Government Spending and Job Creation at Highway Construction Firms: Evidence from Texas

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Abstract

Merging procurement auction data with an employment dataset for highway construction firms in Texas, we provide evidence on the link between government construction spending and firm-level job creation in the highway construction industry during 1999-2006.

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Keywords: highway construction, procurement auction, job creation.

1 Introduction

The highway (roads and bridges) construction sector often accounts for a substantial portion of government expenditure in modern industrialized economies. The US government for instance spends $70 bn annually on building and maintaining American highways. Our goal in this paper is to shed light on the linkage between government construction expenditure and firm-level job creation in the highway construction industry. Our data comes from the US state of Texas, which incidentally represents by itself the 14th largest economy in the world.[1] We combine data from two different government agencies, and are able to track for a set of construction firms,

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[1]The US Department of Commerce's estimate of the 2009 GDP of Texas at $1.14 trillion puts it at number 14 in terms of the World Bank Country GDP rankings (http://data.worldbank.org/).

both the dollar value of government contracts won at procurement auctions, as well as their levels of employment, on a quarterly basis. This allows us to relate variation in the amount of government dollars won by a firm to variation in the number of workers employed by it. We find evidence to support the hypothesis that firms respond to an increase in their roster of unfinished government projects by increasing their number of employees. Moreover, we are able to present a quantitative estimate of the potential of government spending to create jobs in highway construction firms.

Although a large body of work by industrial organization scholars has focused on understanding the strategic bidding behavior of firms at highway procurement auctions (see Hickman, Hubbard and Sağlam (2012) for a survey), we are not aware of any research other than ours that studies job creation at firms that win these auctions. There is, however, a plethora of work in the macroeconomics literature looking at the *aggregate* economy-wide impact of government spending in the transportation sector. In fact, this sector often features prominently in government efforts to stimulate the economy during recessions. For instance, as part of the fiscal stimulus under the American Recovery and Reinvestment Act (ARRA) of 2009, the Obama administration committed $26.6 bn in additional spending on road and bridge projects in 2009-2010. Leduc and Wilson (2012) survey the literature on the macroeconomic effects of transportation spending as part of stimulus programs. Our work is complementary to this line of research, as we present micro-evidence on what goes on at individual highway construction firms when the government decides to buy more road and bridge construction projects.

2 Data

For our study we tracked the work commitments (on government projects) of highway construction firms along with their employment levels. To do this, we matched data from the Texas Department of Transportation (TxDOT) to data from the Texas Workforce Commission's Quarterly Census of Employment and Wages (QCEW).[2]

[2] De Silva, Kosmopoulou and Lamarche (2012) have previously used this data to examine factors that determine the survival of new firms in the highway construction industry in Texas.

TxDOT is the major government procurer of road and bridge construction services in Texas, and it auctions projects throughout the year using first-price sealed-bid auctions. For every such auction during July 1999-December 2006, we have the name and address of the winning firm, the dollar value of the contract won, and its start and end dates. Additionally, TxDOT gave us monthly project fulfilment data, so for each firm we know the dollar value of the work done on its existing contracts in any given month.[3] We sum this amount on a quarterly basis and term it a firm's *quarterly work completed*; it gives us a sense of the firm's short-term production targets for any given quarter. Since some of the data from QCEW is quarterly, we make the frequency of the TxDoT data quarterly as well in order to perform econometric analysis. Using the monthly project completion information we compute the total dollar value of unfinished construction work each firm in our data has across all its open projects for each month. This is done by summing the original dollar value of the unfinished projects in a given month, and then subtracting the work completed by the firm in the past months. We take a quarterly average of this monthly unfinished work and term it a firm's *quarterly backlog*. A firm's backlog in any quarter should be taken to represent its production target in the coming quarters. With these two variables in hand, we have, for each quarter, an idea of a firm's short term production levels (quarterly work completed) as well as its longer-term production targets (quarterly backlog).

Our employment data comes from the QCEW, which gave us access under a confidentiality agreement to a dataset that records for each business establishment in Texas, its name, address, NAICS (North American Industry Classification System) code, startup date, number of branches, number of employees on payroll each month, and quarterly wage bill. Based on name and address we were able to match in the QCEW dataset 451 out of the 742 firms that win TxDOT contracts during the duration of our analysis.[4] Out of these we select in-state firms that report NAICS Code 2373: Highway, Street, and Construction, which yields a final sample of 310 firms. For these firms, TxDOT is very likely to be the major source of demand for their

[3] Firms are required to report this data to TxDoT per contract requirements. In most other studies of highway construction (e.g. Jofre-Bonet and Pesendorfer (2003)) researchers have had to make assumptions about the rate of work completion for lack of access to completion data.

[4] A two-sample t-test for the mean backlogs of the matched firms (in the QCEW data) and the unmatched firms reveals that there is no statistical difference between their mean backlogs (p-value of .499).

Table 1: Summary statistics

Variables	Firm level averages
Number of unique firms	310
Average monthly employment per quarter	86.195
	(128.7567)
Quarterly average of monthly backlog (in $)	5,045,526.30
	(2.16e+07)
Average of quarterly sum of monthly work completed	501,911.40
(in $)	(1,467,868)
Average quarterly wage compensation (in $)	12,513.07
	(14,464.68)
Age (in months)	200.594
	(152.812)
Number of current branches	1.408
	(1.579)
Quarterly average of county unemployment rate	5.430
	(1.313)
Quarterly average of the relative	1.009
number of building permits	(.188)

Standard deviations are in parentheses.

services, which makes our backlog and work completed variables good approximations of the demand faced by a firm.[5] With this matching procedure, we are able to relate for the first time in the literature, the employment decisions of highway construction firms to the size of government projects won by them.

We summarize our data in Table 1. The average firm has about 86 employees and pays an average quarterly remuneration of $12,513 per employee. It tends to carry around $5 mn backlog of unfinished work monthly in an average quarter. The average firm completes about $502,000 worth of work every quarter, is about 17 years old, and has 1.4 branches. To account for market-level trends we use the quarterly average unemployment rate for the county that a firm is located in (5.43% on average). To factor in possible private sector demand for highway construction firms' services, we include the normalized quarterly average of the number of building permits

[5] For out-of-state firms, TxDOT projects are likely to represent only a small fraction of their overall production targets. Similarly for firms with other NAICS codes (e.g. NAICS code 5617: Landscaping Services) we can not be sure of the private sector demand for their services, which makes using their TxDoT backlog of projects a very imprecise indicator of their demand.

issued in Texas.

3 Firm Level Job Growth

Our interest is in empirically relating the quarterly employment levels of highway construction firms in Texas to their quarterly backlog and work completed amounts. The hypothesis is that an increase (decrease) in its short-term and long-term work commitments leads a firm to increase (decrease) the size of its workforce. As a firm (a) wins government projects and (b) works on those projects, its production targets fluctuate from quarter to quarter. Winning a project now increases future production targets and working on existing projects reduces them. The size of the new projects (the increase in production targets) and the actual work that will get done on existing projects (the decrease in production targets) both tend to be uncertain. Therefore, a firm needs to adjust the size of its workforce frequently to meet its production targets. Too few workers will slow the pace of work completion, while too many workers will reduce profitability. Thus, we expect a firm to adjust its employment levels in response to changes in demand for its highway construction services (as measured by backlog and work completed) by the government.

Our assumption here is that a firm's production targets drive its employment levels, rather than vice versa. Based on conversations with industry experts we understand that construction firms in Texas are able to hire and let go of workers quite easily. Texas is a right-to-work state and consequently has one of the lowest rates of worker unionization in the country (Swanstrom, 2008). At any rate, in a given quarter, the production targets of a firm are more a function of the projects it has previously won, and less a function of the bids it has placed in that quarter (which could conceivably be correlated with its employment decisions). This is because the firm is not able to immediately begin working on projects it has just won; most projects have a start date at least 30 days or more in the future. Therefore, we do not believe that the firms' employment in a quarter affects its production targets in that quarter. Current production targets depend on projects won more than a month ago (often in the previous quarter) but current employment depends on current production targets.

We first regress the log of a firm's quarterly employment on the log of its quarterly average backlog (Table 2).[6] As controls we include the log of the quarterly remuneration per employee for the firm, branches reported in that quarter, and age of the firm. We include firm fixed effects to capture unobserved firm heterogeneity that is not accounted for by our controls. We also include time dummies (one for each quarter) to control for possible industry-wide shocks and the seasonal nature of construction work. Accounting for seasonality is especially important in this industry since it is common for construction firms to hire workers for specific projects and then let these workers go at the conclusion of projects, returning them to the labor market. In the second specification, we replace the time dummies with quarter dummies but include as an explanatory variable the quarterly average of the relative number of building permits issued in Texas.

The results show that an increase in a firm's backlog in any given quarter is associated with an increase in the size of its workforce (job creation). The size of this elasticity is 0.013 and it is statistically significant. This job creation is also affected by the prevailing wage rates in the industry. An increase in the average quarterly wage amongst the employees of a firm reflects an increase in the cost to the firm of hiring similar workers. We find that this is associated with a decrease in the size of its workforce, with an elasticity of $-.27$ that is statistically significant. The number of employees also increases, with statistical significance, the longer a firm has been in business (age) and the greater the number of its branches. We find similar results when we replace backlog with the log of the quarterly work completed (columns 3 and 4), although the coefficient on work completed is slightly smaller than the one on backlog. The effect however is clear: firms respond to an increase in their short-term and long-term production targets by increasing the size of their workforce. This fact should be of interest to policy makers. An increase in government spending in the construction sector will lead to firms winning more projects on average. This will increase their short-term and long-term production targets, which in turn will lead to job creation.

Since we use a fixed effects design, the coefficient on backlog and work completed in columns

[6] Robust standard errors in parentheses. ***$= p < 0.01$, **$= p < 0.05$, * $=p < 0.1$. All data is quarterly.

Table 2: Regression results

Variable	Log(employment)$_{it}$				ΔLog(employment)$_{it}$			
	OLS				Arellano-Bond			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log(backlog)$_{it}$	0.013***	0.013***						
	(0.001)	(0.001)						
Log(work completed)$_{it}$			0.010***	0.010***				
			(0.001)	(0.001)				
Log(average wage)$_{it}$	-0.277***	-0.284***	-0.282***	-0.289***				
	(0.027)	(0.028)	(0.027)	(0.028)				
Log(current number of branches)$_{it}$	0.234***	0.262***	0.241***	0.270***				
	(0.062)	(0.064)	(0.061)	(0.063)				
Log(age)$_{it}$	0.137***	0.120***	0.138***	0.123***				
	(0.022)	(0.025)	(0.022)	(0.025)				
County unemployment rate$_{t-1}$		-0.010*		-0.011**				
		(0.005)		(0.005)				
Relative number of building permits$_t$		0.058		0.051				
		(0.038)		(0.038)				
ΔLog(backlog)$_{it}$					0.011***	0.011***		
					(0.002)	(0.002)		
ΔLog(work completed)$_{it}$							0.009***	0.009***
							(0.002)	(0.002)
ΔLog(average wage)$_{it}$					-0.190***	-0.184***	-0.195***	-0.188***
					(0.028)	(0.028)	(0.029)	(0.028)
ΔLog(current number of branches)$_{it}$					-0.045	-0.019	-0.043	-0.012
					(0.215)	(0.212)	(0.215)	(0.212)
ΔCounty unemployment rate$_{t-1}$						-0.008		-0.009
						(0.008)		(0.008)
ΔRelative number of building permits$_t$						-0.002		-0.010
						(0.062)		(0.062)
ΔLog(employment)$_{it-1}$					0.522***	0.417***	0.519***	0.413***
					(0.053)	(0.075)	(0.053)	(0.076)
Time effects	Yes		Yes		Yes		Yes	
Firm effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter (seasonal) effects		Yes		Yes		Yes		Yes
Observations	8,403	8,093	8,403	8,093	8,093	8,093	8,093	8,093
R^2	0.864	0.867	0.863	0.866				
Wald χ^2					457.760	191.830	458.890	150.480
Hansen test χ^2					291.25	300.36	292.35	303.31
A-B test for AR(1): Pr(z)					0.000	0.000	0.000	0.000
A-B test for AR(2): Pr(z)					0.160	0.228	0.128	0.233

Table 3: Regression results with lagged terms

Variable	Log(employment)$_{it}$			ΔLog(employment)$_{it}$		
	OLS					AB
	(1)	(2)	(3)	(4)	(5)	(6)
Log(backlog)$_{it}$	0.013***	0.011***	0.011***			
	(0.001)	(0.001)	(0.001)			
Log(backlog)$_{it-1}$		-0.008***	-0.008***			
		(0.001)	(0.001)			
Log(backlog)$_{it-2}$			0.001			
			(0.001)			
Log(average wage)$_{it}$	-0.223***	-0.155***	-0.161***			
	(0.025)	(0.022)	(0.022)			
Log(average wage)$_{it-1}$		0.100***	0.083***			
		(0.019)	(0.019)			
Log(average wage)$_{it-2}$			0.037***			
			(0.012)			
Log(employment)$_{it-1}$		0.839***	0.803***			
		(0.014)	(0.022)			
Log(employment)$_{it-2}$			0.035*			
			(0.019)			
ΔLog(backlog)$_{it}$				0.010***	0.010***	0.011***
				(0.001)	(0.001)	(0.002)
ΔLog(backlog)$_{it-1}$					0.001	-0.006***
					(0.001)	(0.001)
ΔLog(average wage)$_{it}$				-0.160***	-0.175***	-0.177***
				(0.017)	(0.018)	(0.027)
ΔLog(average wage)$_{it-1}$					-0.054***	0.050***
					(0.011)	(0.018)
ΔLog(employment)$_{it-1}$						0.546***
						(0.051)
Time effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,403	8,093	7,784	8,051	7,784	8,093
R^2	0.862	0.959	0.958	0.107	0.121	
Wald χ^2						542.17
Hansen test χ^2						297.15
A-B test for AR(1): Pr(z)						0.000
A-B test for AR(2): Pr(z)						0.161

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. All data is quarterly.

1-4 estimates the change in a firm's mean employment level in response to a change in its production targets. At this point it is important to acknowledge that a firm's employment level is likely to persist from quarter to quarter. With panel data, one needs to be careful in introducing the lagged dependent variable (employment) as a regressor, since it can be endogenous due to the presence of the fixed effects. In a small-T large-N panel this could cause inconsistent estimates of the coefficient on the lagged dependant variable. In our data $T = 30$, so inconsistency of estimates is unlikely to be an issue for us. Still, for robustness, we estimated the model using the methodology of Arellano and Bond (1991), which uses lags of the endogenous variable as instrumental variables in a GMM estimator to produce consistent estimates. The model is transformed to one in first differences and we report these results in columns 5-8. The coefficients on the first difference of backlog and work completed are positive, statistically significant and of a similar (although somewhat smaller) magnitude than the OLS estimates. The coefficient on the lagged first difference of employment is in the range $.41 - .52$ which suggests an additional fact: firms tend to ramp up (down) employment for multiple quarters. Positive (negative) changes in employment in one quarter are associated with positive (negative) changes in employment in the next quarter. As a final robustness check, we present in Table 3 some specifications that include multiple-period lags of employment, backlog and wage as explanatory variables (columns 1-3). We also present the results in first differences (columns 4-5) and the Arellano-Blundell estimate of the coefficients. Again, the coefficients on $\log(\text{backlog})_{it}$ and $\Delta\log(\text{backlog})_{it}$ are stable across specifications and similar to the ones reported in Table 2.

4 Concluding Remarks

Our access to the confidential QCEW dataset on firm employment in Texas allowed us to study the employment levels of highway construction firms alongside their short-term and long-term production targets resulting from TxDOT auctions during 1999-2006. An increase in government contracts won increases the backlog and quarterly work completion goals of the winning firms. Our results suggest that these firms respond by increasing the size of their workforce. This in turn suggests that an increase in annual procurement spending—which will lead to an increase in average backlog and quarterly work completion across all firms—will likely spur aggregate job creation in the industry. This finding should be of interest to policy makers. We note here that in our analysis we have focused on employment at firms that win the contracts. Since subcontracting can occur in this market, it is likely that when a firm wins a project employment also increases at subcontractor firms who may never win a project at auction. Thus, our results likely represent only a conservative estimate of the effect of government spending on employment at highway construction firms.

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