Government Spending and Job Growth in the Highway Construction Industry: Evidence from Texas

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Abstract

Using information on procurement auctions for road construction in Texas during 1999-2006 we provide evidence on the link between government construction spending and firm-level job growth in the highway construction industry.

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1 Introduction

The highway and bridge construction sector often accounts for a substantial portion of governement expenditure in modern industrialized economies. The US government for instance spends $70 bn annually on building and maintaining American bridges and highways. Our goal in this paper is to shed light on the linkage between government construction expenditure and firm-level job growth in the highway and construction industry. Our data comes from the US state of Texas, which incidentally represents by itself the 14th largest economy in the world. We combine data from two different government agencies and are thus able to track for a set of road and bridge construction firms both the dollar value of government contracts won 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 projects by increasing the number of employees. Thus we present an estimate of the potential for government spending to create jobs in the road and bridge construction industry.

We are not aware of any other study that links employment growth in the road and bridge construction industry to government spending on construction. However, there is a plethora of work looking at aggregate impacts of government spending in the transportation sector in general. In fact the transportation sector often features prominently in government efforts to stimulate the economy during recessions. For

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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. Papers by Wilson (2012), Dupor (2012), and Conley and Dupor (2013) and analyze among other things the effect of the ARRA stimulus in highway construction on *aggregate* job creation in terms of national and state employment and GDP multipliers. Leduc and Wilson (2012) review the literature on the efficacy of transportation spending as part of stimulus programs. Our paper should be considered as complementary to these papers. While they look at the linkage between construction spending and job-growth at a macroeconomic level, we present micro-evidence on what goes on at the level of individual construction firms when the government decides to buy more road and bridge construction projects.

2 Data

For our study we needed to track the work commitments of road 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).

TxDOT is the major government procurer of road and bridge construction services in Texas, and it auctions projects on a monthly basis using first-price sealed-bid auctions. For every such auction during July 1999-December 2006, we have the name and address of the firm that won the auction, the type of contract (asphalt, bridgework, earthwork, and so on), the dollar value of the contract won, and its start and end dates. Additionally, TxDOT gave us monthly project fulfilment data, so we know for each firm the dollar value of the work done on its existing contracts in any given month. Using this information we know in any given month the total dollar value of unfinished work a firm has across all its projects. We calculate this by summing the dollar value of unfinished projects in any given month and subtracting from it the total value of all the work done on these projects by the firm in the past months (as reported to TxDOT per contract requirements). We term this unfinished work a firm's *backlog* which shoud be taken to represent a firm's production target in the coming months. We also compute monthly *backlog by type* variables which represent a firm's backlog in any given month on asphalt projects, bridge projecs, earthwork projects and so on. While *backlog* is a monthly variable we convert it into a quarterly one by computing a firm's average backlog during the three months of each quarter. This is done since the QCEW data is quarterly.

Our interest is in relating the (now quarterly) *backlog* variable to a firm's quarterly employment levels, the idea being that a firm's production targets should affect the number of workers on its payroll. Our employment data comes from the QCEW which gave us access to a confidential dataset that records for each business establishment in Texas its name, address, NAICS (North American Industry Classification System) code, startup date, number of branches, the number of employees on payroll every quarter, 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. Out of these we select in-state firms that report NAICS Code 2373: Highway, Street, and Construction which reduces the sample to a further 310 firms. For these firms TxDOT is very likely to be the major source of demand for their services, which makes our backlog variable a good approximation of the demand being faced by a firm.[1]

We summarize our data in Table 1. The average firm has about 86 employees and pays an average quarterly wage of $12,513 per employee. It tends to carry about $5 mn backlog of unfinished work in an average quarter with asphalt ($1.34 mn), bridge work ($1.57 mn) and earth work ($.52 mn) representing the largest three sub-categories. The average firm completes about $502,000 worth of work every quarter, is about 17 years old, and has 1.4 branches.

3 Firm Level Job Growth

Based on conversations with industry experts it is our understanding that it is relatively easy for firms to hire and fire workers quickly. Therefore, we expect a firm to adjust its employment levels in response to the changes in the level of demand for its services. The level of demand is represented by a firm's backlog which is a result of the firm winning contracts at TxDOT auctions. There are several reasons why a firm's backlog in a given quarter can be considered an exogenous variable for determining its employment level in that quarter. Firstly, firms usually can't predict whether they will win a contract at an auction owing to the asymmetry of information about rival firms' costs and the fact that bids are submitted simultaneously. Moreover, it takes more than a month before a firm begins work on a project it has just won. Therefore a firm's current need for workers is less a function of contracts won recently and more a function of the backlog variable that aggregates all previously won contracts. Finally, sometimes firms are unable to foresee across-the-board increases or decreases in TxDOT's aggregate spending goals, which causes unanticipated increases (decreases) in their backlogs since they win more (less) projects than they

[1] For firms that are out-of-state, TxDOT projects are likely to represent only a small fraction of their overall production targets. Similary 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 project a very imprecise indicator of their demand.

expected, and which they must now accomodate by adjusting their workforce.

We regress the log of a firm's quarterly employment on the log of its quarterly average backlog (Table 2). To account for labor market conditions we include a firm's quarterly wage bill per employee as an explanatory variable. Additionally, we include firm fixed effects to control for variation in employment due to firm size, as well as time dummies (one for each quarter) to control for possible industry-wide shocks and the seasonal nature of construction work. One can see that both backlog and wage levels affect a firm's employment with statistical significance (column 1). Employment increases with backlog with an elasticity of .015 and decreases with the prevailing wage with an elasticity of $-.23$. Since a firm's employment levels may persist from period to period, we include lagged employment as well as lagged backlog and wage levels in the second and third specifications (columns 2 and 3). The coefficient on lagged employment is around .79 and statistically significant indicating persistence in the employment levels of firms from quarter to quarter. Backlog and wage continue to affect employment with statistical siginificance and comparable magnitudes as the first specification. However, lagged backlog and lagged wages also affect employment in the current quarter although the magnitude of these effects is less than that of backlog and wages in the current quarter.[2] We also estimate the model in first differences (columns 4 and 5). The coefficients on backlog and wages are statistically significant and of comparable magnitude as before. Again, the magnitude of the effect of the lagged terms is less than that of their counterparts in the current quarter. Thus, overall Table 2 presents clear evidence for the claim that firms respond to an increase in their backlog by hiring more workers.

With panel data, one needs to be careful in introducing the lagged dependent variable as a regressor which can become endogenous due to the presence of the fixed effects. With small T large N panel data this can cause inconsistent estimates of the coefficient on lagged employment. Since $T = 30$ in our data the inconsistency is not likely 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 (Column 6). The coefficients on backlog and wage retain their signs, significance and magnitude. The persistence paramter (coefficient on lagged employment) however reduces to .424 suggesting that employment is less persistent than what an OLS regression might suggest.

Since backlog clearly affects the firm level job growth it is useful to consider whether it matters

[2] In our data the average contract has a duration of 150.28 days. Thus it is possible for a firm to hire workers for a project in one quarter and let them go in the next quarter once the project is over. This can create intertemporal linkages between backlog and employment. Similarly a high prevailing wage in a previous quarter might force a firm to delay its hiring for a later quarter again creating an intertemporal relationship between wages and employment.

what kind of projects comprise that backlog. In our final regression (Table 3) we replace *backlog* by the *backlog by type* variables. Asphalt projects appear to have the greatest and most immediate impact on employment while bridge and earthwork projects seem to affect employment only with a lag. In our study we have not drawn a distinction between new construction and "shovel-ready" maintenance or repair projects. This might be important since new construction is likely to affect employment only with a lag to account for time spent planning the project. Since a bridge or earthwork project is more likely to be new construction than an asphalt project (which can often entail repaving an existing road), it might explain the coefficients on asphalt, bridge and earthwork backlogs.

4 Concluding Remarks

Our ability to match data on the employment at construction firms in Texas to data on their production targets (backlog) has allowed us to shed light on the process of employment growth at these firms. Firms appear to respond to an increase in their roster of unfinished projects by increasing the size of their workforce, with the most immediate increase occuring for asphalt projects. This finding should be of interest to policy makers concerned with employment in this industry. 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 firms that are subcontractors (which may never win an actual project at auction). Thus, our results likely represent only a conservative estimate of the effect of government spending on employment in the construction industry.

References

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Table 1: Summary statistics

Variables	Firm level		
	Average	Minimum	Maximum
Number of unique firms	310		
Average monthly employment per quarter	86.195	1	1530
	(128.7567)		
Average value of backlog (in $)	5,045,526.30	0	4.10e+08
	(2.16e+07)		
Average value of asphalt work backlog (in $)	1,341,656.00	0	7.06e+07
	(4,763,660.00)		
Average value of bridge work backlog (in $)	1,570,561.00	0	1.91e+08
	(9,635,505.00)		
Average value of earth work backlog (in $)	519,537.80	0	3.86e+07
	(2,118,876.00)		
Average value of traffic work backlog (in $)	340,689.50	0	3.22e+07
	(1,383,145.00)		
Average value of subgrade work backlog (in $)	403,184.70	0	2.29e+07
	(1,422,839.00)		
Average value of miscellaneous backlog (in $)	860,107.60	0	7.35e+07
	(3,869,541.00)		
Average work completed (in $)	501,911.40	0	2.60e+07
	(1,467,868)		
Average wage (in $)	12,513.07	1,000.00	166,771.70
	(14,464.68)		
Age (in months)	200.594	1	852
	(152.812)		
Number of current branches	1.408	1	16
	(1.579)		
Quarterly county unemployment rate	5.430	2.2	11.467
	(1.313)		
Quarterly average of the number of building permits	1.009	.708	1.410
	(.188)		

Standard deviations are in parentheses.

Table 2: Regression results

Variable	Log(employment per quarter)$_{it}$			ΔLog(employment per quarter)$_{it}$		
			OLS			AB
	(1)	(2)	(3)	(4)	(5)	(6)
Log(employment per quarter)$_{it-1}$		0.794***	0.793***			
		(0.016)	(0.033)			
Log(employment per quarter)$_{it-2}$			0.008			
			(0.029)			
Log(backlog)$_{it}$	0.015***	0.013***	0.013***			
	(0.001)	(0.001)	(0.001)			
Log(backlog)$_{it-1}$		-0.008***	-0.003*			
		(0.001)	(0.002)			
Log(backlog)$_{it-2}$			-0.006***			
			(0.001)			
Log(average wage)$_{it}$	-0.230***	-0.209***	-0.214***			
	(0.027)	(0.018)	(0.019)			
Log(average wage)$_{it-1}$		0.119***	0.130***			
		(0.016)	(0.018)			
Log(average wage)$_{it-2}$			0.032**			
			(0.013)			
ΔLog(employment per quarter)$_{it-1}$						0.424***
						(0.082)
ΔLog(backlog)$_{it}$				0.012***	0.013***	0.013***
				(0.001)	(0.001)	(0.003)
ΔLog(backlog)$_{it-1}$					0.007***	-0.001
					(0.001)	(0.002)
ΔLog(average wage)$_{it}$				-0.182***	-0.212***	-0.209***
				(0.017)	(0.018)	(0.034)
ΔLog(average wage)$_{it-1}$					-0.035***	0.051***
					(0.013)	(0.020)
Time effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,140	7,785	7,443	7,785	7,443	7,785
R^2	0.860	0.953	0.954	0.126	0.142	
Wald χ^2						443.360

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 3: Regression results with backlog types

Variable	$\text{Log(employment per quarter)}_{it}$	
	(1)	(2)
$\text{Log(employment per quarter)}_{it-1}$	0.796***	0.793***
	(0.015)	(0.032)
$\text{Log(employment per quarter)}_{it-2}$		0.011
		(0.028)
$\text{Log(asphalt work backlog)}_{it}$	0.019***	0.017***
	(0.004)	(0.004)
$\text{Log(bridge work backlog)}_{it}$	-0.008**	-0.008**
	(0.004)	(0.004)
$\text{Log(earth work backlog)}_{it}$	-0.012**	-0.010*
	(0.005)	(0.005)
$\text{Log(traffic work backlog)}_{it}$	-0.001	0.001
	(0.003)	(0.004)
$\text{Log(subgrade work backlog)}_{it}$	-0.006**	-0.006**
	(0.003)	(0.003)
$\text{Log(miscellaneous backlog)}_{it}$	0.019***	0.017***
	(0.004)	(0.004)
$\text{Log(asphalt work backlog)}_{it-1}$	-0.010***	-0.006
	(0.003)	(0.004)
$\text{Log(bridge work backlog)}_{it-1}$	0.007*	0.005
	(0.004)	(0.004)
$\text{Log(earth work backlog)}_{it-1}$	0.002	-0.003
	(0.005)	(0.006)
$\text{Log(traffic work backlog)}_{it-1}$	0.007*	0.006
	(0.003)	(0.004)
$\text{Log(subgrade work backlog)}_{it-1}$	0.006**	0.006**
	(0.002)	(0.003)
$\text{Log(miscellaneous backlog)}_{it-1}$	-0.016***	-0.009
	(0.004)	(0.005)
$\text{Log(asphalt work backlog)}_{it-2}$		-0.008**
		(0.003)
$\text{Log(bridge work backlog)}_{it-2}$		0.005*
		(0.003)
$\text{Log(earth work backlog)}_{it-2}$		0.008*
		(0.005)
$\text{Log(traffic work backlog)}_{it-2}$		-0.001
		(0.003)
$\text{Log(subgrade work backlog)}_{it-2}$		0.001
		(0.003)
$\text{Log(miscellaneous backlog)}_{it-2}$		-0.010***
		(0.004)
$\text{Log(average wage)}_{it}$	-0.202***	-0.206***
	(0.018)	(0.018)
$\text{Log(average wage)}_{it-1}$	0.115***	0.129***
	(0.016)	(0.018)
$\text{Log(average wage)}_{it-2}$		0.029**
		(0.013)
Time effects	Yes	Yes
Firm effects	Yes	Yes
Observations	7,785	7,443
R^2	0.954	0.955

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1