estimates and 95% confidence intervals from regressing income tax rates on winning percentage by league and year for 1995 to 2017. Control variables include league-specific MSA average income, population, amenities, and franchise age.

Figure A.2: Franchise Age and Team Winning Percentage, 1977-2017



Source: Author's calculations based on data from SportsReference.com.

Note: This graph displays the average winning percentage of teams by the number of years the franchise has existed for NBA, NFL, MLB, and NHL teams 1977-2017. Teams changing locations remain the same franchise.