THE ECONOMIC IMPACT OF SPORTS STADIUM CONSTRUCTION: The Case of the Construction Industry in St. Louis, MO

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ABSTRACT: *This article examines the St. Louis construction industry's employment with special attention given to the periods during which the Kiel Center and the Trans World Dome were being built. We analyze whether the construction of a major sports stadium increases construction industry employment. An econometric model is developed to explain the times series trend of construction industry employment in the St. Louis SMSA. The statistical evidence suggests that the levels of employment in the construction industry were neither higher nor lower during the construction of these stadia. It is argued that construction on these projects merely substituted for other construction projects in this SMSA.*

George Bernard Shaw once said "if you laid all economists end-to-end they would never reach a conclusion." There is much truth to this quip, but there are some issues on which most economists agree. One of these issues is the economic impact of professional sports teams and sports facilities. Despite the claims of economic impact statements commissioned and funded by professional sports teams and other stadium proponents, the independent academic research on this subject has yielded a consistent conclusion: the existence of a sports franchise in an SMSA does not generate positive net benefits for the SMSA and could actually generate negative net benefits.

Baade and Dye (1990), analyzing data for cities that had baseball stadiums renovated or built between 1965 and 1983, found an overall insignificant effect on the level of aggregate personal income in the cities and a significant negative effect on the cities' regional share of income. They also found an insignificant effect on retail sales and a significant negative impact on the cities' regional share of retail sales. Similarly, Rosentraub, Swindell, Przybylski, and Mullins (1994) found little if any appreciable difference in employment and payroll growth between cities when they compared Indianapolis to similar cities to examine Indianapolis' strat-

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egy to invest in sports related downtown redevelopment. Baade (1996) examined whether sports teams or stadiums have a significant economic impact on the cities in which they reside. Using data from 48 cities from 1958 to 1987, he found no significant impact on the change in municipality per-capita income attributable to the existence of a team or a stadium. He also found that there was no significant impact on municipality share of state employment in the amusement and recreation industry (SIC 79) in the pooled data but he did find some small significant impacts in select cities.

Other researchers have found significant negative impacts associated with the existence of sports teams. Coates and Humphreys (1999) examined the 37 cities in the United States with NBA, NFL, or MLB teams and found that the existence of these teams decreases the level of real per capita income in a city. One of the reasons cited for the lack of any measurable economic impact is that the jobs produced by a sports team appear to be a direct result of purchases not made in other sectors of the economy. Focusing on the same 37 cities, Coates and Humphreys (2000) examined the effect of sports teams on specific sectors of the SMSAs' economies. They found that the presence of a sports team increases employment and earnings in the amusement and recreation sector but decreases it in all other sectors by an amount that offsets the increase in the amusement and recreation sector. This provides evidence that consumers reallocate spending from other sectors of a regional economy to sporting events. This explains the overall findings in their 1999 article.

These results are not surprising when one considers the resources that produce sporting events. By in large, most of the spending that goes towards these resources goes to the players and to the owners of the teams. For example, according to 1996 expenditure data obtained from Financial World (Badenhausen, Nikolov, Alkin, & Ozanian, 1997), 59% of baseball team operating expenditures went towards player salaries. Most players do not live in the cities that they represent. Consequently, it is plausible that a good portion of their income leaves the cities that they represent. It is also plausible that a large share of owners' incomes derived from the operation of a sports team will also leave their host cities.

However, the permanent jobs directly created by a sports team within its host city tend to be seasonal and low-wage jobs (ushers, concessionaires, etc.). Because consumer expenditures on sporting events displaces spending from other sectors of a regions' economy (e.g., restaurants, bars, retail stores, and movie houses), this can lead to lower employment and lower wages in those sectors. Many of the jobs in these other sectors would pay comparable wages but would be year-round. It is also plausible that a greater proportion of spending in these industries will circulate throughout an economy. Hence, the results presented by Coates and Humphreys are not surprising.

Therefore, the evidence suggests that, at best, the existence of sports teams and sports stadiums in an SMSA causes consumers to redistribute their purchases between alternative entertainment purposes or between different geographic areas within the SMSA. At worst, they can actually decrease earnings and employment in their SMSAs. Hence, the existence of major league teams and the construction of sports stadiums do not provide a catalyst for economic development.

However, this body of literature does not claim that there are no benefits to an SMSA having a sports team that would justify a government subsidy to construct a sporting venue. What they do question, however, are the claims of the economic impact statements that attempt to justify public subsidies on the grounds of substantial economic net benefits.

Noll and Zimbalist (1997) argue that sports teams generate external benefits to their host SMSAs and, as a consequence, subsidies may be justified to ensure the socially optimal quantity of sports competition in an MSA. However, the economic impact statements ignore such externalities. Johnson, Groothuis, and Whitehead (2001), analyzing the case of the Pittsburgh

Penguins of the NHL, argue that the value of public goods generated by the Penguins is less than the cost of a new arena. Consequently, while construction of a new stadium or renovation of an old stadium should not be fully funded by the public, some public funds are warranted.

One issue that has not received much attention in the independent literature is the effect of building a sports facility on construction employment in an SMSA. Because the construction activity occurs for a relatively short period of time, the effect on construction employment and all its derivatives is temporary. However, this effect is still an economic benefit.

The construction generated by the building of any facility will constitute an economic net benefit on employment levels only if those workers employed on the stadium project would have been otherwise unemployed. Of course, determining if a person would be unemployed if they were not working at a particular position or doing a similar job in another location would be a difficult task. However, one can examine if overall construction employment is significantly higher in an SMSA during periods when sports facilities are being constructed.

During the 1990s, two major league sports facilities were constructed in St. Louis, Missouri: the Kiel Center and the Trans World Dome (currently the Edward Jones Dome). The Kiel Center houses the NHL's St. Louis Blues, athletic teams from Saint Louis University, and other athletic and non-athletic events. It was financed with a mixture of public and private financing: The city of St. Louis provided $34.5 million for the project while 20 corporations provided $30 million in cash and guaranteed $98 million in construction loans. It was constructed between March 1992 and October 1994 at a cost of $170 million (Munsey & Suppes, 2001).

The Trans World Dome was constructed from May 1993 to October 1995 at a cost of $280 million. It was constructed primarily to bring an NFL franchise back to St. Louis to replace the St. Louis Cardinals (a franchise that departed for Phoenix, Arizona in 1988). It was successful in this endeavor and now houses the St. Louis Rams. The Dome has also hosted various other sporting events as well as many non-athletic events. It is owned by the city of St. Louis and was funded with 100% public funds from various state and local government levels (Munsey & Suppes, 2001).

In comparison, consider road and bridge projects undertaken in the St. Louis metropolitan area. According to figures released by the Missouri Department of Transportation (personal communication, Linda Wilson, December 21, 2000), total road construction spending in 1994 on the Missouri side of the St. Louis metropolitan area amounted to $125 million. Considering construction on the arenas were spread over multiple periods, the projects, especially the Trans World Dome, compare favorably to the road projects in terms of the dollar size of the projects.

In this article, the level of construction employment will be theoretically and econometrically modeled with particular attention given to the St. Louis SMSA and the time periods during which the Kiel Center and the Trans World Dome were being constructed. We will examine if overall employment in the construction sector of the St. Louis SMSA was higher in those periods during which the stadia were under construction. We find no evidence that construction industry employment in the St. Louis SMSA was higher in the periods during which the Kiel Center and the Trans World domes were being constructed.

THE THEORETICAL ANALYSIS

The following theoretical model outlines the framework used in the development of the econometric model of this article. Consider a city defined as the SMSA with an available supply of construction labor L_c. The construction workers need not live in the SMSA of the city—they just need to be able to be employed there. These are workers who would be employed in SIC

15, 16, and 17 in the United States. Of course, there are other industries that are impacted directly and indirectly by construction projects. However, according to the Regional Input-Output Modeling System (RIMSII) multipliers provided by the US Bureau of Economic Analysis the construction industry receives the lion's share of the employment impacts from a given expenditure made in the construction industry. For example, according to 1997 RIMSII multipliers for the state of Missouri, $1 million spent on a construction project will generate roughly 27 jobs, 12 (44.4%) of which are construction jobs (see Table 1). Unfortunately, St. Louis multipliers were not available for this research project. However, in comparison, if $1 million were spent on a construction project in Columbia, a city smaller than many St. Louis suburbs, this spending would generate 11.5 construction jobs in the Columbia metropolitan area (according to 1997 RIMSII multipliers for the Columbia metropolitan area). This suggests: 1) the effects of local construction expenditures will be mostly felt locally with only peripheral impacts on the rest of the state, and 2) because the St. Louis SMSA is vastly larger than the Columbia metropolitan area, it is likely that the St. Louis RIMSII construction multipliers are the larger of the two and thus closer to the Missouri multipliers.

Suppose that there are currently n construction projects that utilize the construction workers with the number of workers employed at building site i denoted as L_i where $\sum_{i=1}^{n} L_i + u_c = L_c$. u_c is the number of construction workers out of L_c who are currently unemployed. Hence, $\sum_{i=1}^{n} L_i$ represents the level of employment in the industry.

For the purposes of this study, an unemployed worker is one not currently working in the construction field in the city. This person is not necessarily unemployed or actively seeking work. Instead the worker must not be working in the construction industry in the city. This person could come from another industry (i.e., the retail industry) or he could come from the construction industry in another city. Recall that we are ultimately interested in finding whether an SMSA realizes an increase in the number of workers employed in the construction industry when it has a large project under construction. Therefore, whether these workers would have been employed elsewhere, while an important issue in the overall scheme, is immaterial to this particular study.

The workers have physical and human capital abilities that are useful in the construction of a building, and these abilities are assumed to be exogenously determined. Because this is the case, L_c is also assumed to be exogenously determined.

TABLE 1

Jobs per $1,000,000 Spent in the Construction Industry in Missouri

Industry Aggregation	RIMSII Multiplier
Farm and agricultural services, forestry	0.455
Mining	0.0762
Construction	11.9885
Durable goods	1.6176
Non-durable goods	0.7354
Transportation and public utilities	0.916
Wholesale trade	0.8486
Retail trade	2.6935
FIRE	1.0759
Services	6.2669
Households	0.1573
Total	26.8309

Suppose the construction project j will be completed using the production function $Q_j = f(L_j, L_{oj}, K_j)$. Q_j can be thought of as the size of the project. L_{oj} is the number of other labor inputs (such as plumbers and electricians) and K_j is the number of units of capital used at site j. Let this production function be twice continuously differentiable in L_j with $[\partial Q(.)]/\partial L_j > 0$ and $[\partial^2 Q(.)]/\partial L_j^2 < 0$. Because we are examining construction employment, for simplicity we assume L_{oj} and K_j are exogenously determined.

When construction begins on a new project in this city, there are two areas from which construction workers can be pulled: from another job site or from the ranks of the unemployed as defined above (u_c). If $u_c = 0$ then it must be the case that the number of workers employed at site j must be drawn from the other $n - 1$ projects. Hence, $\sum_{k \neq j} \Delta L_k = L_j$ where ΔL_k represents the loss of construction workers from site $k \neq j$.

However, if $u_c > 0$, then the new project can pull some workers from the unemployed labor pool. If this is the case, then the construction industry will realize an increase in the level of employment. According to the RIMSII multipliers for the state of Missouri given in Table 1, the Kiel Center's \$170 million construction cost should have translated into 2,038 construction jobs and the Trans World dome's \$280 million price tag should have generated 3,357 construction jobs. As noted above, it is likely that the greatest effects would be in the St. Louis SMSA and that they occurred in the periods during the periods when the stadia were being constructed. We shall see if these results pan out in the following section.

THE EMPIRICAL ANALYSIS

The Data and the Models

All data used in the regression analyses presented in this article were obtained from the databases of the Economic and Policy Analysis Research Center in the Department of Economics at the University of Missouri. The wage and employment data for the construction industry used in the analysis are for the St. Louis SMSA. The data consist of 112 quarterly observations spanning the period from the first quarter of 1971 to the fourth quarter of 1998. Table 2 presents the list of, and the summary statistics for, the continuous variables used in the following regressions.

For any observation at quarter q, the basic model analyzed is

$$SAECC_q = \alpha X_q + \beta_1 KIEL + \beta_2 TW + \gamma T_q + \upsilon_q. \tag{1}$$

TABLE 2

Listing and Means of Continuous Variables

Variable	Abbreviation	Mean	Std Dev	Minimum	Maximum
St. Louis Employment, Construction[a]	SAECC	49553.96	9560.81	26251	68315
St. Louis Quarterly Wages, Construction[b]	SAWCC	26126.39	8539.72	12007	42509
US—Invest, Total Nonresidential[c]	GINQ	561.24	210.94	277.90	1182.30
St. Louis Building Permits, Total[b]	SABP	4059.21	1289.16	1524	7820
Bond Yield, AAA Corporate	FYAAAC	9.21	2.08	6.33	15.01
US–CPI, All Items[d]	PZUNEW	102.29	39.57	39.90	164.00
N = 112					

Note: Dates 1971Q1 to 1998Q4.
[a]Seasonally Adjusted.
[b]Seasonally Adjusted at an Annual Rate.
[c]Real 1987 Dollars.
[d]Not seasonally adjusted.

α is a ($1 \times n$) matrix of parameters on the continuous variables contained in the ($n \times 1$) matrix X_q. Kiel is a dummy variable equal to one for the quarters during which the Kiel Center was under construction. *TW* is a dummy equal to one for the quarters during the Trans World dome was being constructed. β_1 and β_2 are the parameters on the Kiel and Trans World dummy variables, respectively. γ is a ($1 \times m$) matrix of parameters on the various dummies contained in the ($m \times 1$) matrix T_q which contains dummies that control for time-specific effects on St. Louis construction industry employment. For example, the variable D74Q2 = 1 for the second quarter of 1974 and 0 otherwise. D8889 is equal to one for the years 1988 and 1989 and 0 otherwise. ν_q is a stochastic disturbance term, which follows particular processes described below.

ARCH Models and Regression Results

We analyze several different models because we feel that similar results will strengthen the conclusions. The first four models were analyzed using various ARCH models using maximum-likelihood estimation. Time series variables may appear statistically correlated merely because they both move together over time—not because of any causation between the variables. ARCH models control for these autoregressive processes that frequently occur in time series data. ARCH models also control for differences in variances that can occur in some time series variables. This is an important control because construction employment increases over time and, as a result, its variance will also increase.

In each case, a backstep selection process was performed to determine the appropriate lag to place on the disturbance terms. In this approach, the software package used (SAS) deleted insignificant estimated lagged disturbances from the model, leaving only significant estimated lagged disturbances. This method was employed because it allows the data to determine what the appropriate lag is rather than having the researcher use trial-and-error to discover it. In each case, the disturbance was found to follow an AR(1) process. In addition, Lagrangian Multiplier tests and Q tests were performed on the disturbances to test for potential ARCH processes. The tests suggested that the disturbances follow an ARCH(1) process in each case. Hence, the disturbance terms are assumed to be generated by the following AR(1)-ARCH(1) process:

$$\upsilon_q = \varepsilon_q - \varphi\upsilon_{q-1}$$

$$\varepsilon_q = \sqrt{h_q}\mu_q$$

$$h_q = \varpi + \delta\varepsilon^2_{q-1}$$

$$\mu_q \sim iid(0,1).$$

Model 1 is given by the following equation:

$$SAECC_q = \alpha_0 + \alpha_1 GINQ_q + \beta_1 KIEL + \beta_2 TW + \gamma T_q + \upsilon_q$$

$GINQ_q$ is the level of national real non-residential fixed investment and is used to control for the amount of construction spending in St. Louis. We use the national level of investment because we did not have state or local investment expenditures available. However, this is a satisfactory control because non-residential investment spending in St. Louis and non-residential investment spending in the nation should be positively correlated. The regression results are given in the Table 3. First note that the model fit the data very well ($R^2 = 0.9841$) and most parameters are significant at least at the 10% level of significance. A normality test on the estimate of the error term $\varepsilon_q/\sqrt{h_q}$ suggests that they are normally distributed (the p-value on the null hypothesis that they are not normally distributed is 0.1561). The residuals were uncorrelated over time and were homescedastic.

The parameter estimate for non-residential investment is significant and positive. This suggests that a $1 billion expenditure in national non-residential investment increases construction employment in St. Louis by over 35 workers. However, the parameter estimates for both the Kiel and Trans World dummies are positive but highly insignificant. Thus, this model suggests that after controlling for investment expenditures, the level of construction employment in St. Louis was not larger on average than in other quarters covered in the study.

Model 2 is the same as model 1 except it includes building permits for the St. Louis SMSA lagged one quarter. We include this variable as an additional control on the amount of St. Louis-specific non-residential investment spending. While using national non-residential investment helps control for construction expenditures, it does not fully control for construction expenditures in St. Louis. Adding lagged building permits to the model provides an additional control for this. We use the lagged variable because building permits are issued before construction begins on a project. Model 2 is given by the following equation:

$$SAECC_q = \alpha_0 + \alpha_1 GINQ_q + \alpha_2 SABP_{q-1} + \beta_1 KIEL + \beta_2 TW + \gamma T_q + \upsilon_q.$$

The regression results for this model are also given in Table 3. Once again, the model fit the data very well ($R^2 = 0.9823$) and most variables are significant at least at the 10% level of significance. A normality test on the estimated errors found them to be normally distributed (p-value on the null is 0.6405). The residuals were uncorrelated and homoscedastic.

The parameter estimate on non-residential investment is significant and positive suggesting that a $1 billion expenditure on non-residential investment in the US gives work to approximately 36 construction workers in St. Louis. The parameter estimate on lagged building permits is also positive and significant, but it is very small. It suggests that if the number of building permits issued in any particular quarter rises by 2500, only one additional construction worker will be employed in the current quarter, all else equal. However, as in model 1, the parameter estimates on the Kiel and Trans World dummies are both positive but highly insignificant suggesting that, on average, after controlling for non-residential investment expenditures and the number of lagged building permits, there is no evidence of higher or lower levels of construction employment during the periods when the two major sports facilities were being built.

Models 3 and 4 are the same as model 2 with the addition of an average interest rate measure. While businesses will consider their expectations of interest rates when deciding whether to invest in a project, the amount of expenditures may not appropriately control for changes in the expectations. Consequently, we added average interest rates to the model. Model 3 contains the interest rate measure $FYAAAC_{q\to q-3}$, the average AAA corporate bond rate during the past four quarters including the current quarter. Model 3 is thus given by

$$SAECC_q = \alpha_0 + \alpha_1 GINQ_q + \alpha_2 SABP_{q-1} + \alpha_3 FYAAAC_{q\to q-3}$$
$$+ \beta_1 KIEL + \beta_2 TW + \gamma T_q + \upsilon_q.$$

The regression results from model 3 are given in Table 3. As in models 1 and 2, the model fits the data very well ($R^2 = 0.9844$) and most parameters are highly significant. The residu-

TABLE 3

ARCH Model Regression Results

Variable	Parameter Estimate	Standard Error
Model 1:		
Intercept**	29369	5877.5
US—Invest, Total Nonresidential**	35.693784	6.9491
KIEL	464.045247	1352.3
TW	669.407129	7965.5
D72Q3**	−1870.31584	933.8
D74Q2**	−13480	1078.7
D80Q2**	−4024.501309	837.5
D81Q2*	−1129.948883	607.1
D88Q1*	881.418519	494.7
D91Q1*	−2928.234377	1629.1
AR(1)**	−0.956396	0.0328
ARCH0**	1664195	41.3859
ARCH1	1.08E−19	4.22E−11
R-Sq	0.9841	
Model 2:		
Intercept**	27172	5327.8
US—Invest, Total Nonresidential**	36.396445	6.9857
SL—Building Permits, Total: Lag 1*	0.407488	0.2108
KIEL	205.76392	1334.4
TW	773.59061	7806.4
D74Q2**	−13733	1303.6
D79Q2	957.707762	706.8
D80Q2**	−3992.895504	1257.5
D88Q1	598.159731	572.9
AR(1)**	−0.947544	0.0361
ARCH0**	1831391	32.1129
ARCH1	2.12E−22	5.38E−11
R-Sq	0.9823	
Model 3:		
Intercept**	22955	5078
US—Invest, Total Nonresidential**	37.135506	5.8532
SL—Building Permits, Total: Lag 1**	0.615098	0.2485
Bond Yield, AAA Corporate: Curr to Lag 3	339.007383	267.9
KIEL	293.048079	1359.9
TW	706.871	5221.9
D74Q2**	−13848	1305.9
D79Q2*	1116.614146	640.5
D80Q2**	−4144.594403	1174.4
D81Q2*	−1037.668709	588.8
D87Q2*	−1822.689824	812.2
D91Q1	−2649.985721	2246.9
AR(1)**	−0.950729	0.0358
ARCH0**	1708046	11.0812
ARCH1	8.67E−19	3.42E−11
R-Sq	0.9844	
Model 4:		
Intercept**	25750	5940.5
US—Invest, Total Nonresidential**	36.651932	6.5606
SL—Building Permits, Total: Lag 1**	0.519568	0.236
Bond Yield, AAA Corporate: Lag1 to Lag 4	93.824587	274.7
KIEL	154.993845	1162.1
TW	826.830093	6778.7
D74Q2**	−13847	1187.6
D79Q2*	1048.255951	635.3
D80Q2**	−3936.562106	1196.3
D87Q1**	2555.622824	1135
D91Q1	−2689.020407	2065.7
AR(1)**	−0.953003	0.0372
ARCH0**	1664566	23.6761
ARCH1	1.08E−19	3.84E−11
R-Sq	0.9847	

*Significant at 5% to 10%
**Significant at less than 5%

als were uncorrelated and homoscedastic and normality tests on the estimated errors suggest they are normally distributed (p-value = 0.3635).

The parameter estimate on non-residential investment expenditures is once again positive and significant. According to this estimate, a $1 billion increase in this expenditure will cause St. Louis construction industry employment to increase by 37 workers. The parameter estimate on lagged building permits is also positive and significant, suggesting that a 3000 unit increase in building permits in one period causes just less than two construction workers to be employed on average during the following period in St. Louis. The parameter estimate on the average AAA bond rate is insignificant. This suggests that non-residential investment expenditures adequately capture interest rate expectations. In addition, there is no evidence that the Kiel and Trans World dummies are significant.

Model 4 uses the average AAA corporate bond rate during the previous four quarters, $FYAAAC_{q-1\rightarrow q-4}$. The following model was thus estimated:

$$SAECC_q = \alpha_0 + \alpha_1 GINQ_q + \alpha_2 SABP_{q-1} + \alpha_3 FYAAAC_{q-1\rightarrow q-4} + \beta_1 KIEL + \beta_2 TW + \gamma T_q + \upsilon_q.$$

The results from the regression run on model 4 are also given in Table 3. The model fits the data well ($R^2 = 0.9847$) and most parameters are significant at least at the 10% level of significance. A normality test on the estimated errors suggests they are normally distributed (p-value = 0.6544). The residuals were uncorrelated and homoscedastic.

As in the previous models, the parameter estimates on non-residential investment and on lagged building permits are both positive and highly significant. They suggest that a $1 billion increase in national non-residential investment expenditures and a 2500 unit increase in the previous quarter will increase construction employment in St. Louis by 36.7 and 1 worker, respectively. As in model 3, the parameter estimate on the average of the four previous quarters' AAA corporate bond rate is insignificant suggesting, once again, that non-residential investment expenditures adequately controls for interest rate expectations. As in all other models, there is no evidence that the Kiel and Trans World dummies are significant. Hence, regardless of how Equation 1 was modeled, there is no evidence that the level of employment in the construction industry was any higher or lower than in other quarters, all else equal.

Two-Stage Regression Model and Regression Results

One of the potential shortcomings of models 1 through 4 is that they each include non-residential investment expenditures as a regressor. It is conceivable that any employment effects caused by construction on the Kiel Center and the Trans World Dome are captured by this regressor, which causes the parameter estimates for their respective time dummies to be insignificant. Hence, it is valuable to analyze an alternative model that does not contain non-residential investment as an explanatory variable.

Consequently, a regression was run on the following model

$$SAECC_q = \alpha_0 + \alpha_1 SAWCC_q + \alpha_2 SABP_{q-1} + \beta_1 KIEL + \beta_2 TW + \gamma T_q + \upsilon_q. \tag{2}$$

To control for possible correlation between $SAWCC_q$, quarterly construction wages in the St. Louis SMSA, and υ_q, $SAWCC_q$ was estimated using the following model:

$$SAWCC_q = \phi_0 + \phi_1 CPI_{q-2} + \beta_2' T' + \upsilon_q'. \tag{3}$$

CPI_{q-2}, the US Consumer Price Index for all items lagged 2 quarters, was used as the instrument. We use this as a regressor because changes in wages are often due to cost-of-living adjustments, which can be captured by including a measure of prices. Backstep selection was used to determine the autoregressive nature of the disturbance υ'_q and performing a Lagrange Multiplier test and a Q test to determine the existence of ARCH processes suggests the disturbance follows the following AR(1,3)-ARCH(1) process:

$$\upsilon'_q = \varepsilon'_q - \varphi' \upsilon'_{q-1} + \varphi'_2 \upsilon'_{q-3}$$

$$\varepsilon'_q = \sqrt{h'_q}\mu'_q$$

$$h'_q = \varpi' + \delta' \varepsilon^2_{q-1}$$

$$\mu'_q \sim iid(0,1)$$

Equation 3 was estimated using maximum likelihood estimation and predictions for nominal $SAWCC_q$ were calculated. (Regression results are available from the author.) These predicted values were then used in the estimation of Equation 2. Two second-stage models were analyzed: one using predicted nominal wages and one using predicted real wages. Predicted real wages were obtained by dividing predicted nominal wages by the St. Louis CPI for all urban consumers. Backstep selection to determine the order of autocorrelation and Lagrangian Multiplier and Q tests to determine the ARCH process on the disturbance υ_q suggests the following AR(1, 8)- ARCH(1) process generates the disturbances for the equation using nominal wages:

$$\upsilon_q = \varepsilon_q - \varphi_1 \upsilon_{q-1} + \varphi_2 \upsilon_{q-8}$$

$$\varepsilon_q = \sqrt{h_q}\mu_q$$

$$h_q = \varpi + \delta \varepsilon^2_{q-1}$$

$$\mu_q \sim iid(0,1)$$

The same selection and test criteria were used to determine the ARCH process on the disturbance υ_q suggests the following AR(1, 2)- ARCH(1) process generates the disturbances for the equation using real wages:

$$\upsilon_q = \varepsilon_q - \varphi_1 \upsilon_{q-1} + \varphi_2 \upsilon_{q-2}$$

$$\varepsilon_q = \sqrt{h_q}\mu_q$$

$$h_q = \varpi + \delta \varepsilon^2_{q-1}$$

$$\mu_q \sim iid(0,1)$$

The regression results were obtained using maximum likelihood estimation and are given in Table 4. Consider the estimated equation using the predicted nominal wages. The model fits the data well ($R^2 = 0.9840$) and most variables are significant at least at the 10% level of

TABLE 4

Two-Stage Least Squares Model: Second Stage Estimated Wages Only

Nominal Wages			Real Wages		
Variable	Parameter Estimate	Standard Error	Variable	Parameter Estimate	Standard Error
Intercept**	17699	1743.1	Intercept**	100449	1103.6
SL—Predicted Quarterly Wages, Construction**	1.016408	0.0508	SL—Predicted Quarterly Wages, Construction**	−1.986248	0.1904
SL—Building Permits, Total: Lag 1**	1.31001	0.2907	SL—Building Permits, Total: Lag 1	0.669251	0.909
KIEL	−1441.83951	1383	KIEL	−717.391222	5922.2
TW	18.056543	2096.2	TW	2511.01028	5335.7
D8889**	3812.29599	1478.5	D8889	4559.31856	3809.1
D1990**	3724.73980	1786	D1990	2943.33894	3844.4
D74Q2**	−18585	1355	D74Q2	5043.16289	3961.8
D80Q2*	−4397.34006	2563.7	D80Q2	−5143.89738	3978
D96Q3	3377.13357	2495	D96Q3	663.211524	6044.8
D73Q1	781.286829	629	D73Q1	−1932.78358	2962.2
D79Q2**	2172.63814	795.5	D79Q2	396.591709	4266.9
D83Q2**	−2965.51869	947.3	D83Q2	−2940.47247	3408
D87Q2**	−3929.48361	1094.9	D87Q2	−894.849068	4637.9
D88Q2*	1476.94402	783.9	D88Q2**	−270.453755	29.2974
D95Q1**	−2988.66835	1433	D95Q1**	3719.68702	361.8
D96Q4**	4000.08810	1249.8	D96Q4	2734.59618	3716.1
AR(1)**	−0.820418	0.0661	AR(1)**	−0.710236	0.2765
AR(8)**	0.208833	0.0667	AR(2)	−0.275571	0.2895
ARCH0**	1874847	3.7774	ARCH0**	8757154	2.0928
ARCH1	2.60E−18	2.18E−11	ARCH1	2.12E−22	4.54E−10
R-Sq	0.984		R-Sq	0.961	

Note. *p < .10. **p < .05.

significance. A normality test suggests the estimated error is normally distributed (p-value = 0.3917). Analysis also suggests that neither autocorrelation nor heteroscedasticity is a problem with our estimated model.

The parameter estimate on the predicted quarterly nominal wage is significant and positive suggesting that a $1000 increase in annual rate quarterly nominal wages brings an additional worker into the construction industry. The parameter estimate on lagged building permits is also positive and significant suggesting that an additional 1000 building permits issued in a particular quarter will bring one more construction worker employment during the following quarter. As in models 1 through 4, the parameter estimates on the Kiel and Trans World dummies are insignificant.

Now consider the estimated equation using the predicted real wages. The model fits the data well ($R^2 = 0.9623$) and a normality test suggests the estimated error is normally distributed (p-value = 0.1703).

The parameter estimate on the predicted quarterly wage is significant and negative suggesting that a $1000 increase in annual rate quarterly wages forces two workers out of the construction industry. The parameter estimate on lagged building permits is also positive and significant suggesting that an additional 2000 building permits issued in a particular quarter will bring one more construction worker employment during the following quarter. As in all previous models analyzed, the parameter estimates on the Kiel and Trans World dummies are insignificant. Hence, despite the way we empirically model construction employment, the data suggest that there was no more nor no less employment in St. Louis' construction industry during the construction of the Kiel Center or the Trans World Dome.

DISCUSSION AND CONCLUSION

Independent economists agree that the economic impact statements used to justify public subsidies for sport stadia overstate the economic benefits of the stadia and the teams they house. They do so by providing gross benefits as the total benefits of the teams and stadiums rather than subtracting the benefits that would have been derived had sports fans spent their incomes in another fashion rather than on sports. They also do so by ignoring what would have been done with public subsidies had they not been given to sports teams.

Previous studies have examined the impact of sports teams and facilities and have found no impact on the economies of the host cities. The present study examines a potential but ignored effect of major stadium and arena construction: its impact on the regional construction industry. The case examined was that of the impact of stadium construction on the construction sector of the St. Louis, Missouri, SMSA during the early and mid-1990s. By econometrically modeling construction employment during the 1970s, 1980s and 1990s, we found that there was neither more nor less construction employment within the St. Louis MSA during the time the Kiel Center and the Trans World Dome were being constructed.

According to the RIMSII multipliers, 44% of the jobs created by a $1,000,000 construction project in Missouri would be in the construction industry. The vast majority of these jobs would be local. However, the present study suggests that instead of creating new construction jobs, jobs were shifted from projects that would otherwise have been undertaken, resulting in no new job creation in the construction industry.

In addition, there were no out-of-the ordinary wage changes that occurred during the three and one-half year period when the stadiums in St. Louis were being constructed that can be directly linked to the stadia. These results, coupled with the more extensive analysis on construction employment, suggest that the net impact of stadium construction on construction employment and worker incomes is zero.

Given that the analysis in the present article focuses on the case study of St. Louis, one may wonder about the generalizability of these findings: Is St. Louis a typical city? Table 5 presents some average macroeconomic indicators for 24 selected major league cities in the US during the period from 1974 to 1999. Note that St. Louis is below average in three of the four categories. In the fourth category, SMSA unemployment rate, it has a higher-than-average unemployment rate. In only one category (real personal per-capita personal income growth) is the difference between St. Louis and the average not statistically significant. These data show that St. Louis is not a typical city: it is smaller, has a lower personal per-capita personal income, and a higher unemployment rate. There is also no reason to believe that construction makes up a different proportion of the St. Louis workforce than the other cities included in Table 5. Consequently, if sports stadium construction were to have any positive effect on employment and wages in a construction industry, we should see it in St. Louis.

Another question to ask is the following: were the economic conditions in the St. Louis SMSA such that they would mask any potential effects that construction of the arenas might have had on the construction industry? Table 6 presents the St. Louis unemployment rate and the year-ago growth rate of per-capita personal income from the period from 1976 to 1998. Recall that the Kiel Center was built from 1992 to 1994 and the Trans World Dome was built during the period from 1993 to 1995. The unemployment rate was relatively high in 1992 and 1993,

TABLE 5

Selected Major Sports City Economic Indicators

City	Average Real Per-Captia Personal Income	Average Real Per-Capita Personal Income Year-Ago Growth	Average SMSA Population	Average Unemployment Rate
Los Angeles	15794	1.14	10,461,491	7.47
Atlanta	14729	2.27	2,724,819	5.27
Baltimore	15194	1.72	2,313,527	6.28
Boston	16027	2.48	5,544,153	5.43
Chicago	16446	1.75	7,425,188	6.62
Cincinnati	14083	1.94	1,511,199	5.98
Cleveland	15174	1.56	2,252,113	6.53
Dallas/Fort Worth	15210	1.95	3,668,908	4.93
Denver	16219	2.05	1,584,649	4.91
Detroit	15359	1.69	4,344,968	8.48
Houston	15440	1.66	3,139,876	5.84
Kansas City	14628	1.60	1,540,576	5.32
Miami	13416	0.87	1,811,352	7.66
Milwaukee	15257	1.65	1,417,404	5.12
Minneapolis/Saint Paul	16268	2.10	2,412,096	4.17
New York	17467	2.04	8,523,633	8.13
San Francisco	19217	1.89	3,530,071	5.47
Philadelphia	15428	1.96	4,869,470	6.30
Phoenix	13611	1.84	2,021,957	5.19
Pittsburgh	14168	1.68	2,477,542	6.87
San Diego	14822	1.47	2,203,744	6.45
Seattle	17025	2.36	1,861,506	6.20
St Louis	14708	1.81	2,467,621	6.43
Tampa Bay	13324	2.10	1,868,262	5.52

TABLE 6

St. Louis Economic Indicators

Year	St. Louis Unemployment Rate	Real St. Louis Per-Capita Personal Income Year-Ago Growth
1976	7.1	4.4
1977	6.6	4.4
1978	5.7	3.4
1979	5.4	−0.3
1980	8.2	−3.1
1981	8.5	0.6
1982	9.9	0.4
1983	10.6	3.7
1984	7.3	5.3
1985	7.4	2.6
1986	7.0	2.9
1987	6.6	1.8
1988	6.0	2.1
1989	5.5	1.2
1990	6.0	−0.2
1991	7.0	−1.3
1992	6.2	2.0
1993	6.3	1.1
1994	4.8	2.0
1995	4.7	1.8
1996	4.5	0.9
1997	4.2	3.5
1998	4.3	2.5

and fell quite precipitously in 1994. Per-capita personal income growth ranged from 1.1% to 2% during this period. During the mid 1990s, the US economy was recovering from the early-1990s recession, and this explains why the St. Louis unemployment rate fell in the mid-1990s. However, recall from the analysis that we found no effect that construction of the two sports stadiums analyzed had any noticeable impact on employment in the construction industry in St. Louis. This suggests that the growth in employment during 1994 must have come from other sectors within the St. Louis economy.

Last, consider the use of public funds for the building of sports stadiums. One could plausibly argue that if these funds were spent elsewhere in the economy, either by the government (on a different project) or by consumers (in terms of tax breaks and the resulting consumption spending), the resulting change in overall demand would stimulate new construction projects. Thus, one would not expect public spending on sports stadiums to cause employment in the construction industry to increase. Yet the method of financing does not explain why we do not observe any more construction employment during the building of sports stadiums in a locale. The results presented in this article suggest that construction workers at a given site would have been working at another site. Whether the financing for either project is public or private is immaterial.

The evidence within the independent literature on the economic impact of sports teams and stadiums suggests that the only plausible positive effects are external benefits. However, Johnson, Groothuis, and Whitehead (2001) argue that the externalities are less than the cost of a new stadium. Hence, a government may plausibly provide some subsidies to sports teams, but it should never fully fund the projects. If the public sector wants to generate economic development, its money might be better spent elsewhere.

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