International Tax and Public Finance
https://doi.org/10.1007/s10797-021-09685-y

State income taxes and team performance

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Accepted: 26 June 2021

Abstract
Professional athletes are both highly paid and highly mobile workers. Previous research has shown that athletes respond to state income taxes differentials through bargaining and migration. If athletes are compensated for state tax burden, teams located in higher taxed states may be at a competitive disadvantage. I examine the effect of state income taxes on professional sports team performance. Using within-team variation in state top marginal income tax rates, I show that, only after the availability of free agency, did state income tax increases lower team winning percentages. I find that for each percentage point increase in state income tax rates, team winning declines by 0.70 percentage points.

Keywords Income tax · Tax incidence · Mobility · Sports

JEL Classification H23 · Z23

1 Introduction

Do higher state income taxes harm firms? Income taxes are levied on households, but as Wallace (1993) shows state income tax incidence depends on the mobility elasticity of capital relative to labor. This paper examines the state income tax burden in a unique market, professional sports, where teams—the capital in question—are highly immobile and players—the labor—are highly mobile to test whether higher state income tax hinders team performance.

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Published online: 31 July 2021

Anecdotal evidence suggests higher state income taxes disadvantage professional sports teams. Across the four major US sports leagues, 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]

This is the first paper to examine the income tax effect on professional sports team performance, but it builds on several papers looking at income taxes and sports. Perhaps the most closely related work is Kleven (2013), which studies soccer player mobility in response to variation in top marginal income tax rates across countries. Kleven (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 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 Robert (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 Daniel (2014) reports a high elasticity of mobility among star scientists in response to state income tax rates. Moretti and Wilson (2017) 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.[2] 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 works, 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).

[1] Nine states have no income tax. I use the nine states with the highest top marginal income tax rate for the comparison group. A long championship drought is defined as 25 years or longer; the analysis includes US teams only. The list of teams with long droughts is drawn from https://www.businessinsider.com/longest-championship-droughts-pro-sports-2017-8.

[2] Technically, Moretti and Wilson (2017) utilize 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 property tax burden in the location decision, although robustness checks confirm that inclusion of sales and property tax rates do not affect results.

To test the link between state income taxes and team performance, this paper analyzes team performance in the four major US professional sports leagues: the National Basketball Association (NBA), the National Football League (NFL), the National Hockey League (NHL), and Major League Baseball (MLB). To address concerns that the association between team performance and income tax rates may be coincidental, I examine how the tax rate effect changed with the adoption of free agency. Achieving 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.[3] Team competition over players is crucial because it allows players to shift the income tax burden onto teams.

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, then higher tax rates could boost team performance. Teams could also increase payroll to help compensate for the increased tax burden, although this response is often limited by league salary cap rules. Alternatively, teams may offset higher taxes by increasing spending on other inputs, such as coaching, scouting, or team amenities, to offset the reduction in player quality. However, in a competitive league, teams with a persistent disadvantage would likely be expected to perform worse on average.

I compare the link between tax rates and team winning percentage before and after the introduction of free agency in each league using within-team variation in top state marginal income tax rates. Prior to free agency, there was a small positive association between income tax rates and winning. After the introduction of free agency, changes in state income tax rates significantly influence team performance. Each percentage point increase in the top marginal income tax rate is associated with a 0.70 percentage point decrease in win percentage. The tax rate effect on team performance is robust to a variety of specifications, such as controlling for sales and property taxes or alternative tax rate measures. Changing the outcome measure to be championships or finals appearances also yields similar results.

The estimated effect size is non-trivial. The main analysis effect size of − 0.70 means that a one standard deviation increase in tax rate will result in 2.05 fewer wins over an 82 game season.[4] Translating the reduction in team performance into player value on the free agent market and comparing to expected team tax burden reveals that most of the state income tax incidence is borne by teams.

[3] 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.

[4] Both the NBA and the NHL play 82-game seasons. MLB plays a 162-game season, and the NFL plays a 16-game season. Full sample tax rate standard deviation is 3.58.

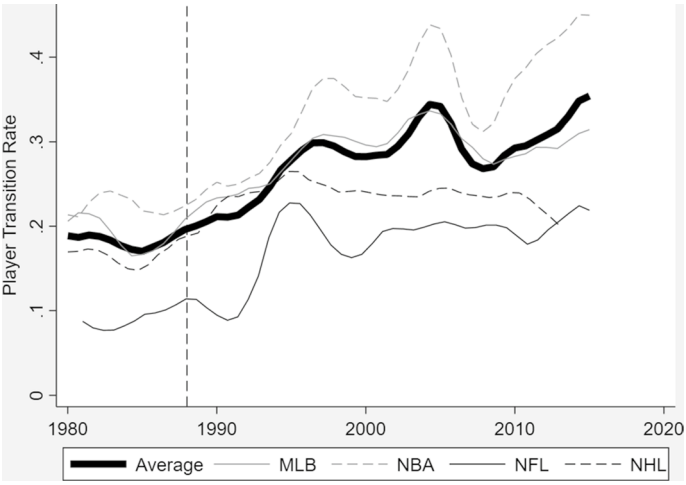

Fig. 1 Player transition rates by league. *Source*: Author's calculations based on data from SportsReference.com. *Notes:* This figure displays the rate of player movement between teams each year by league. Sample is among players with at least 4-year experience and active in both the current and previous year. Dotted line is in 1988, the first year of free agency for any league in the sample (MLB)

2 Summary of theoretical model

State income tax rates could affect team performance if players shift the income tax burden to teams. As discussed in Wallace (1993), the incidence of differential state income taxes can be determined using a general Harberger (1962) model allowing taxes to affect the various factors of production given in McClure (1970). A main implication of the model is that the incidence of income taxation borne by the labor market (in this case, the athletes) depends on the elasticity of labor mobility relative to the elasticity of capital.

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, player mobility was low because collective bargaining agreements gave teams monopsony power to negotiate contracts. However, in the late 1980s and early 1990s, player unions were able to successfully push for unrestricted free agency, or the ability to negotiate contracts with any team.[5] Prior work has shown that free agency increased player negotiating power, compensation and competitive balance in professional sports (Lee, 2010; Leeds and Kowalewski, 2001; Larsen et al., 2006; Hakes and Sauer, 2006).

Free agency greatly increased player mobility, as can be seen in Fig. 1. Currently, 37% of players change teams each season compared to 19% in 1980. Conversely,

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

franchises cannot easily change locations and rarely do so. Since 1990, there have been sixteen franchise relocations, making the annual mobility rate 0.5%. While measuring precise mobility elasticities with respect to income is challenging for both players and franchises, players are clearly more mobile than teams in professional sports.

Another aspect of professional sports to consider 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 means that team investment will depend on the local ticket price demand. In turn, areas with greater population and with higher incomes are expected to invest more in their teams (i.e. higher team salaries).

Finally, in professional sports the competition between teams is to produce a zero-sum good: wins. Professional sports leagues strictly regulate both the number of 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), I consider only the relative values of team inputs.

The relatively elastic mobility of athletes compared to teams 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. Prior 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. Similar results of tax burden compensation have been found by Kopkin (2012) and Ross and Robert (2007). Given this relationship, teams in high-tax states may face the choice of increasing payroll or winning fewer games.

3 Empirical model

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

$$Y_{ijst} = \beta_0 + \beta_1 \tau_{st} + \beta_2 \tau_{st} \times FA_{jt} + \beta_3 X_{ijst} + \gamma_i + \delta_{jt} + \epsilon_{ijst} \quad (1)$$

The win percentage, Y_{ijst} for team i in league j, state s, and year t is modeled as a function of the top state marginal income tax rates, τ_{st}, an indicator variable, FA_{jt}, equal to one if the league allowed free agency, and other team characteristics, X_{ijst}, including metro-area population, average income, and amenity values. Equation 1 includes team fixed effects, γ_i, and league-by-year fixed effects, δ_{jt}.

In Eq. 1, the coefficient β_1 represents the relationship between income tax rates, τ_{st}, and win percentage prior to the introduction of free agency. The coefficient β_2 represents the change in the relationship between income tax rates and win percentage after free agency is introduced. Both β_1 and β_2 are identified from within-team variation in income tax rates over time. This variation can come either from changes in state income tax rates or from team relocations between states.

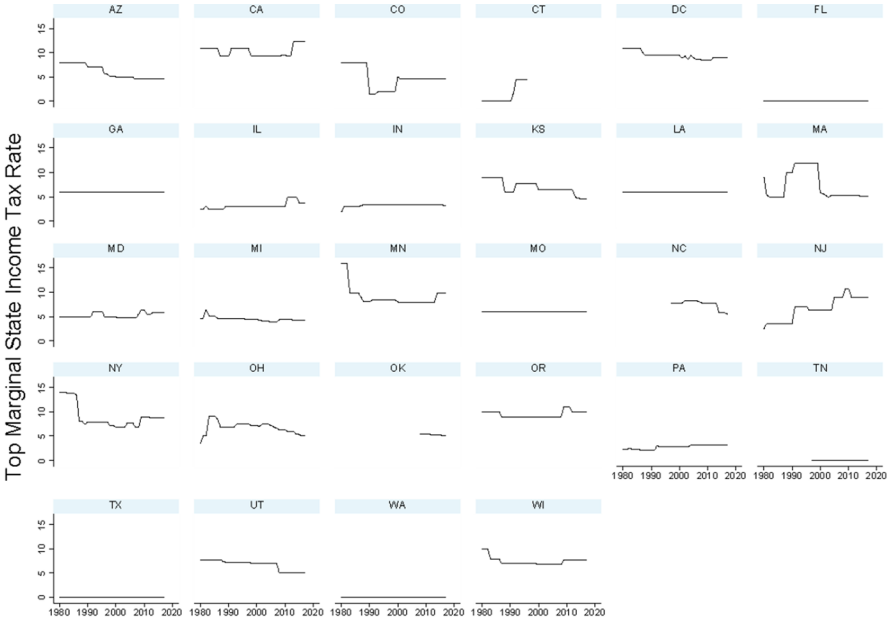

Fig. 2 Top state statutory marginal income tax rates, 1980–2017. *Source*: The Council of State Governments: "The Book of the States", 1980–2017. *Notes* This figure displays the top state statutory marginal income tax rate on earned income. Sample restricted to years in which each state had at least one professional sports team

Assuming that free agency allowed players to negotiate compensation for state income tax differentials, the coefficient on the interaction of the free agency indicator variable with income tax rate, β_2, reveals the effect of state income taxes on team performance. This interpretation assumes that the process for determining state income tax changes remained constant over time.

Equation 1 is also estimated removing team fixed effects (γ_i) and removing team characteristics (X_{ijst}). Changes in β_2 across these specifications reveal how allowing for cross-sectional variation and observable characteristics influence the income tax rate effect.

4 Data

To determine the income tax rate effect on winning, I compare top statutory state marginal income tax rates to professional sports team performance data. Top state marginal income tax rate data from 1980 to 2017 come from the publication *The Book of the States* produced by the Council of State Governments. Figure 2 shows the top marginal income tax rate across states that have professional sports teams. Using top marginal income tax rates follows previous work on state mobility of high earning households, such as Kleven (2013) and Moretti and Wilson (2017), which focus on top marginal income tax rates to describe state policy regimes. Between

1980 and 2017, the average top marginal tax rate is 5.7%. 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%, followed by Oregon at 9.9% and Minnesota at 9.85%.

I assign players the state income tax associated with the team location. In general, states tax resident income regardless of the state it was earned in. Additionally, states may require workers to pay income taxes in the state it was earned (DiMascio, 2006). Exceptions to state income taxes come from bi-lateral state reciprocity agreements. Currently 17 states (10 with professional sports teams) have a reciprocity agreement with at least one other state, where residents that work in another state only pay income tax in the home state. These agreements are typically limited to metro areas that cross state borders such as Cincinnati (Ohio, Kentucky, and Indiana) and Minneapolis (Minnesota and Wisconsin). No state without an income tax has a reciprocity agreement and most reciprocity states have similar income tax rates so result in minimal tax avoidance. Without a reciprocity agreement, players working in one state and residing in another must pay income taxes in both states. Players' other sources of income, such as that from endorsements, are subject to income tax of the player's state of residence, raising the potential tax burden teams may have to compensate players for beyond their team contract salary.

Income earned in games played in the player's home state is taxed only by the home state, but income earned in road games can be taxed by both the residence state and the road game state. Most states currently administer a "jock tax", where nonresident athletes playing road games must consider part of their salary earned in the road team's state, so players often must file many state income taxes each year (DiMascio, 2006; Green, 1998). Some states exempt players from the jock tax if salaries are below a minimum threshold or minimum number of games played in the state (Fratto, 2007). Several states offer a credit for out-of-state income tax payments, but for a majority of states the jock tax adds to the resident state income tax burden (DiMascio, 2006).

Jock taxes impose both a significant cost and nuisance on players and teams, but only minor team variation in the expected jock taxes exists since the distribution of opponent states is similar across teams. To verify this, I computed expected road game taxes for MLB, NBA, and NFL teams based on opponent top marginal tax rates and season schedules. The standard deviation of expected road team tax burden across teams within the same league is 0.14%. The standard deviation of expected road team tax burden across teams within the same metro area but differing leagues is similarly small at 0.12%. This is one-sixteenth of the overall within league-year state income tax standard deviation of 1.99%. Incorporating state jock tax regulations may alter the jock tax differentials, but are unlikely to be large enough to significantly affect behavior. Further, the effective tax rate players pay in non-resident states is unclear. Since only a small portion of their income is subject to the tax for

each state, the effective tax rate is well below the top marginal rate for states with progressive income tax rates. Due to the limited variation, effective rate complexity, and potential salience issues, I ignore jock taxes in my income tax calculations.

Team performance is assessed using regular season data on wins and losses (or points, in hockey).[6] I also explore alternative outcome measures, such as championships or finals appearances. Historical team records for the MLB, NFL, NBA, and NHL are collected from Sports-Reference (http://www.sports-reference.com/).

Inherent league differences require adjustments to make winning comparable. For example, the winning percentage distribution is more diffuse in NBA, with a win percentage standard deviation of 15.66, compared to the MLB win percentage standard deviation of 7.1. These differences mean that an equally sized win percentage increase is more difficult to achieve in MLB relative to the NBA. To make team win percentage comparable across leagues, I adjust each league winning percentage to have a mean of 50 and a standard deviation of 15.66.[7] To avoid complications arising from including expansion teams, which often take many years to become competitive, the sample is restricted to teams in existence by 1980.[8] I also exclude Canadian teams as complications from the differential tax systems, lack of comparable amenity measure, and purchasing power differences make direct comparisons to US-based teams difficult (Fratto, 2007). Including Canadian teams would likely strengthen the income tax effect as the average Canadian team faces a 2.5% higher combined federal and state/provincial income tax rate and has a 1.8% lower winning percentage.

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 which I will control for. Annual average income data come from the Bureau of Economic Analysis, and metropolitan-area population estimates come from the US Census Bureau. Due to their skewed distributions I log the income and population variables. Because winning is a zero-sum outcome, control variables are standardized by league-year for interpretability. 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 matter for team performance—higher amenities may reduce labor cost. In a standard location-choice labor market model 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. Higher amenity values could serve as a bargaining advantage when teams are enticing free agents. A player who values warm weather may sacrifice some salary to play in a place like Miami, FL, rather than Buffalo, NY. Players on a Buffalo-based team do not have to reside in the location year-round and

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

[7] The standard deviation of 15.66 sets the NBA as a benchmark. The MLB win percentage standard deviation is 7.1, the NHL is 20.7, and the NFL is 19.5.

[8] Beginning in 1980 allows inclusion of teams from both the ABA-NBA and the NHL-WHA mergers.

Table 1 Franchise summary statistics

	1980–1988		1989–2017	
	(1)	(2)	(3)	(4)
	High tax	Low tax	High tax	Low tax
Winning percentage	51.12	48.50	49.90	52.24
	(14.68)	(15.76)	(14.80)	(15.09)
Tax rate	10.28	2.98	8.74	3.30
	(2.24)	(2.21)	(1.62)	(2.15)
Population	− 0.02	0.02	0.17	− 0.00
	(1.19)	(0.73)	(1.27)	(0.69)
Income	0.35	− 0.34	0.45	− 0.25
	(1.08)	(0.74)	(1.14)	(0.71)
Local amenities	0.44	− 0.40	0.46	− 0.39
	(1.05)	(0.69)	(1.07)	(0.72)
Observations	387	405	1200	1394

High and low tax franchises defined in relation to the median state top marginal tax rate for time period, which is 6.00% for both periods. Log population and log income variables standardized by league-year. Tax rates are top statutory marginal state income tax rates. Local amenity estimates come from Albouy (2015)

could enjoy amenities of other locations during the season. However, this behavioral response should decrease the magnitude of estimated team amenity effects. While amenity values cannot be observed directly, Albouy (2015) estimates MSA-level amenity values indirectly using local wages, population, and home values. This estimate provides a static measure of amenity values, but many amenity value components, such as climate and terrain, are fixed characteristics. Alternative estimates of local amenities exist such as Desmet and Rossi-Hansberg (2013). To verify that the main results are not altered by the amenity measure choice, Appendix Table 9 displays results substituting in the Desmet and Rossi-Hansberg (2013) measure in place of the Albouy (2015) measure. Additionally, because professional athletes may value local amenities differently than the general population, Appendix Table 9 also includes 23 amenity component variables utilized in Desmet and Rossi-Hansberg (2013) in place of the single aggregate amenity measure. These substitutions have only a minor effect on the tax rate effect estimates.

To identify the income tax effects on team performance, I utilize the introduction of unrestricted free agency into professional sports. Free agency provided a shock to player mobility, giving players leverage during contract negotiations. Unrestricted free agency was gained in collective bargaining agreements at different times for

Table 2 Income taxes, free agency, and team performance

	(1)	(2)	(3)	(4)	(5)
Tax rate	0.327	0.285	0.129	0.134	0.217
	(0.219)	(0.229)	(0.314)	(0.329)	(0.348)
FA × tax rate	− 0.659**	− 0.684**	− 0.702**	− 0.701**	− 0.831***
	(0.262)	(0.263)	(0.283)	(0.281)	(0.272)
Population		0.054		0.966	
		(0.653)		(2.423)	
Income		0.033		− 1.316	
		(0.752)		(0.931)	
Local amenities		0.400		− 1.525	
		(0.727)		(2.068)	
Team FE	No	No	Yes	Yes	Yes
Mean tax rate	5.986	5.986	5.986	5.986	5.986
Observations	3386	3386	3386	3386	3386

*$p < 0.10$; **$p < 0.05$; ***$p < 0.010$

This table displays estimates of regressing tax rates interacted with whether the league allowed free agency on team winning percentage between 1980 and 2017. Robust standard errors clustered at the team level. All specifications include league-by-year fixed effects. Tax rate is the top statutory marginal state income tax rate. Sample excludes expansion teams since 1980. First years for free agency are 1988 for MLB and NBA, 1993 for NFL and 1995 for NHL. Population, income, and amenities variables standardized by league-year. Column (5) includes league-specific covariates. Local amenities estimates come from Albouy (2015)

each league. MLB and the NBA were the earliest leagues to adopt free agency in 1988, while the NFL followed in 1993 and the NHL in 1995.[9]

Table 1 displays summary statistics of professional teams between the sample period of 1980 and 2017. The table is split by the pre-free agency period of 1980–1988 and the post-free agency period of 1989–2017, and by if the team is in an above or below median state tax rate. The difference in average tax rates between high tax and low tax teams decreases across periods, from 7.30 for the early period to 5.44% for the later period. This difference in winning between periods flips from higher tax states winning 2.62% more often in the early period to losing 2.34% more often in the later period. While teams in low tax states have lower incomes and amenities than teams in high tax states, differences in these and other covariates remain similar across time periods.

[9] Prior work in NFL free agency effects such as Lee (2010), Leeds and Kowalewski (2001), and Larsen et al. (2006) similarly focus on 1993. Zimbalist (2002) cites 1995 as the first year of unrestricted free agency in the NHL. MLB unrestricted free agency officially began in 1976. I use 1988 due to collusion cases that were brought, and won, by players between 1985 and 1987. Tom Chambers became the first NBA free agent signing with the Phoenix Suns in 1988.

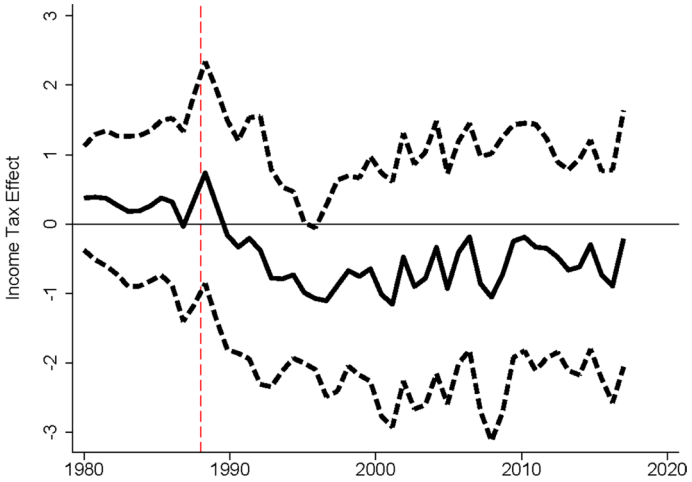

Fig. 3 Income tax effect on team performance, by year. *Source*: Author's calculations based on data from SportsReference.com. *Note:* The solid thick line displays annual income tax rate effects by year for 1980–2017. The associated 95% confidence intervals are dotted lines. The dotted vertical line is in 1988, the first year of free agency for any league in the sample (MLB). All specifications include league-by-year and team fixed effects. Control variables include MSA average income, population, and amenities

5 Results

Using a team fixed-effects framework, I estimate the effect of state income taxes on professional sports team performance by comparing the change in the relationship between taxes and winning in the pre-free agency and post-free agency eras in professional sports. The consistency of the income tax effect is then examined by estimating the model separately for each league. Robustness checks test how alternate tax rate and performance measures alter the income tax effect size. Lastly, sales and property taxes are incorporated to allow for a more comprehensive measure of state tax burden. All specifications cluster robust standard errors at the team level.

Table 2 displays results from Eq. 1, which estimates the income tax rate effect on team performance using variation across time in the relationship between taxes and winning before and after the introduction of free agency for each league. Columns 1 and 2 include league-year fixed effects, while Columns 3 and 4 add team fixed effects to isolate the tax rate effect using within-team variation. Column 5 allows for league-specific covariate coefficients. Prior to free agency, within-team changes in tax rates were associated with positive and statistically insignificant changes in winning percentage, with coefficient estimates ranging between 0.129 and 0.327. This means that when player mobility was restricted, there was only a weak and even positive correlation between income tax rates and team performance.

Following the introduction of free agency, the relationship between taxes and winning changed starkly. Column 3 of Table 2, which includes team fixed effects but no other covariates, shows that following free agency each percentage point increase in the top state marginal income tax rate was associated with a 0.702 percentage point decrease in the team regular season winning percentage. Controlling

Table 3 Income tax rates, free agency, and team performance, by league

	MLB		NBA		NFL		NHL	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Tax rate	− 0.846*	− 0.775	0.492	0.498	− 0.832	− 0.749	1.145*	1.343**
	(0.428)	(0.459)	(0.797)	(0.887)	(0.517)	(0.515)	(0.612)	(0.626)
FA × tax rate	− 0.263	− 0.536	− 0.608	− 0.514	− 0.940**	− 1.087***	− 1.551*	− 1.577**
	(0.436)	(0.445)	(0.727)	(0.754)	(0.437)	(0.386)	(0.784)	(0.715)
Population		4.732		4.032		− 5.193		8.246***
		(5.528)		(6.226)		(4.512)		(2.536)
Income		− 1.644		0.343		0.115		− 1.124
		(1.615)		(1.956)		(1.888)		(1.834)
Local amenities		28.893		− 3.056		− 9.112*		− 0.662
		(18.114)		(2.944)		(5.266)		(12.928)
Team FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	925	925	836	836	1064	1064	561	561

*$p < 0.10$; **$p < 0.05$; ***$p < 0.010$

This table displays estimates of regressing tax rates interacted with whether the league allowed unrestricted free agency on team winning percentage between 1980 and 2017, by league. Robust standard errors clustered at the team level. All specifications include league-by-year fixed effects. Tax rate is the top statutory marginal state income tax rate. Sample excludes expansion teams since 1980. First years for free agency are 1988 for MLB and NBA, 1993 for NFL and 1995 for NHL. Population, income, and amenities variables standardized by league-year. Local amenities estimates come from Albouy (2015)

for team characteristics in Column 4 only marginally changes this tax rate effect to 0.701, with both specifications being statistically significant at the 95% confidence level. This estimate implies that a one standard deviation increase in the state tax rate (3.58%) would project a 2.45 percentage point decline in team winning percentage or 2.05 games over an 82 game season.[10] Considering an extreme case, the recent relocation of the Oakland Raiders from a high income tax state (California) to a no income tax state (Nevada) projects a winning percentage increase of 8.6 percentage points or about 1 game per NFL season.

To further understand the evolution and variation in the income tax effect, I estimate Eq. (1) separately by year and by league. Figure 3 presents the annual point estimates (β_2) and 95% confidence intervals of the income tax rate effects between 1980 and 2017. Though in no single year is the income tax effect statistically different from zero, in all 9 years prior to any league having free agency, there was a positive income tax effect estimate. This relationship changed shortly after the introduction of free agency and since 1990 the annual income tax effect has remained negative.

[10] Appendix Table 10 displays an analogous table using team-by-state fixed effects and standard errors. Results are quite similar to team fixed-effects model.

Table 3 displays coefficients from estimating Eq. 1 separately by league both with and without team covariates. In the pre-free agency period, both the NBA and NHL reveal a positive association between taxes and winning, while the NFL and MLB reveal a negative association. However, for all four leagues the introduction of free agency has a strong negative change on the relationship between income taxes and team performance. The income tax effect is only statistically significant in the NFL and NHL but is of similar magnitude or larger than the pooled estimate for all specifications. The consistent negative association of changes in income tax rates and decreased winning for all four leagues following free agency helps to validate the pooled sample estimates.

While each league reveals a negative income tax effect, there is cross-league variation in the estimated effect size with the NHL income tax effect triple that of the NBA or MLB. As previously mentioned, Wallace (1993) suggests that the tax incidence depends on the mobility elasticity of players. One indicator of player mobility elasticity may be whether they are US or foreign born. US-born players may be more mobility inelastic for family, social, or cultural attachments. The high percentage of foreign-born players in the NHL (72%) may contribute to the high NHL income tax effect as the NFL (3%), MLB (29%) and the NBA (23%) have a relatively small share of foreign-born players.[11]

Leagues vary on a number of other dimensions that may affect income tax effects, such as average player salary, salary cap and free agency rules, arbitration, and contract restrictions on maximums, minimums, and length. Separately identifying the effect of each factor is challenging because there are more policy dimensions than leagues and few within-league changes. Average player salary could alter the income tax effect as greater income may affect the relative important of tax burden to other factors such as local amenities or social ties. The league-specific income tax effect sizes are nearly in reverse order of average player salary, with the NHL having the lowest paid players, followed by the NFL, MLB, and the NBA. Having a salary cap should predict an increase in the income tax effect since it limits the ability of higher taxed teams to compensate by increasing total payroll. MLB is the only league without a salary cap, yet has the lowest estimated income tax effect. However, MLB substitutes a salary cap with greater revenue sharing which can have a similar effect on team spending (Zimbalist, 2002, 2010).

The proposed mechanism through which income taxes affects winning is that teams must compensate players for state tax burden and this lowers the marginal product (player quality) of spending for teams in higher tax states. The average payroll for MLB and NBA during this period is $93 and $68 million. If the full incidence of the state tax burden is borne by teams, then each percentage point increase in income taxes costs $0.93 and $0.68 million; however, if state taxes are fully deductible at the top federal tax rate, these increases drop to $0.59 and $0.43 million.

[11] https://www.forbes.com/sites/stuartanderson/2020/07/27/immigrant-players-steal-bases-and-basketballs-not-jobs.

Table 4 MLB and NBA player salary and wins above replacement

	MLB	NBA
WAR	1009***	1814***
	(32)	(79)
Observations	8467	2525

*$p < 0.10$; **$p < 0.05$; ***$p < 0.010$

This table presents results from regressing MLB and NBA player value, wins above replacement (WAR), on salary (in $000s) between 1995 and 2014. Player salary data comes from https://www.eskimo.com/~pbender/ for the NBA and http://www.seanlahman.com/baseball-archive/statistics/ for the NBA. Control variables include MSA population, income, and amenities. Year fixed-effects not shown. Sample includes only veterans with at least 4-year experience

Table 5 State income taxes rates and team performance, alternative tax measures

	State + Federal		NBER		3-Year MA	
	(1)	(2)	(3)	(4)	(5)	(6)
Tax rate	0.443	0.464	0.457	0.486	0.062	0.065
	(0.598)	(0.609)	(0.401)	(0.406)	(0.324)	(0.341)
FA × tax rate	− 1.198**	− 1.203**	− 0.633**	− 0.627**	− 0.741***	− 0.739***
	(0.467)	(0.464)	(0.301)	(0.296)	(0.281)	(0.279)
Population		1.115		1.308		0.862
		(2.331)		(2.336)		(2.447)
Income		− 1.326		− 1.264		− 1.080
		(0.924)		(0.928)		(0.934)
Local amenities		− 1.470		− 1.428		− 1.688
		(2.049)		(2.126)		(2.060)
Team FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean tax rate	43.263	43.263	5.780	5.780	6.014	6.014

*$p < 0.10$; **$p < 0.05$; ***$p < 0.010$

This table estimates the income tax effect on team winning percentage using alternative tax rate measures. Robust standard errors clustered at the team level. Columns (1) and (2) use the combined state and federal statutory tax rates and incorporates the deductibility of these rates from each other. Columns (3) and (4) use the alternative NBER measure of top marginal income tax rates. Columns (5) and (6) use a 3-year moving average of the statutory top state marginal tax rate.

Using the income tax estimates in Table 2, each percentage point increase in state taxes decreases winning percentage by 0.70 percentage points. For MLB, including the win percentage standard deviation adjustment, this translates into 0.45 wins and for the NBA this translates into 0.57 wins. Alternatively, from the league-specific results in Table 3, a state tax increase in MLB results in 0.40 fewer wins and 0.42 fewer wins in the NBA. If a state tax increase costs MLB and NBA teams $0.59 and $0.43 million and lowers wins by 0.45 and 0.57 wins, the implied cost-per-win

estimate is $1.32 million and $0.76 million or $1.48 million and $1.02 million with the league-specific results. These cost-per-win numbers are lower-bound estimates if state taxes are not fully deductible due to the alternative minimum tax and could be up to 33% higher if state taxes are fully non-deductible. Similarly, if team location affects taxation on additional player income, such as endorsements or investment, these cost estimates would be understated.

I compare my estimated income tax effect to the relationship between player value and salary on the free agent market. Two leagues, MLB and the NBA, have created measures that translate player statistics into a value metric known as Wins Above Replacement (WAR), or the expected change in team wins the player provides. To estimate the cost-per-win price on the player free agent market, Table 4 regresses WAR on free-agent player salaries, controlling for other team characteristics. I find that each additional win a player provides is associated with a salary increase of $1.01 million in MLB and $1.81 million the NBA. Compared to the income tax based estimates of $1.48 million and $1.02 million, this comparison suggests the income tax findings are plausible and that teams may bear the full burden of state income tax burden. However, the precision on the team tax burden share is too wide to draw strong conclusions on the incidence share.

5.1 Robustness

While using the top statutory marginal income tax rate is a common measure of state income tax burden for high-earning individuals, Columns (1) through (4) of Table 5 test the robustness of the income tax effect on team performance by estimating Eq. 1 using alternative measures of state tax burden.

The interplay of state and federal income taxes is complicated. Several states allow for deduction of federal income taxes. State income taxes are deductible from federal income taxes if the household itemizes deductions. However, the full amount of state taxes may not be federally deductible because of the alternative minimum tax. The alternative minimum tax affects high-earning households and imposes a minimum tax rate households must pay regardless of claimed tax deductions. Athletes that claim enough deductions to trigger the alternative minimum tax will have the value of state tax deductibility eroded and potentially erased depending on their total deduction amount.

Alternatively, to account for tax code complexity, the NBER provides a measure of maximum state income tax rates. This NBER rate is the simulated marginal income tax rate on an additional $1,000 dollars of income for very high earners.[12] While similar to statutory top marginal income tax rates, the NBER income tax rate captures tax policy complexity arising from variation in treatment of deductions and tax bracket levels.

Columns (1) and (2) of Table 5 incorporate both federal and state tax deductibility with a combined top federal and state marginal tax rate measure. Columns (3)

[12] Specifically, for a married household earning $1,500,000.

Table 6 Income tax rates and championships

	Championships		Finals	
	(1)	(2)	(3)	(4)
Tax rate	0.037	0.038	− 0.070	− 0.103
	(0.252)	(0.261)	(0.350)	(0.342)
FA × tax rate	− 0.521**	− 0.520**	− 0.564	− 0.592*
	(0.239)	(0.244)	(0.340)	(0.329)
Population		− 0.024		− 1.491
		(0.973)		(1.717)
Income		0.195		− 1.782
		(0.755)		(1.447)
Local amenities		− 0.035		− 1.144
		(1.133)		(1.780)
Team FE	Yes	Yes	Yes	Yes
Observations	3386	3386	3386	3386

*$p < 0.10$; **$p < 0.05$; ***$p < 0.010$

This table displays estimates of regressing income tax rates interacted with whether the league allowed free agency on team championships and finals appearances (in percentage points) between 1980 and 2017. Robust standard errors clustered at the team level. Tax rate is the top state statutory marginal income tax rate. Sample excludes expansion teams since 1980. All specifications include league-by-year fixed effects. Population, income, and amenities variables standardized by league-year. Local amenities estimates come from Albouy (2015)

and (4) use the NBER maximum state income tax measure. Both of these alternative tax rate measures yields statistically significant and similar results to the primary specification in Table 2. While the point estimates for the combined federal and state tax rate are higher relative to the state income tax measures, this is due to scaling. That is, for each percentage point increase in the state income tax rate, the state plus federal measure will only increase by about 0.6 percentage points since this state tax will be deductible at the 39.5 marginal income tax rate. Comparing estimates while adjusting for the deductibility, each percentage point increase in state income tax rates lowers team win percentage by 0.73 in Column (2). This is quite similar to the NBER estimate of 0.63 in Column (4), and the statutory state tax estimate of 0.70 in Column (4) of Table 2. The consistency of the tax rate effect across these three measures shows that assumptions about deductibility or effective tax rates paid by high earners do not significantly alter the main findings.

Changes to state income taxes may take several years to filter into team performance due to multi-year player contracts or tax salience. Columns (5) and (6) of Table 5 account for this dynamic tax effect by including a 3-year moving average of state income tax rates. This dynamic tax effect increases the magnitude of the tax rate effect by about 20% while maintaining its statistical significance.

Another concern may be that regular season winning percentage may not be the best measure of team performance since the primary goal of each team is to

Table 7 Income, sales, and property tax rates and team performance

	(1)	(2)	(3)	(4)
Tax rate	0.148	0.145	0.315	0.353
	(0.316)	(0.329)	(0.463)	(0.464)
FA × tax rate	− 0.715**	− 0.706**	− 0.728*	− 0.711
	(0.298)	(0.295)	(0.416)	(0.428)
Sales tax	0.606	0.564	2.311*	2.157*
	(1.003)	(0.985)	(1.281)	(1.280)
FA × sales tax	− 0.433	− 0.311	− 1.159	− 1.075
	(0.912)	(0.908)	(1.189)	(1.176)
Property tax			1.517	1.275
			(2.700)	(2.578)
FA × property tax			− 1.636	− 1.235
			(1.638)	(1.566)
Population		0.878		4.593
		(2.414)		(4.313)
Income		− 1.268		− 0.756
		(0.928)		(1.044)
Local amenities		− 1.799		10.234
		(2.096)		(11.803)
Team FE	Yes	Yes	Yes	Yes
Observations	3386	3386	2250	2250

*$p < 0.10$; **$p < 0.05$; ***$p < 0.010$

This table displays estimates of regressing income and sales tax rates interacted with whether the league allowed free agency on team winning percentage between 1980 and 2017. Robust standard errors clustered at the team level. Income Tax rate is the top state marginal income tax rate. City-level property tax rates from the Lincoln Land Institute 50-State Property Tax Comparison Study, 1992–2013. Population and income variables standardized by league-year. Local amenities estimates come from Albouy (2015)

win a championship. Table 6 addresses this concern by estimating Eq. (1) using a binary indicator for whether a team either won a championship or made it to the finals as the outcome variable. This change results in very similar results. Prior to the introduction of free agency, there was a negligible relationship between state income tax rates and championships. Following the introduction of free agency, each percentage point increase in top state marginal income tax rates decreased the likelihood of winning a championship and finals appearance by 0.52 and 0.59 percentage points, respectively.

This paper focuses on top marginal income tax rates because of its size and salience to both players and teams. However, players may consider a more comprehensive accounting of the expected state tax burden when negotiating contracts and selecting teams. Sales taxes follow income taxes as the largest source of state tax revenue, while property taxes account for the largest share of local (city and county) tax revenue. State and local governments might offset decreases

Table 8 Income taxes, free agency, and team performance alternative free agency timing

	(1)	(2)	(3)	(4)	(5)
Tax rate	0.334*	0.284	0.115	0.127	0.154
	(0.163)	(0.194)	(0.320)	(0.332)	(0.359)
FA (phase-in) × tax rate	− 0.729***	− 0.755***	− 0.756***	− 0.743***	− 0.978***
	(0.256)	(0.261)	(0.236)	(0.246)	(0.262)
Tax rate	0.231	0.182	0.059	0.072	0.108
	(0.155)	(0.189)	(0.342)	(0.354)	(0.391)
FA (alternate) × tax rate	− 0.591**	− 0.609**	− 0.547**	− 0.532**	− 0.768***
	(0.223)	(0.225)	(0.227)	(0.240)	(0.270)
Team FE	No	No	Yes	Yes	Yes

*$p < 0.10$; **$p < 0.05$; ***$p < 0.010$

This table displays estimates of regressing tax rates interacted with whether the league allowed free agency on team winning percentage between 1980 and 2017. Robust standard errors clustered at the team level. All specifications include league-by-year fixed effects. Tax rate is the top statutory marginal state income tax rate. Sample excludes expansion teams since 1980. Rows 1 and 2 use the first years for free agency are 1988 for MLB and NBA, 1993 for NFL and 1995 for NHL, equally phased in over 5 years. Rows 3 and 4 use the first years for free agency are 1995 for MLB and NBA, 1994 for NFL and 1991 for NHL. Column (5) includes league-specific covariates. Population, income, and amenities variables standardized by league-year. Local amenities estimates come from Albouy (2015)

in income tax rates with increases in sales and property tax rates. This would partially offset the expected tax burden from a location and bias our tax effect estimates towards zero if unaccounted for. In this sample, both sales tax and property taxes have a negative correlation of − 0.16 with the top marginal income tax rates. Sales and property taxes are important to consider when evaluating the total tax burden of a location, but may also be easier to mitigate than income taxes through shifting more consumption out of state or residing in lower-property tax cities or counties.

Columns (1) and (2) of Table 7 report results from estimating Eq. 1 while allowing sales tax rates to affect team performance differentially pre- and post-free agency. Similar to income taxes, the relationship between sales taxes and team performance is negatively correlated following the introduction of free agency, though the sales tax effect is half the size of the income tax effect and statistically insignificant. Columns (3) and (4) add property taxes to the estimation, though reduce the sample as effective property taxes are only available for a subset of cities in the 50-State Property Tax Comparison Study. Property taxes have a negative but statistically insignificant relationship with winning following free agency. All four specifications endorse the prior income tax effect magnitude though lose some statistical significance, ranging between − 0.706 and − 0.728.

I use the introduction of free agency in collective bargaining agreements in each league to identify the income tax effect on winning. One limitation of this approach is that because player contracts are typically several years long, the free agency effect should phase in over time. Rows 1 and 2 of Table 8 alter the free agency variable to phase in equally over 5 years since the initial free agency date. Alternatively, because subsequent collective bargaining agreements adjusted and expanded free

agent rights there may be disagreement over the exact date of free agency. Because free agency is used as a shock to player mobility, I test each league for the timing of a structural break in average player transition time-series, shown in Fig. 1. I find a structural break date of 1995 for MLB, 1995 for the NBA, 1994 for the NFL, and 1991 for the NHL. Rows 3 and 4 of Table 8 report income tax effect coefficients using this alternative free agency date. Both phasing-in free agency and the mobility-based free agency dates report similar income tax effects as Table 2.

6 Conclusions

Who bears the burden of state income taxation: capital or labor? In the context of professional sports, teams, as opposed to players, bear the bulk of state income taxation burden. Using within-team variation in top state marginal income tax rates, I show that each percentage point increase in state income taxes lowers team winning percentage by 0.70 percentage points. A key factor in determining the state income tax incidence is the competition among teams for players. Prior to free agency, the negative relationship between income taxes and winning did not exist.

While professional sports is a specialized market consisting of a highly mobile labor force and a highly immobile set of firms, these findings have important implications. A number of other markets, such as the market for physicians, star scientists, and CEOs also consist of high-earning and mobile workers that work for immobile firms such as hospitals systems, research laboratories, and factories. Policymakers in states which employ large numbers of these types of workers should consider that changes to income tax rates are more likely to be passed through to firms as opposed to being borne by high-earning workers.

For professional 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 Milwaukee, WI. This problem could be mitigated by adjusting the salary cap or revenue sharing agreements to account for income tax disparities.

Several avenues for future work seem particularly intriguing in light of these results. One question is investigating whether state taxes are reflected in franchise valuations. If teams consistently lose more in states with higher taxes, one might expect lower franchise values. However, state or local governments may end up bearing the tax burden if teams are able to negotiate increased subsidies, such as stadium financing or property tax relief. Second, a deeper investigation into the mechanisms driving cross-league differences in income tax effects could reveal the extent that teams mitigate higher income taxes by investing in alternative team inputs, such as coaches, scouting, front-office staff, or non-pecuniary benefits. Lastly, an interesting extension would be considering how income taxes affect teams' expansion or relocation choices, as several expansion teams have moved to low income tax

states.[13] A similarly interesting and plausible question is whether state income tax rates are capitalized into team value and absorbed by owners.

Appendix

See Tables 9 and 10.

Table 9 Income taxes, free agency, and team performance, alternative amenities

	(1)	(2)	(3)	(4)	(5)	(6)
Tax rate	0.327	0.334	0.328	0.129	0.132	0.239
	(0.219)	(0.229)	(0.458)	(0.314)	(0.330)	(0.502)
FA × tax rate	− 0.659**	− 0.663**	− 0.606	− 0.702**	− 0.706**	− 0.615
	(0.262)	(0.262)	(0.380)	(0.283)	(0.281)	(0.395)
Population		0.119	9.400*		1.010	1.148
		(0.656)	(5.437)		(2.467)	(5.965)
Income		− 0.107	− 1.024		− 1.871	− 1.687
		(0.674)	(1.351)		(1.163)	(1.343)
Local amenities		− 0.439			0.022	
(Desmet and Rossi-Hansberg)		(0.673)			(1.614)	
Team FE	No	No	No	Yes	Yes	Yes
Individual amenities	No	No	Yes	No	No	Yes
Observations	3386	3386	2043	3386	3386	2043

*$p < 0.10$; **$p < 0.05$; ***$p < 0.010$

This table displays estimates of regressing tax rates interacted with whether the league allowed free agency on team winning percentage between 1980 and 2017. Robust standard errors clustered at the team level. All specifications include league-by-year fixed effects. Tax rate is the top statutory marginal state income tax rate. Sample excludes expansion teams since 1980. First years for free agency are 1988 for MLB and NBA, 1993 for NFL and 1995 for NHL. Population, income, and amenities variables standardized by league-year. Columns (2) and (5) include local amenities estimates from ?. Columns (3) and (6) include 23 individual amenity variables from ? such as temperature, proximity to the coast and water, crime, health, and education.

[13] 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).

Table 10 Income taxes, free agency, and team performance, team-by-state fixed effects

	(1)	(2)	(3)	(4)	(5)
Tax rate	0.327	0.285	0.111	0.114	0.105
	(0.219)	(0.229)	(0.390)	(0.393)	(0.411)
FA × tax rate	− 0.659**	− 0.684**	− 0.677**	− 0.679**	− 0.867***
	(0.261)	(0.262)	(0.292)	(0.291)	(0.266)
Population		0.054		1.113	
		(0.646)		(3.733)	
Income		0.033		− 1.230	
		(0.753)		(0.950)	
Local amenities		0.400		1.008	
		(0.728)		(8.900)	
Team-by-state FE	No	No	Yes	Yes	Yes
Mean tax rate	5.986	5.986	5.986	5.986	5.986
Observations	3386	3386	3386	3386	3386

*$p < 0.10$; **$p < 0.05$; ***$p < 0.010$

This table displays estimates of regressing tax rates interacted with whether the league allowed free agency on team winning percentage between 1980 and 2017. Robust standard errors clusters at the team-by-state level. All specifications include league-by-year fixed effects. Tax rate is the top statutory marginal state income tax rate. Sample excludes expansion teams since 1980. Rows 1 and 2 use the first years for free agency are 1988 for MLB and NBA, 1993 for NFL and 1995 for NHL, equally phased in over 5 years. Population, income, and amenities variables standardized by league-year. Column (5) includes league-specific covariates. Local amenities estimates come from Albouy (2015)

Acknowledgements The author would like to thank the editor, two anonymous referees, experts at The Tax Institute at H&R Block and The Tax Foundation, and UIC seminar participants for valuable discussions, feedback, and suggestions.

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