The Impact of College Football Games on Local Sales Tax Revenue: Evidence from Four Cities in Texas

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This paper analyzes the net impacts of college football games on the sales tax revenues and taxable sales of four mid-sized cities in Texas. The paper addresses the question in the title, but also asks whether state policy-makers might be justified in encouraging schools in their state to play one another based on the local economic impact those games will have. In general, our evidence suggests the answer to that question is no.
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INTRODUCTION

A football game day in a college town can be frenetic, especially if the school plays football in Division I, the top echelon of college sports. Thousands of visitors from around the state and region flock to the host city, spending money in bars and restaurants, hotels and motels, and even inside the stadium. All of this commercial activity carries with it sales tax revenues to the state and to the community. Of course, the large crowds lead to more traffic in town, greater congestion in the streets and eating and drinking establishments, and an increased need for police and emergency services relative to non-game days. One important policy question is whether the event generates net additional economic activity, and associated sales tax revenue, which would help offset any additional costs borne by the host city thereby increasing the net benefit of hosting the event.[1]

In this paper, we analyze how monthly sales tax revenue in four small- to medium-sized cities in Texas (Austin, College Station, Lubbock, and Waco) is influenced by college football games being held in their jurisdictions. Each of the four cities investigated is home to a university that plays football in the Football Bowl Subdivision (FBS) of NCAA Division I (formerly known as Division I-A): the institutions are the University of Texas (UT) at Austin (Austin), Texas Tech University (Lubbock), Baylor University (Waco), and Texas A&M University (College Station). Using these data, we assess the impact of FBS football games on the sales tax revenues of the host jurisdiction and assess whether conference games, games against teams from within the state, and games against specific rivals have different impacts on local sales tax revenues than other games.

The importance of games against rivals has a policy dimension that does not feature prominently in the evaluation of professional franchises and games.

State politicians have expressed interest that public colleges and universities in their state schedule football games against one another. During the 1990s, legislators in Texas took positions on the rumored departure of UT at Austin and Texas A&M University from the now-defunct Southwest Conference. After the 1987 ''Death Penalty'' imposed on Southern Methodist University by the NCAA and the 1991 departure of the University of Arkansas to the Southeastern Conference, there was an increased pressure on the eight Texas teams that comprised the Southwest conference.[2] An Associated Press article dated August 17, 1990, reported, ''Texas House Speaker Gib Lewis says he strongly opposes the University of Texas or Texas A&M University leaving the Southwest Conference. He vowed 'to do everything in my power to prevent it from happening' — even slashing appropriations to the two universities. For fiscal 1991, the Legislature appropriated $233 million to UT and $183 million to Texas A&M — none of it for athletics.'' The article also indicated ''[a] common concern is that the smaller schools left in the conference would lose too much income from television revenues and ticket sales without UT and Texas A&M on their schedules.''

The issue did not go away, and in February of 1994, speculation that UT, Texas A&M, Baylor, and Texas Tech were considering offers to enter the Big Eight Conference ''prompted several Texas legislators to hold hearings on the SWC's future and to pledge legislative retaliation if any teams flee the conference.'' While no legislative retaliation occurred when these four teams did eventually leave the Southwest Conference, these news stories emphasize how the scheduling of college football games and the organization of college conferences can be an important policy issue for some state legislators.[3]

While there has been little work done specifically on estimating the effects of college sports on local economies, there is a larger literature measuring the effects of holding sporting events of various types.[4] The general consensus in the academic literature that analyzes these issues *ex post* is that there is not a large return in terms of permanent jobs or income (see, for example, Porter 1999; Baade and Matheson 2001, 2004a, b; Coates and Humphreys 2002; Matheson and Baade 2005; Coates 2006). However, the literature focusing on the amount of tax revenue generated while the event is taking place, which reflects the immediate net impact of the event on local spending, is less developed.

Baade et al. [2008] examine how sports-related strikes and lockouts impact a host city's share of state taxable sales in Florida. They test for any negative impact of events *not* being held. They find no statistically significant evidence that work stoppages, opening of a new stadium, or the arrival of a new team influence taxable sales. Coates [2006] estimates the impacts on local sales tax revenues in Houston, Texas, from hosting the 2004 NFL Super Bowl and the 2004 Major League Baseball (MLB) All-Star game. He finds that hosting the Super Bowl may have generated an increase in sales tax revenues collected in Houston but the MLB All-Star Game likely did not. Coates and Depken [2007] evaluate the impact of a wide array of professional and amateur, regular season, playoff, and championship sporting events and a national political convention on sales taxes in 26 Texas municipalities. While they include college football games in their analysis, they do not control for which teams were playing in any game. This paper extends their analysis by using more refined game-level data to assess the impact of games against ''rivals,'' against teams within the conference, and against teams from within Texas.[5]

THE DATA AND EMPIRICAL SPECIFICATION

To estimate the effects of college football games on sales tax revenue, data on monthly sales tax allocations for Austin, Waco, Lubbock and College Station, Texas, from January 1984 through February 2008, were obtained from the Texas Comptroller's Office. We combine the tax data with data on the number of home games in each city in each month, identifying which team is visiting, whether that game is against a conference opponent, and whether the game is against an out-of-state opponent.[6] Our final data set is comprised of 1,160 observations covering the time period January 1984 through February 2008. As our sample period covers approximately 24 years, we convert the nominal monthly sales tax allocations to real 2004 dollars using the monthly Consumer Price Index as reported by the Bureau of Labor Statistics.[7]

Texas is a convenient state in which investigation of the impact of college football games on sales tax revenue can be carried out, as Texas does not have a state income tax and raises a significant portion of the state government's revenues from a state sales tax, currently set at 6.5 percent. Local cities can charge up to an additional 2 percent in sales taxes, which can be dedicated to general city funds or to specific projects, such as mass transit, street maintenance, or stadium construction. Our data reflect the local jurisdiction's portion of the overall sales tax collected in the jurisdiction and focus only on the host city of the game.[8]

The descriptive statistics of the data are provided in Table 1. The upper panel reports descriptive statistics for the entire sample of 1,160 observations describing

Table 1 Descriptive statistics of the data sample

Variable	Mean	Std. Dev.	Min	Max
Full sample: All observations				
Real tax revenue (2004 dollars)	3305769.00	3155052.00	264901.00	14900000.00
12-month change in real tax revenue (000s)	107.20	431.27	−2365.97	2369.41
Total football games	0.47	0.89	0.00	4.00
In-state opponents	0.25	0.59	0.00	3.00
In-conference opponents	0.31	0.72	0.00	3.00
UT visits	0.03	0.17	0.00	1.00
Texas A&M visits	0.03	0.17	0.00	1.00
Baylor visits	0.03	0.17	0.00	1.00
Texas Tech visits	0.03	0.17	0.00	1.00
Observations	1,160			
Partial sample: Includes only observations with NCAA football games				
Real tax revenue (2004 dollars)	3317104.00	3105779.00	296586.30	12800000.00
12-month change in real tax revenue (000s)	87.32	443.51	−1959.86	1846.37
Total football games	1.87	0.73	1.00	4.00
In-state opponents	0.97	0.83	0.00	3.00
In-conference Opponents	1.22	0.95	0.00	3.00
UT visits	0.12	0.33	0.00	1.00
Texas A&M visits	0.12	0.32	0.00	1.00
Baylor visits	0.12	0.32	0.00	1.00
Texas Tech visits	0.12	0.32	0.00	1.00
Observations	294			

Notes: Data describe Austin, Waco, College Station, and Lubbock, Texas, from January 1984 to February 2008. Sales tax revenue obtained from the Texas Comptroller's office. Football game dates and opponents collected by the authors.

the entire period from January 1984 to February 2008, whereas the bottom panel reports descriptive statistics of those months during which football games were played (August, September, October, November, and December). We report the level of real sales tax revenues and the 12-month difference of sales tax collections. The 12-month difference subtracts real revenues in a given month of one year from the real revenues for that same month in the next year.

The upper panel of Table 1 reports the average real monthly sales tax revenue for the entire sample was $3.305 million, with the greatest monthly average tax revenue being collected in Austin ($8.15 million on over $413 million of real taxable sales) and the lowest monthly average tax revenue being collected in College Station ($0.89 million on $63 million of real taxable sales).[9] The lower panel shows that the average sales tax collected during the last 4 months of the year was slightly (but not statistically significantly) higher at $3.317 million. Therefore, without controlling for the type or location of the opponent, there is no immediate evidence that NCAA college football games materially impact local sales tax revenues.

The bottom panel of Table 1 reports that the average number of football games (during the months of the football season) was roughly two games per month, of which one of these games was an in-state opponent, and one game was an in-conference opponent (although these groups are not necessarily mutually exclusive). Among the four teams in our sample, each team visits one of the other three teams on a home-and-away rotating basis. For example, UT plays Texas A&M in Austin in even-numbered years and in College Station in odd-numbered years. Therefore, each team visiting one of the other cities represents about 12 percent of the observations during the football season.

Table 2 provides a tabulation of how often each of the teams in our sample visits another city in the sample during the months of the football season. As can be seen, none of the four teams visit each other during the month of August. During the month of August, visitors tend to be in-state non-conference rivals and a mix of out-of-state conference and non-conference opponents.[10] Of the four teams in the sample, only Baylor and Texas Tech visited one of the other teams during the month of September.[11]

We assume a linear relationship between real tax revenues and the college football games played in the city

$$(1) \qquad RTAX_{it} = \alpha_i + \lambda_i TIME_{it} + \beta EVENTS_{it} + \varepsilon_{it}$$

where i indexes the city, t indexes the month, and ε_{it} is a zero-mean error term. The dependent variable, $RTAX_{it}$, is the real monthly sales tax revenues for city i in month t, measured in 2004 CPI adjusted dollars. The parameters include α_i, a city-specific

Table 2 Count of visits among four sample universities

School	Home town	August	September	October	November	December	Total
University of Texas	Austin	0	1	6	28	2	37
Texas A&M	College Station	0	0	23	11	2	36
Texas Tech	Lubbock	0	9	17	11	0	37
Baylor University	Waco	0	6	17	12	0	35

Notes: Counts indicate the number of times each university visited one of the other three universities in each month of the college football regular season. For instance, the University of Texas played only one away game in the month of September against Texas A&M, Baylor, or Texas Tech during the sample period.

fixed effect constant over time, λ_i, a city-specific time trend, and β, a vector of parameters that measure the net impact of additional football games, additional conference games, additional games against in-state opponents, and games against the other three institutions in our data.[12]

Figure 1 depicts the monthly real sales tax revenue for the four cities in the sample. Visual inspection suggests that at least three of the series (Austin, Waco, and Lubbock) might be non-stationary, thereby making the specification in equation (1) incorrect. An Im–Pesharan–Shin [2003] panel unit-root test with four lags yields a test statistic of -1.49 with a 1 percent critical value of -2.4, suggesting that real sales tax revenue is characterized by a unit root. The non-stationarity of sales tax
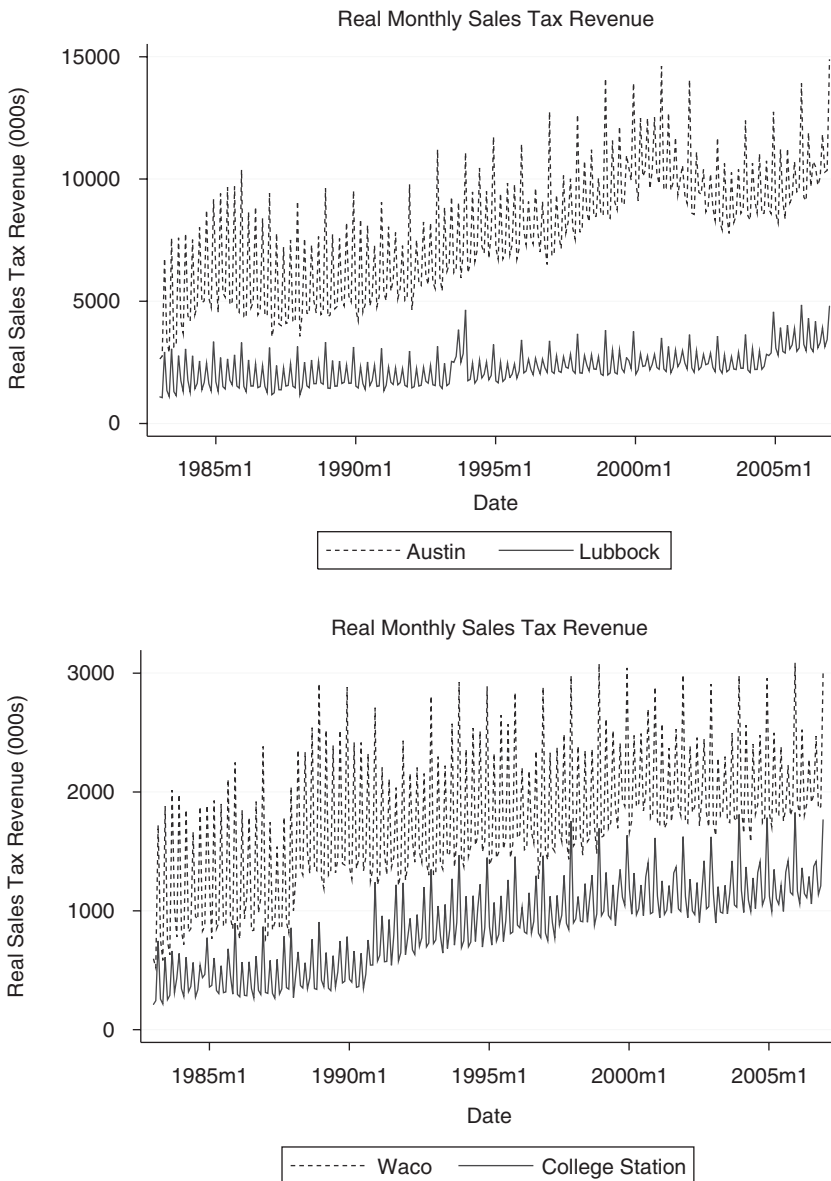

Figure 1. Monthly real sales tax revenues.

revenues, coupled with the cyclical and seasonal spikes of real sales tax suggests that some form of differencing is appropriate. One approach would be to take month-to-month differences. However, in the state of Texas businesses remit sales tax revenues on different schedules; some smaller firms pay sales taxes only once a quarter whereas others pay every month.

To avoid mistakenly attributing a month-to-month change in sales tax revenues to a football game or other event when the change is caused by reporting policies, we take the 12-month difference in real sales tax revenues, that is the year-to-year change. Figure 2 depicts the year-to-year changes in real sales tax revenues for the
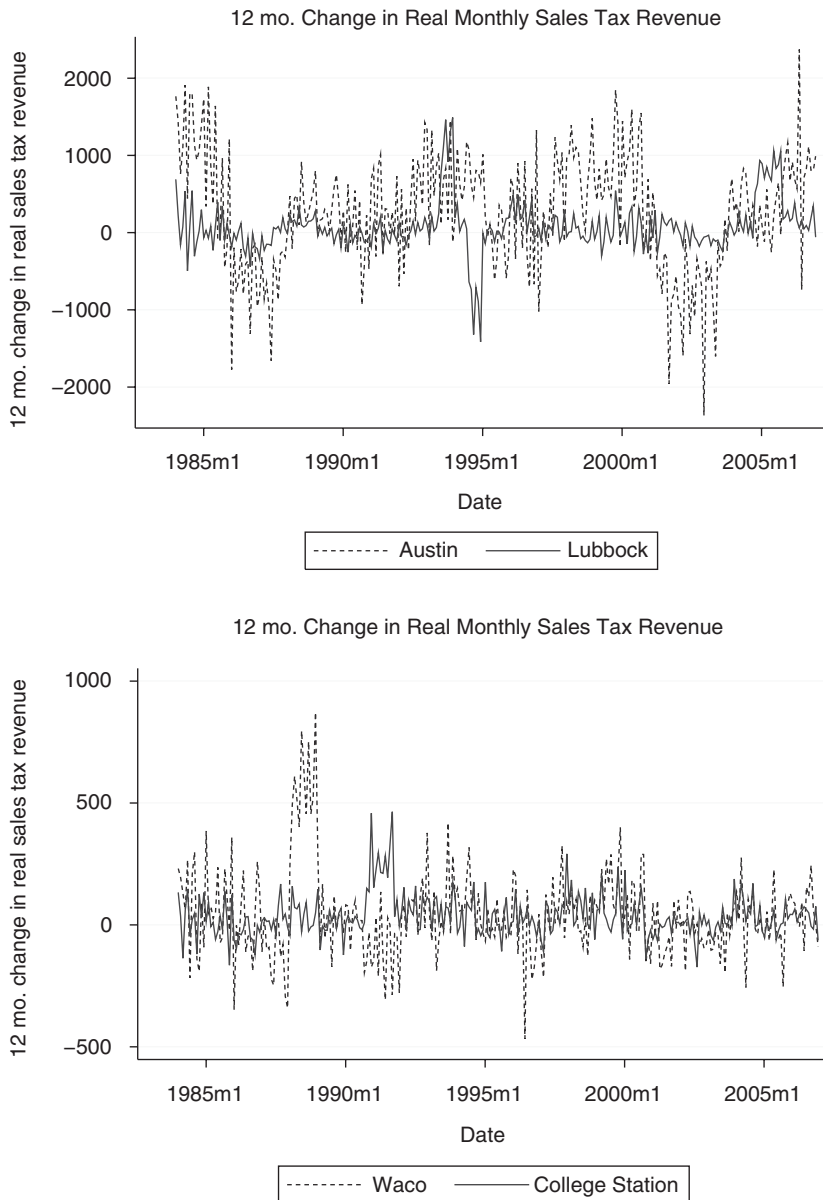

Figure 2. 12-month change in monthly real sales tax revenues.

four cities in the sample. Visual inspection suggests that the 12-month differenced sales tax revenue seems stationary. An Im–Pesharan–Shin [2003] panel unit-root test with four lags yields a test statistic of −3.341 and a 1 percent critical value of 2.40. Thus we reject the null hypothesis that the 12-month differenced data are non-stationary.

We thus use the 12-month difference of the model described in equation (1). In this approach the dependent variable is measured as the year-to-year change in real sales tax revenue for a given month, that is, sales tax revenue in January of 1990 less the sales tax revenue in January of 1989. The independent variables are also differenced by 12-months, for example, the number of football events in August 1990 less the number of football events in August 1989.

When taking differences, the city fixed effects in equation (1), α_i, are differenced out of the model. The city fixed effects in the estimated equation are actually the city-specific growth rates, λ_i, in equation (1).[13]

The estimating equation after 12-month differencing is

$$(2) \qquad \Delta RTAX_{it} = \lambda_i + \beta \Delta EVENTS_{it} + \Delta \varepsilon_{it}$$

To further control for seasonality and general macroeconomic trends (both in the state of Texas and the United States) a year time trend and month dummy variables are also included in the specifications. While general trends and dummy variables are not ideal for this purpose, variables that might better control for temporal changes in local economic conditions are difficult if not impossible to measure at the city level with the same frequency by which the sales tax data are collected.[14] Finally, we control for city-specific heteroscedasticity and city-specific autocorrelation.[15]

EMPIRICAL RESULTS AND DISCUSSION

Table 3 presents various specifications of the estimating equation described in the previous section. Model (1) in Table 3 is a baseline specification wherein the explanatory variables include total games played in city i in month t, the total in-conference opponents that played in city i in month t, and the total number of in-state opponents that played in city i in month t. This model imposes the restrictions that the impact of an additional game, an additional conference game, and an additional game against an in-state opponent has the same impact on sales tax revenues in Austin, College Station, Waco, and Lubbock.[16]

Model (1) in Table 3 indicates that, on average, an additional NCAA football game held in Austin, College Station, Waco, or Lubbock, during the sample period, reduced local sales tax revenues but the parameter estimate was not statistically different from zero. Thus, any increases in local sales tax revenue caused by visitors and residents contributing new spending to attend the event, seems to be offset, on average, by reductions in local spending in other areas. This reduction in other spending might be caused by what we term the "hunker-down effect," wherein local residents stay home rather than venture out to spend money. Alternatively, the reduction in spending may be caused by what we term the "skedaddle effect," where locals flee town to avoid the game day crowds and therefore spend money in some other jurisdiction. If local spending is crowded out by spending on the event, the net effect on local sales tax revenue could be zero; a result consistent with that found in the baseline model.

Table 3 Estimation results (dependent variable 12-month difference in real tax revenues)

City	Variable	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
	Total games	−17.94	12.54	−17.07	−20.85*	−0.22
		(11)	(17.4)	(10.8)	(10.8)	(21.6)
Austin	Total games[a]		−135.9*			−245.1
			(70.6)			(152)
College Station	Total games[a]		−30.71*			−26.99
			(18.5)			(26.1)
Lubbock	Total games[a]		−67.03***			−30.3
			(22.7)			(32.8)
	In-state opponents	−16.27	−11.99	52.80**	−12.87	47.25
		(10.3)	(10.1)	(25.1)	(10)	(28.9)
Austin	In-state opponents[a]			−149.4*		−103.4
				(78.1)		(104)
College Station	In-state opponents[a]			−70.14***		−69.87**
				(26)		(31.1)
Lubbock	In-state opponents[a]			−105.0***		−45.32
				(30.2)		(43.1)
	In-conference opponents	29.07**	30.32**	31.05**	71.05***	22.51
		(12.8)	(12.8)	(12.6)	(25.4)	(32.3)
Austin	In-conference opponents[a]				−110.6	208.4
					(85.7)	(186)
College Station	In-conference opponents[a]				−34.98	25.15
					(24.4)	(36.3)
Lubbock	In-conference opponents[a]				−86.00***	−40.68
					(28.4)	(42.6)
	Constant	61.84**	62.71**	62.49**	62.90**	63.17**
		(25.5)	(25.8)	(25.8)	(25.9)	(25.9)
	Observations	1,160	1,160	1,160	1,160	1,160

[a]Waco is the reference city.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.
Notes: All specifications include a time trend and month dummy variables and allow for city-specific heteroscedasticity and AR(1) error terms. Standard errors in parentheses.

Model (1) suggests that sales tax collections vary depending on who the opponent is. For instance, a generic football game reduces net tax revenues collected in the host city by approximately $18,000; however, the parameter estimate is only significant at the 10.1 percent level and an in-state opponent reduces sales tax revenues by an additional $16,000 ($p = 0.11$). While the individual parameters are not significant at conventional levels, combining them indicates that an in-state opponent reduces sales tax revenues in the host city by approximately $34,000 ($p = 0.01$). On the other hand, an in-conference opponent increases tax revenues by approximately $29,000 ($p = 0.02$). Combining all three parameters suggests that an in-state, in-conference opponent has essentially no impact on local sales tax revenues: the point estimate is approximately −$5,000 with a *p*-value of 0.502. This suggests that in-conference opponents generally bring sufficient new dollars to offset the reduction in tax revenues incurred by hosting a generic football game against an in-state opponent. In other words, during these games the inflow of new spending more than offsets the reduced spending caused by the "hunker-down effect" and the "skedaddle effect."

Model (2) in Table 3 differentiates the effects of a game by the city in which it is played, using Waco (home of Baylor University) as the reference category, but still restricting the impact of in-state opponents and in-conference opponents the same across the four cities. In other words, Model (2) allows us to test whether the impact of an additional game (regardless of opponent type) on the sales tax revenues collected in Waco, Lubbock, College Station, and Austin is the same. The null hypothesis that these differentiated effects are jointly zero is rejected at the 5 percent level, ($\chi^2_{(3)} = 11.20$, $p = 0.01$). During the sample period, an additional game held in Austin *reduced* sales tax revenues by an average of $136,000 relative to Waco. Furthermore, an additional game in College Station reduced sales tax revenue by an average of $31,000 and in Lubbock reduced sales tax revenue by $67,000, relative to Waco. This suggests that the inflow of new spending in Austin, College Station, and Lubbock, did not offset the reduction in spending caused by any "hunker-down effect" and "skedaddle effect." In-state opponents have no significant impact on local sales tax revenues but in-conference games do have a positive influence on local sales tax revenues, as in Model (1).

When combining the parameter estimates from Model (2) in various scenarios, we once again find that for Austin and College Station an in-state, in-conference game has no net impact on local sales tax revenues, suggesting that the inflow of new money spent during the event is offset by other reductions in local spending. This is not the case in Lubbock, where an in-state, in-conference game corresponds with an average reduction in sales tax revenues collected in Lubbock of approximately $37,000 ($p = 0.02$). One explanation is the relative isolation of Lubbock; the city is approximately 350 miles from Dallas, 425 miles from El Paso, and 575 miles from Houston.

Model (3) in Table 3 allows for testing whether the impact of an additional in-state opponent on the tax revenue collected in the four cities is the same, using Waco as the reference category, restricting the impact of additional games and in-conference opponents to be the same for the four cities in the sample. Testing the null that these separate city effects are all zero is easily rejected ($p = 0.004$). The results suggest that, on average, an in-state rival increases tax revenues in Waco but might have no impact or actually reduce revenues by approximately $100,000 in Austin ($p = 0.19$), might have no impact or actually reduce tax revenues by approximately $17,000 in College Station ($p = 0.11$), but significantly reduces local tax revenues by approximately $52,000 in Lubbock ($p = 0.006$).

These differential impacts might be explained by the transportation network in Texas. Waco is located on Interstate 35, approximately 80 miles south of Dallas and 100 miles north of Austin. Thus, any in-state rivals playing in Waco have a relatively shorter distance to travel and this distance is traveled on interstate highway. Waco's proximity to Austin and Dallas, both of which have relatively large airports (Austin has 25 gates, Dallas-Fort Worth airport has 174 gates), might make it easier for fans from further away (whether in-state or out-of-state residents) to attend a game in Waco. On the other hand, Lubbock is geographically distant from the majority of the larger population centers in Texas and surrounding states and its airport, with only nine gates, is primarily serviced by regional jet service.

Model (4) in Table 3 tests for differences across the host cities in the dimension of in-conference opponents, using Waco as the reference category, restricting the impact of additional games and additional in-state opponents to be the same across the four cities in the sample. The joint hypothesis that these coefficients are all zero is rejected ($p = 0.007$). The results suggest that in Waco, an in-conference opponent

increases local tax revenues by \$71,000. Combining the parameter estimates shows that in-conference opponents have no additional impact on local sales tax revenues in Austin ($p = 0.64$) and Lubbock ($p = 0.43$) but there is, on average, an increase in local sales tax revenue in College Station of approximately \$36,000 ($p = 0.01$) during a game between Texas A&M and a conference opponent.

Model (5) in Table 3 allows for the effects of total games, in-state games, and conference games to all vary across the four cities in the sample, using Waco as the reference category. Only one of these coefficients is individually significant, that of an in-state game in College Station. The nine coefficients are, however, jointly significant ($p = 0.009$). Interestingly, none of the groups (total games, conference games, or in-state games), reject the null of jointly being equal to zero. It is also possible to test the null that the effects for a given city are all zero. For example, one can test the null that the coefficients for total games, conference games and in-state games played in Austin are zero. This hypothesis is rejected ($p = 0.01$). The analogous nulls for Lubbock and for College Station are not rejected.

In Table 4 the marginal impacts of additional games, in-state opponents, and in-conference opponents are restricted to be equal across the four cities but the impact of a UT–Texas A&M game on the tax revenues collected in Austin, the impact on tax revenue in Waco of a Baylor–Texas A&M game played in Waco, and so on, are allowed to vary.[17] The results suggest that when Texas A&M visits Texas Tech in Lubbock or Baylor University in Waco, there is no significant change in local tax revenues in those two cities. However, when Texas A&M visits Austin, sales tax revenues in Austin fall by approximately \$410,000. This result is somewhat surprising given the heated rivalry between UT and Texas A&M but is robust to various specifications and sub-samples of the four cities investigated here.

From Table 4, when Baylor visits Austin, sales taxes in Austin fall by approximately \$237,000. However, when Baylor visits College Station, sales taxes in College Station increase by approximately \$47,000. What is the difference between the Baylor Bears visiting Austin vs College Station, especially when both

Table 4 Visiting team effects

City	Visiting university				
	UT	Texas A&M	Tex. Tech.	Baylor	H_0: All jointly zero[a] [p-value]
Austin		−410.64***	−102.49	−237.04*	10.94
		(131.21)	(129.99)	(128.18)	[0.01]
College Station	−55.17***		14.18	47.32**	17.25
	(20.45)		(21.27)	(23.07)	[0.00]
Lubbock	11.82	−52.89		−64.81	2.91
	(45.44)	(50.35)		(46.53)	[0.41]
Waco	24.35	20.91	99.54***		8.00
	(33.40)	(33.31)	(36.18)		[0.05]
H_0: All jointly zero[a]	8.66	11.23	8.44	11.17	
[p-value]	[0.03]	[0.01]	[0.04]	[0.01]	

[a]The test statistic is distributed Chi-square with three degrees of freedom ($\chi_c^2 = 7.815$ at $\alpha = 0.05$).
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.
Notes: Dependent variable is year-to-year change in real monthly sales tax revenue. The specification includes a time trend, month dummy variables, and total games, in-state games, and conference game variables. The analysis allows for city-specific heteroscedasticity and AR(1) error terms. Standard errors in parentheses, *p*-values in brackets.

cities are essentially equidistant from Waco? Perhaps more people travel to College Station for the game against Baylor because Kyle Field in College Station is a bit larger than Texas Memorial Stadium in Austin, thereby increasing the possibility that a Baylor Bear fan might find a ticket to the game. On the other hand, perhaps the difference is due to city size; Austin with a population of over 700,000 is a much larger city than College Station whose population is about 85,000.

The results from Table 4 further suggest that when Texas Tech visits Austin and College Station there is no appreciable change in local sales tax revenues. However, when Texas Tech visits Baylor, local sales tax revenues in Waco increase by approximately $100,000 on average. Finally, when UT-Austin visits Baylor or Texas Tech, there is no change in local sales tax revenues in those cities, but when UT-Austin visits Texas A&M there is a decrease in local sales tax revenues in College Station of approximately $56,000.

The reciprocal relationship between Texas A&M and UT-Austin is interesting. Whenever that particularly heated rivalry comes to town, local sales tax revenues decrease. Perhaps this is because a sufficiently large number of people come to the game but bring their own tailgating supplies, thereby reducing spending in the city relative to other games played during the season. Perhaps enough fans live close enough to drive to the game on game day and return home that night, thereby reducing the time during which any new spending might occur and reducing the net change in tax revenue relative to other months of the year. Finally, we point out that, in 2006, personal income in the Austin-Round Rock MSA was approximately $55 billion whereas in the College Station-Bryan MSA personal income was approximately $5.1 billion [Bureau of Economic Analysis 2007]. While the tax revenue data utilized in this study are specific to the city that hosts the game not the Metropolitan Statistical Area, if the relative size of College Station to the College Station-Bryan MSA is similar to the relative size of Austin to the Austin-Round Rock MSA, then the relative impacts of the Texas A&M–UT game are nearly the same in both cities.

The bottom row and the last column of Table 4 report the results of joint hypothesis tests that all of the parameter estimates in the column or row are jointly equal to zero. Consider the last column for the row labeled Austin. The Chi-square value of 10.94 is for the test of the null that all of the coefficients on the three visiting team variables are jointly zero. This null is rejected, with a p-value of 0.01. In other words, the visiting teams do have a significant impact on sales tax revenues in Austin. Likewise, teams visiting Waco and College Station have statistically significant effects on sales tax revenues in those cities.

The bottom row tests the null hypothesis that a given team has effects on sales tax revenues in the cities it visits. In the column headed UT, for example, the Chi-square statistic is 8.66 with a p-value of 0.03. This indicates that when UT at Austin football team goes on the road, the cities visited experience a change in their sales tax revenues. Reading across this bottom row it is clear that each of the four teams affects revenues in at least one city it visits.

Model (7), reported in Table 5, is a very general specification including all of the variables included in Models (1)–(5) except for the month dummies.[18] Furthermore, we include variables that indicate the host city of the visiting team. For example, when Baylor visits UT, we create an indicator variable that takes a value of one for Waco in that month. Our intent is to test whether there are meaningful changes in local sales tax revenues in the host city of a visiting team. Given the proximity of many institution-dyads, it is conceivable that large numbers of fans make the trip for

Table 5 Visiting team and traveling effects[a]

City	UT	Texas A&M	Tex. Tech.	Baylor	H₀: All jointly zero[b] [p-value]
Visiting university					
Austin		−770.27***	−344.54*	−445.28**	17.3
		(189.94)	(198.28)	(195.35)	[0.00]
College Station	−34.45		26.53	12.34	3.88
	(25.09)		(27.47)	(36.11)	[0.28]
Lubbock	31.56	37.32		44.48	0.5
	(67.02)	(85.09)		(67.9)	[0.92]
Waco	−28.99	−28.09	78.4*		6.48
	(45.45)	(58.85)	(47.65)		[0.09]
H₀: All jointly zero[b]	2.51	16.87	6.66	5.74	
[p-value]	[0.47]	[0.00]	[0.08]	[0.12]	
Visited university					
Austin		−369.15**	−79.17	−218.95	7.14
		(175.43)	(172.35)	(161.39)	[0.07]
College Station	10.16		15.66	−60.11**	5.82
	(19.58)		(22.49)	(29.61)	[0.12]
Lubbock	−6.53	−1.86		92.21	2.60
	(56.29)	(62.37)		(57.53)	[0.46]
Waco	−28.95	−26.14	79.12*		4.17
	(43.72)	(59.81)	(42.08)		[0.24]
H₀: All jointly zero[b]	5.27	4.61	4.33	8.01	
[p-value]	[0.15]	[0.20]	[0.23]	[0.05]	

[a]The specification includes a time trend, and total games, in-state games, and conference game variables for each city.
[b]The test statistic is distributed Chi-square with three degrees of freedom ($\chi_c^2 = 7.815$ at $\alpha = 0.05$).
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.
Notes: The analysis allows for city-specific heteroscedasticity and AR(1) error terms. Standard errors in parentheses, p-values in brackets.

an away game. Does an exodus of supporters reduce net sales tax revenues collected for that month? If the answer is yes, then it may be beneficial to discourage institutions from playing games against especially close opponents.[19]

We find that when UT visits Texas A&M local tax dollars in Austin fall by approximately $369,000, which is significantly less than the decline in tax revenues in Austin when Texas A&M visits UT. There are no statistically significant impacts on Austin tax revenues when UT visits Baylor or Texas Tech, although the parameter estimates are negative. The upper portion of Table 5 is analogous to Table 4, the bottom half of Table 5 shows the effects on the home city of the visiting team.

The remainder of the city pairs carry insignificant parameter estimates except for College Station when A&M visits Baylor and for Waco when Baylor visits Texas Tech: College Station sales tax revenues fall by about $60,000, whereas revenues increase in Waco by about $79,000. The bottom row reports the test statistics for the null hypothesis that each school visiting a specific other school has a harmful effect on the sales tax revenues of the home city. For example, the last row under Baylor has a test statistic of 8.01 and a p-value of 0.05. This means that in Austin, College Station, and Lubbock, sales tax revenues are lower when UT, A&M, or Texas Tech, travel to Waco. This may be because of the relative ease of traveling to Waco from each of the other cities, as Waco is the most centrally located of the four, or because

Baylor University is an easier place to get tickets for out-of-town fans. For whatever reason, it does suggest that when a team goes on the road it may have harmful effects on that team's home city.

The last column in the lower half of Table 5 shows similar results in a different way. This column reports the results of the joint hypothesis test that all of the away games for a specific team have no impact on revenues in the traveling team's home city. Only for Austin can this null hypothesis be rejected. The upshot is that Austin loses sales tax revenues when UT visits A&M, Baylor, or Texas Tech, but it loses even more if UT hosts those teams. The other cities do not generally experience lost revenues when their institutions go on the road.

In general, our results do not suggest that college football games generate much additional sales tax activity, at least among the four schools and cities in our data. However, this does not imply the net benefits of hosting a college football game are negative. The considerable amount of consumer surplus generated during a college football game, for both host-city residents and visitors, likely comprise the majority of the benefits of hosting an event; any net increase in sales tax revenue would only reflect a small percentage of this increased consumer surplus. Because of the difficulty of measuring consumer surplus we have limited our investigation to measuring tangible benefits that the host city in the form of additional sales tax revenue generated from hosting college football games.

However, corroborating evidence for our results comes from an examination of hotel occupancy rates. The idea is that home game weekends ought to make for greater hotel occupancy than other weekends, as fans from across the state and country return to town to attend the game. Games against the rivals might be especially big draws. Unfortunately, the hotel occupancy data we found is quarterly. In those data, it is the case that the rate of hotel occupancy is statistically significantly smaller at the 10 percent level or better, during the third and fourth quarters of the year than during the first and second quarters in three of the four cities in our data. These cities are Austin, College Station and Waco. In other words, hotel occupancy is lower during the football season, on average, than during the rest of the year in those three cities. On the other hand, occupancy rates are, on average, greater in Lubbock during the football season than during the rest of the year.

It is possible that hotel occupancy rates are higher on game weekends than non-game weekends during the college football season, which the quarterly data might not reveal. However, if game weekends do have higher hotel occupancy than non-game weekends, the additional visitors do not seem to be in sufficient numbers to produce large boosts to sales tax revenues. In other words, lower occupancy rates in the quarters during the football season are consistent with less or no greater sales tax revenues associated with the collegiate football games. This provides additional, albeit indirect, support for the results presented here.

CONCLUSIONS AND DISCUSSION

This paper focuses on the impact of Division I Football Bowl Series (FBS) games on the local tax revenues of the specific cities that host them. We narrow our focus to four cities in Texas that host a single Division I FBS team, have no other major professional franchises, and play in a Bowl Championship Series Conference: Austin, College Station, Waco, and Lubbock. These four cities host "big-time"

college football programs and have played in the same conference during the period we investigate: either the Southwest Conference or the Big Twelve Conference.

Rather than focusing on consumer surplus or the total costs of hosting a college football game, both of which are difficult, if not impossible, to measure with available data, our question is whether there is a meaningful impact on local sales tax revenues when a football game is played in a particular tax jurisdiction. The question is pertinent in at least three areas. First, there is a small but growing literature that investigates the impact of sporting and cultural events on local sales tax revenues in an attempt to test for whether an event has a meaningful immediate impact on the local host economy. Second, there are several institutions of higher learning in the country that are contemplating either starting a football program or upgrading their program to a higher division. To the extent that officials at those schools and in the host towns are concerned about the influence of new or bigger football games on local resources, the results presented herein are potentially valuable. Finally, it has been suggested by at least two state legislatures that in-state games generate considerable economic activity and therefore flagship institutions should try to schedule games with other lower-tiered in-state institutions.

Our first contribution is to the wider literature concerning the economic impact of a mega-event on the local host economy. We stress that our data only focus on the specific city that hosts the college football game and not the surrounding area. We do not measure any spatial spillovers, whether positive or negative; while the question is valid and the results potentially important, it is beyond the scope of the current project and must be addressed in future research. However, the results obtained in this study are consistent with the other studies that focus on the influence of a mega-event on local sales tax revenue, to wit, the effects vary in their magnitude and sign but are likely to be considerably lower than politicians and local convention bureaus claim. The results here are also consistent with those of Baade et al. [2007] that indicate that big-time college football appears to have no discernible impact on either employment or income in the cities where those teams play.

Our second contribution is in the arena of the public finance of mega-events. In many cases, big-time football games put increased stress on local security and medical personnel, including fire and rescue, emergency medical technicians, and police. For example, the US Census estimates that College Station, TX, had a resident population of 67,890 in 2000. On a given Saturday afternoon at Kyle Field, there might be more than 80,000 people in the stadium and an unmeasured number outside the stadium during the game. As witnessed by the localized bombing that occurred in Norman, Oklahoma, during the 2005 game between the Oklahoma Sooners and the Kansas State Wildcats [Associated Press 2005], a cataclysmic event would put considerable strain on first responders and the security–medical infrastructure of a relatively small town. In response, many smaller cities reach out for reciprocity from neighboring towns, for example for additional emergency medical technician teams, and other city and county police officers for traffic and crowd control. Some cities might appeal to the state for additional state patrol officers to assist in traffic and crowd control. To the extent that the host city can export the cost of additional medical, security, and traffic management, the influence of the event on local tax revenues is of lesser concern. However, if the city cannot export all or any of the additional costs incurred by new or larger football games, the net impact on sales tax revenues is important. A net drain on local sales tax revenues requires the host city to determine if any increased exposure of the

town, stock of goodwill with current residents, stature with the state legislature, and any other non-monetary benefits of hosting such events, is worth the financial costs involved.

Our final contribution concerns potential legislative interference in college football scheduling. If the results from these four cities in Texas can be generalized to other, similarly sized and geographically situated cities in the country, then they suggest that there is little economic reason for any interference in college football scheduling. However, our results should not be taken to suggest that the benefits to the citizens are so small that the legislature should consider dropping football programs at their state-supported institutions solely on the grounds of sales tax revenue. There are likely large but unmeasured consumer surplus benefits from games to include potential increases in community and citizens' pride in their city, state, and school. On the other hand, while political benefits might accrue to legislators who are able to pressure flagship institutions to visit smaller, more isolated towns, such benefits are notoriously difficult to measure and remain for future research.

Notes

1. It should be noted that the absence of a net increase in economic activity associated with the event would not imply the net benefits of the event are negative. Indeed, the considerable consumer surplus generated by college football games makes it unlikely that the net benefits are negative.
2. The eight institutions included the University of Texas (Austin), Texas Tech University (Lubbock), Baylor University (Waco), Texas A&M (College Station), the University of Houston, Rice University (Houston), Southern Methodist University (Dallas), and Texas Christian University (TCU) (Fort Worth). After 1995, the four teams we investigate herein joined with the Big Eight Conference to form the Big XII Conference. The other four schools were left to find their own conference affiliations. For example, TCU played in the Western Athletic Conference from 1996–2001, then joined Conference USA from 2001 to 2005, and joined the Mountain West Conference starting in 2005. The conference affiliations of the other teams include Rice (Western Athletic Conference, 1996–2005; Conference USA, 2005-present), Houston (Conference USA, 1996-present), SMU (Western Athletic Conference, 1996–2005; Conference USA, 2005-present).
3. Other examples include the Governor of West Virginia using his 2005 State of the State speech to call for a reinstatement of the Marshall-West Virginia University rivalry, and a 1995 bill submitted to the North Carolina state legislature (but not passed) requiring the University of North Carolina and North Carolina State University to schedule football games against East Carolina University. These two schools now regularly include East Carolina University on their schedules, about which North Carolina state Senator Marc Basnight said, "There are no negatives to it. It benefits the economy of Eastern North Carolina and benefits Raleigh. It fills up the stadiums. All I've heard in the legislative building this week is 'Big game, big game.' Why play some out-of-state team when you can create this much interest?" (*Raleigh News and Observer*, 2007).
4. Examples of this work are Baade et al. [2007], which focuses explicitly on college football's effects, finding little impact on host communities, and Lentz and Laband [2008] who examine athletic department budgets and employment in accommodations and restaurants, finding a positive relationship.
5. Numerous papers focus on attendance to college football games. Kaempfer and Pacey [1986] and Fizel and Bennett [1989] investigate the impact of television broadcasts on game attendance with conflicting results. Leonard [2005] investigates attendance in the context of a "gravity model" and finds that geographic proximity of the two schools whose teams are playing enhances game attendance. Price and Sen [2003] investigate game day attendance to FBS football games during the 1997 season and find that team quality, conference membership, enrollment, and the percentage of students living on campus all enhance attendance whereas proximity to a professional football team attendance.
6. We gathered the dates and opponents of football games held in Austin, College Station, Lubbock, and Waco from James Howell's historical scores archive (available at www.jhowell.net/cf/cfindex.htm, last accessed May 2008).

7. Specifically, we used the CPI — All Urban Consumers (available at www.bls.gov, last accessed April 2008).

8. Local jurisdictions can also place taxes on hotel rooms, rental cars, liquor sales, and other specific transactions; however, these alternative revenue sources are not included in our data.

9. During the sample period there were six different local sales tax rates in Austin, College Station, and Waco, and seven different local sales tax rates in Lubbock. For the first year after a local sales tax rate change, the average year-to-year change in real sales tax revenues was positive ($170,000 in Austin, $90,000 in College Station, $182,000 in Lubbock, and $100,000 in Waco).

10. It is common practice for Division I FBS teams to schedule lower-tiered opponents or exotic out-of-state or out-of-conference teams for early home games (an example of the latter would be the annual Colorado–Colorado State game, which is typically the first game of the year for each team).

11. Traditionally, neither Baylor nor Texas Tech has been a football power and therefore might be scheduled by Texas or Texas A&M relatively early in the conference schedule as preliminary "warm-up" games before the more important games on the schedule, for example the annual "Red River Shootout" between UT and the University of Oklahoma, played in Dallas in October.

12. We attempted to control for the boom/bust cycle related to the oil industry in Texas using the monthly index of petroleum and natural gas production from the Federal Reserve Statistics. This variable was never statistically significant.

13. This does require an adjustment to the standard errors. Specifically, the fixed effects estimator will calculate the standard errors based on $NT-N-k$ degrees of freedom whereas the correct degrees of freedom are actually $NT-2N-k$.

14. For example, population of a tax jurisdiction likely influences the sales tax revenue collected in that jurisdiction. However, population is only available on an annual basis and it is not clear how to interpolate monthly population levels from these annual observations. A similar problem arises when contemplating other potential explanatory variables such as business start-ups, unemployment levels, or disposable income.

15. City-specific heteroscedasticity might arise because of the different sizes of the four cities in the sample. Austin is the largest city, in terms of population, and is also the state capital. To the extent that city size might influence the volatility of sales tax revenues, heteroscedasticity might be expected. Moreover, we might expect to see first-order autocorrelation in the 12-month differenced data if spending patterns in, say, August of one year influence spending patterns in August of the next year. This might occur if new shopping, dining, or recreational opportunities were introduced to the city's economy that influenced spending during a particular month, for example, a new amusement park, a new minor league baseball team, or a new shopping mall. We employ the *xtgls* command in Stata 9.2 to estimate our models.

16. The data investigated herein only measure sales tax and thus do not include any additional excise or user taxes, such as hotel, car-rental, airport, or liquor taxes charged by the host city but collected by a different agency. In many cases, these excise or user taxes are already earmarked for specific projects, for example, to service debt on various public projects, and do not flow into the general funds of the host city. To the extent that the host city incurs marginal costs for an additional game, for example, extra police or medical personnel, only sales tax revenues to the city's discretionary spending can be used to offset these marginal costs. Moreover, we do not attempt to measure non-pecuniary benefits arising from football games such as consumer surplus, civic and school pride.

17. The table does not include the coefficients for total games, in-state games, or conference games. Coefficients for these two variables are, respectively, -26.38 and 26.18 and both coefficients have p-values less than 0.05.

18. Inclusion of the month dummies with all the game specific dummies generated perfect collinearity among the regressors.

19. A similar issue might arise between TCU, located in Fort Worth, and Southern Methodist University, located in Dallas (Texas), as the two institutions are approximately 35 miles apart. Duke University (located in Durham) and the University of North Carolina (located in Chapel Hill, North Carolina) are within 10 miles of each other. Among Division I FBS teams, other proximate dyads include Houston and Rice (6 miles apart), Washington State and Idaho (8 miles apart), Stanford and California — Berkeley (45 miles apart), Southern California and UCLA (14 miles apart), Georgia and Georgia Tech (70 miles apart), Vanderbilt and Middle Tennessee State University (32 miles apart), Miami (FL) and Florida International (7 miles apart), and the University of Central Florida and the University of South Florida (100 miles apart).

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