JOURNAL OF EDUCATION FINANCE
27 (SPRING 2002), 997-1012

Making Hay When It Rains: The Effect Prevailing Wage Regulations, Scale Economies, Seasonal, Cyclical And Local Business Patterns Have On School Construction Costs

BY HAMID AZARI-RAD, PETER PHILIPS, AND MARK PRUS

Construction is a boom-bust industry with expected and predictable seasonal fluctuations in activity along with expected, but much less predictable, cyclical swings in business. Consequently, contractors and workers alike have come to believe in the adage "make hay while the sun shines." When business is brisk, workers accept long hours and contractors take all the business they can handle. Industry suppliers also live and die with the business cycle often raising prices when demand is brisk. Everyone involved in construction seeks to make enough money in the good times to tide them over the bad times that inevitably will come.

Good times for the construction industry, however, may correspond to bad times for the purchasers of construction services. When the construction industry is working full tilt, consumers may be wise to delay purchases until things slow down. Furthermore, large local consumers of construction services, such as school districts, may create their own tight conditions by starting large and multiple projects that create local "cost storms" in local construction markets. This paper asks the question whether school districts would be wise to time their purchases of construction services to avoid overheated construction markets, and spread out their construction

Hamid Azari-Rad is an Assistant Professor and Mark Prus is an Associate Professor and Chair in the Department of Economics at the State University of New York College (SUNY) at Cortland. Peter Philips is a Professor in the Department of Economics at the University of Utah, Salt Lake City.

TABLE 1
AVERAGE ANNUAL INFLATION IN THE CONSUMER PRICE INDEX, THE BUILDING COST INDEX AND THE CONSTRUCTION COST INDEX, 1974-99 AND 1991-99

	Annual Inflation		
Period	CPI-U	BCI	CCI
1974-99	5.3%	4.4%	4.6%
1991-99	2.7%	2.8%	2.8%

plans to avoid overheating the market themselves. In attempting to avoid tight construction markets, school districts may be well advised to pay attention to the seasons as well as the business cycle to avoid beginning construction at the same time as everyone else.

The construction industry is not the only institution that tries to "make hay while the sun shines." Overall strong economic conditions tend to reduce public debt and may favor the prospect of passing school construction bonds. It may not be politically or demographically feasible to delay school construction until economic conditions quiet down. Consequently school districts may consider additional or alternative strategies for containing school construction costs. This paper will consider two possible alternatives; deregulation of public construction and economies of scale in the size of school buildings.

Along with being a highly cyclical part of the economy, construction is also a regulated industry. Especially relevant to public school construction and renovation, prevailing wage requirements regulate the payment to labor in many jurisdictions. Some argue that the elimination of prevailing wage regulations would allow for a significant drop in public school construction cost by cutting the wages and benefits paid to construction workers. Others argue that lower wages will result in a less skilled and less equipped public construction work force that will wipe out most and perhaps all of the savings anticipated by those favoring deregulation. This paper will test these alternative hypotheses by comparing school construction costs in regulated and unregulated environments.

Building larger schools to capture technical economies of scale in construction is a classic cost savings strategy. But can bigness backfire if the project puts excess demand on local construction services driving up prices? Would school districts be better off building somewhat smaller schools spaced out over a longer period to avoid straining local construction services?

In this paper we present estimates of the relative payoffs of these alternative ways of cutting school construction costs—timing purchases, deregulating wages and building larger.

Inflation and School Construction Costs

In the last 25 years, overall building and construction costs in the United States have roughly kept pace with inflation.[1] In the most recent expansion, overall building and construction costs have also tracked inflation closely. Table 1 compares the annual average inflation in the Consumer Price Index-Urban (CPI-U) with the Building Cost Index (BCI) and the Construction Cost Index (CCI) issued by the industry publication *Engineering News Record* (ENR). This comparison shows that over the 25-year span, 1974-99, construction costs have risen somewhat more slowly than the CPI-U, while in the last expansion, construction costs have risen just slightly faster than the CPI-U.

There are no school construction cost indices, but anecdotal evidence suggests that in recent years, school construction costs have risen faster than the overall indices of construction costs. For instance, the June 2000, *Engineering News Record* quarterly cost report states:

A very hot school construction market is also warming up costs. "Realistically, when it comes to schools, you can double the inflation rate shown by most construction cost indexes," says Gregory M. Clark, vice president of estimating for M.A. Mortenson Co., Minneapolis. Tight market conditions allow "busy subcontractors to increase margins by at least that much," he says.

---

1. The U.S. Bureau of Labor Statistics (BLS) issues the consumer price index-urban (CPI-U). This is the common measure of changes in the prices consumers face. The CPU-U uses a "market-basket-of-consumer goods" approach where prices of the same collection of market basket of finished products are compared across time. This index may be broken down into components within the market basket including a housing cost index. However, this housing cost is not a construction cost but a rental cost of a given type of house. The BLS does not issue an index on construction costs. *Engineering News Record* (ENR), a long-standing construction industry publication, has since World War I issued two indices, a building cost index (BCI) and a construction cost index (CCI) that are widely relied upon by construction industry analysts to track cost trends in this industry. These indices a market-basket-of-inputs approach rather than trying to identify a standard building output. Each ENR index takes a given amount of steel, lumber, cement and labor, multiplies these inputs by their prices in two time periods and compares the results. The major problem with this approach is that it cannot capture changes in labor productivity over time. The difference between the two ENR indices is the BCI is more applicable to structures where labor costs are a smaller proportion of total costs and labor skill is needed more in the construction process. The CCI is more appropriate in projects where labor costs are a relatively higher proportion to total costs and skilled labor is a small part of all labor hired. Both indices are derived from a survey of 20 major cities including two from Canada. Both use the same "shopping cart" of materials purchased (steel, cement, and lumber) but the CCI includes 200 hours of common labor while the BCI uses 68.38 hours times the average wage rate from three skilled trades (bricklayers, carpenters and structural iron workers). Tim Grogan, "Using ENR's Indexes: How It's Done," *Engineering News Record* 244, no. 12 (2000): 112. CPI-U from the U.S. Bureau of Labor Statistics, Most Requested Series, Prices and Living Conditions, Consumer Price Index All Urban Consumers, http://stats.bls.gov/top20.html.

TABLE 2
NOMINAL AND REAL AVERAGE SQUARE FOOT CONSTRUCTION COST FOR NEW SCHOOLS, BY TYPE OF SCHOOL, 1992 TO JUNE 1999 AND ANNUAL RATE OF CHANGE

Year	Number	Nominal	% Change	Real	% Change
Elementary Schools					
1992	351	$69.12		$81.88	
1993	247	$74.33	7.5%	$85.49	4.4%
1994	167	$74.25	-0.1%	$83.28	-2.6%
1995	419	$81.46	9.7%	$88.84	6.7%
1996	361	$83.95	3.1%	$88.93	0.1%
1997	454	$89.53	6.6%	$92.71	4.2%
1998	407	$86.96	-2.9%	$88.66	-4.4%
1999	283	$97.56	12.2%	$97.56	10.0%
Middle Schools					
Year	Number	Nominal	% Change	Real	% Change
1992	199	$66.23		$78.45	
1993	119	$72.41	9.3%	$83.29	6.2%
1994	78	$70.35	-2.9%	$78.89	-5.3%
1995	200	$71.39	1.5%	$77.86	-1.3%
1996	139	$83.11	16.4%	$88.04	13.1%
1997	204	$81.90	-1.5%	$84.81	-3.7%
1998	153	$88.18	7.7%	$89.90	6.0%
1999	67	$95.59	8.4%	$95.59	6.3%
High Schools					
Year	Number	Nominal	% Change	Real	% Change
1992	100	$76.94		$91.14	
1993	81	$76.39	-0.7%	$87.87	-3.6%
1994	55	$75.45	-1.2%	$84.61	-3.7%
1995	170	$76.49	1.4%	$83.43	-1.4%
1996	147	$84.48	10.4%	$89.49	7.3%
1997	166	$81.75	-3.2%	$84.65	-5.4%
1998	149	$89.53	9.5%	$91.29	7.8%
1999	152	$100.01	11.7%	$100.01	9.6%

School districts are becoming more aware of fast-moving costs and have started raising budgets to better match inflation, says Randy Lowrance, the Houston-based regional building manager for Gilbance Building Co. He says construction costs have jumped about 12 percent during the last two years.[2] Our own data on nominal and real average square foot construction costs of new schools from 1992 to June 1999 is consistent with the view that school construction costs are outpacing inflation. Table 2 shows average square foot accepted bid price for public and private schools broken down into elementary, middle and high schools.

2. Tim Grogan and Stephen H. Daniels, "Second Quarterly Cost Report," *Engineering News Record* 244, no. 25 (2000): 91.

TABLE 3

NUMBER AND PERCENT DISTRIBUTION OF NEW SCHOOLS BUILT IN THE U.S., 1991-1999

	Regulatory Status			
	No Law		Prevailing Wage Law	
Ownership	Count	Table %	Count	Table %
Private School	151	3.0%	182	3.7%
Public School	1901	38.2%	2740	55.1%

Starting in the mid-1990s these prices began to rise not only in nominal terms but after controlling for consumer goods inflation with the CPI-U. This rise in costs over-and-above inflation accelerates recently with real annual increases for 1999 equaling 10 percent, 6.3 percent and 9.6 percent for elementary, middle and high schools respectively.

Why should school construction costs outpace not only the growth in the consumer price index but also the growth in the cost of other types of building construction? ENR suggests that in recent years school districts have overwhelmed local construction markets. ENR argues that "Today's schools are larger, more complex and built in gusts of new construction, not one at a time." These building programs "create their own cost storms."[3] An alternative hypothesis may be found in the fact that public school construction, which accounts for the majority of all school construction, is in many jurisdictions regulated by prevailing wage restrictions. Table 3 shows that over the period 1991 to 1999, 55.1 percent of all new schools built in the U.S. were public schools built under prevailing wage regulations.

These regulations, which do not apply to the private sector construction, may explain why school construction costs are currently rising faster than other types of construction.

THE DATA

To test the effects of economies of scale in construction, prevailing wage regulations and business cycle effects on school construction costs, we turn to F. W. Dodge data on accepted bid prices for new schools built in the United States. The F.W. Dodge Corporation has provided bidding information to building contractors since the 1940s.[4] As part of this service, F.W. Dodge collects data on the

3. Grogan and Daniels, "Schools: Big Programs Stir Costs," *Engineering News Record*, ibid.

4. Currently FW Dodge is, along with *Engineering News Record*, a subsidiary of McGraw Hill. See http://www.fwdodge.com/ and http://www.fwdodge.com/ for descriptions of each subsidiary.

accepted bid price of a variety of public and private construction projects. For this paper, we have collected F.W. Dodge accepted bid prices for new schools, both public and private, built between the second half of 1991 and the first half of 1999. Accepted bid prices do not include any cost over-runs associated with change orders that take place during the life of the project. Change orders can occur due either to a change in the scope of the project or due to an unforeseen or omitted condition of the project that is encountered after the project has begun. Accepted bid prices cover construction costs and do not include land acquisition. A basic assumption of this paper is that the results we find regarding school construction costs as measured by accepted bid price will also generally hold for final construction costs as well. The virtue of using Dodge accepted bid price data is that it provides us with thousands of observations. No other centralized, cross-state, source of public and private school construction costs exists.

In addition to accepted bid prices, the Dodge data provides us with the date of bid acceptance, the state in which the school was built, the type of school (public or private, elementary, middle or high school), and the square foot size of the project. These data allow us to construct a model where the total cost of a new school is a function of the size of the school, the type of school, the location of the school, the season in which the project begins and the year in which the project begins. In order to capture business cycle effects on school construction costs, we add data on annual average overall state unemployment rates[5], and in order to capture the effects of prevailing wage regulations we add dummy variables indicating the existence of any such law.[6]

Table 4 presents the distribution of new schools by state for our sample. The distribution reflects both state size, demographic growth and business cycle conditions during the time period of our sample, 1991-99.

---

5. U.S. Bureau of Labor Statistics, Most Requested Series, Employment and Unemployment, Local Area Unemployment Statistics, http://stats.bls.gov/top20.html.

6. Over the entire time period of our analysis, 18 states did not have prevailing wage laws regulating school construction. These are Alabama, Arizona, Colorado, Georgia, Florida, Idaho, Iowa, Kansas, Louisiana, Mississippi, New Hampshire, North Carolina, North Dakota, South Carolina, South Dakota, Utah, Vermont and Virginia. Oklahoma's law was judicially annulled at the end of 1995. Kentucky applied its law to schools in July of 1996. Ohio suspended the application of its law to schools in July of 1997. Michigan's law was judicially suspended for the period between late 1994 and mid-1997. Maryland's law applied to some schools but not to most over the period of our analysis.

TABLE 4
PERCENT DISTRIBUTION OF NEW SCHOOLS BUILT BY STATE

State Distribution of New Schools in Sample					
State	Percent of Sample	State	Percent of Sample	State	Percent of Sample
Texas	12.4%	Kentucky	1.9%	New Jersey	1.1%
California	10.6%	Minnissota	1.8%	Louisiana	0.7%
Florida	6.4%	Ohio	1.7%	West Virginia	0.6%
Georgia	6.0%	Massachusetts	1.7%	Iowa	0.6%
North Carolina	4.3%	Indina	1.6%	Nebraska	0.5%
Arizona	3.2%	Nevada	1.6%	Alaska	0.5%
Washington	3.0%	Mississippi	1.5%	Maine	0.4%
Tennessee	2.8%	Maryland	1.5%	South Dakota	0.4%
Michigan	2.8%	Utah	1.5%	Connecticut	0.3%
Illinois	2.6%	Arkansas	1.4%	New Hampshire	0.3%
Virginia	2.5%	New York	1.4%	Wyoming	0.2%
Missouri	2.5%	Idaho	1.2%	Montana	0.2%
Pennsylvania	2.4%	Oklahoma	1.2%	North Dakota	0.2%
Wisconsin	2.4%	Kansas	1.1%	Vermont	0.2%
South Carolina	2.2%	New Mexico	1.1%	Delaware	0.2%
Alabama	2.0%	Oregon	1.1%	Hawaii	0.1%
Colorado	2.0%			Rhode Island	0.04%

TABLE 5
COUNT OF NEW SCHOOLS, MEAN SQUARE FOOT SIZE, NUMBER OF PROJECTS IN A CITY AND STATE UNEMPLOYMENT RATE BY YEAR

		Square Feet		Number of Projects in a City			State Unemployment	
	Count	Mean	Std Deviation	Mean	Std Deviation	Maxi-mum	Mean	Std Deviation
1991	106	78,343	61,442	1.90	2.11	13	6.6%	1.4%
1992	650	83,812	60,083	2.15	2.89	45	7.4%	1.6%
1993	447	82,455	62,413	2.18	2.77	22	7.0%	1.7%
1994	300	86,328	61,815	2.34	4.83	46	5.8%	1.5%
1995	789	92,530	69,485	1.99	2.24	22	5.4%	1.2%
1996	647	87,666	78,143	2.27	4.29	73	5.4%	1.2%
1997	824	93,067	74,421	2.08	2.68	26	4.9%	1.2%
1998	709	84,256	65,324	1.96	2.31	21	4.5%	1.0%
1999	502	81,388	64,905	2.36	3.98	45	4.3%	1.0%

Table 5 shows the number of new schools started (count) by year along with the means and standard deviations for the square foot size of these new schools, the number of school projects of all types including new, additions and alterations started in a single city in a year, and each state's unemployment rate.

TABLE 6
PERCENT DISTRIBUTION WITHIN THE SAMPLE OF SCHOOLS BY TYPE, OWNERSHIP AND WHEN BID WAS ACCEPTED

	Percent of Sample
Elementary Schools	55.4%
Middle Schools	23.9%
High Schools	20.7%
Public Schools	93.3%
Private Schools	6.7%
Bids Accepted in Winter	22.2%
Bids Accepted in Spring	32.3%
Bids Accepted in Summer	25.4%
Bids Accepted in Fall	20.1%

Table 5 also includes the maximum number of new projects of any type begun in a city in any one year. The square foot data will be used to measure technical economies of scale in building schools. The number of projects of any type begun in a city in a year will be used to measure possible local crowding effects caused by bunching school construction. Moreover, the state unemployment rates will be used to measure business cycle effects on school construction costs.

Our data do not support the notion that over the 1990s, new schools have become larger as suggested by ENR. Nor does it support the proposition that school districts are increasingly bunching their new school projects together. However, there is considerable variation in school size and the number of projects begun in local areas. It remains to be seen whether larger schools yield economies of scale or whether the bunching of projects creates excess demand pressures in local construction markets. There is also considerable variation in the business cycle within our sample as measured by state unemployment rates. These rates also indicate a clear tightening of general labor markets over time.

Table 6 shows the percent distribution of new schools within the sample by school type (elementary, middle and high schools), ownership (public or private) and bid acceptance date (winter, spring, summer or fall). Elementary schools account for over half of the number of new schools built. Public schools account for 93.3 percent of the sample. Bid acceptances peak in the spring and fall off most in the fall.

Finally, Table 7 shows the size of new schools both in physical and CPI-U deflated monetary terms by elementary, middle and high schools. High schools are largest holding the greatest potential for

TABLE 7
AVERAGE SQUARE FOOT SIZE AND REAL TOTAL COST OF SCHOOLS IN SAMPLE BY TYPE

	School Type		
	Elementary	Middle	High
Square Feet	65,001	101,615	128,819
Real Total Cost (CPI-U)	$6,089,243	$9,189,945	$12,469,829

economies of scale on the one hand, and creating excess demand for local construction services on the other. In general, we conclude that our sample provides considerable and informative variation in a range of factors that can be used to model variations in school construction costs.

THE MODEL

We estimate the effect of construction market crowding, business cycle effects and prevailing wage legislation on school construction costs using the following fixed effects model:

$$\begin{gathered} LnCost_{it} = \alpha_i + \beta_0 LnUnemploy_{it} + \beta_1 LnNumprojects_{it} + \\ \beta_2 SizeThreshold_{it} + \beta_3 Squarefeet_{it} + \beta_4 Middleschool_{it} + \\ \beta_5 Highschool_{it} + \\ \beta_6 Winter_{it} + \beta_7 Spring_{it} + \beta_8 Summer_{it} + \beta_9 PWL_{it} + \beta_{10} Public_{it} + \\ \beta_{11} (PWLxPublic)_{it} + \varepsilon_{it} \end{gathered}$$

where *lnCost* is the start cost or bid cost deflated using the consumer price index.[7] $a\eth_i$ is the individual effect for each state. The natural log of the state unemployment rate, for all workers for each state, *LnUnemploy*, is used as one indicator of market crowding. When unemployment rates are low, we anticipate that construction labor markets will be tight and school construction costs higher. This double log formulation allows us to interpret the coefficient on the variable *LnUnemploy* as an elasticity. That is, a ten percent change in a state's unemployment rate will lead to a constant X percent change in costs. *LnNumprojects* is a second variable that we use to test for market crowding. When school districts start multiple projects in a given year, they may create tight market conditions and drive up costs. Finally, the variable *SizeThreshold* is used to test for a third type of market crowding, namely the construction of large projects. *SizeThreshold* is a dummy variable that equals one if the school being built is over 167,773 feet. We use

7. In unpublished tests, the use of an alternative, a private building cost index published by the *Engineering News Record* yielded very similar results to the tests reported here.

the natural log of the square footage of each project, *Squarefeet,* to account for economies of scale. Again, we use a double log formulation to generate an elasticity. *Middleschool* and *Highschool* are dummy variables identifying school type in order to test for cost differences between elementary, middle and high schools. When the dependent variable is logged and the independent variable is dichotomous, the coefficient on the dummy variable is interpreted as a percent change in the unlogged value of the dependent variable due to the presence of the variable being indicated. Thus, the dummy variables for school type test whether cost differences exist between elementary, middle and high schools and by what percent. *Winter, Spring* and *Summer* are dummy variables indicating the quarter in which the project was started. The hypothesis here is that starting projects in the fall builds into the teeth of winter weather conditions and may raise total bid price. *PWL* is a dummy variable indicating that the project is built in a state with a prevailing wage law. The geographical dispersion of prevailing wage laws is not random. These laws are common in the North and West and absent during our time period in the South. The Great Plains and Mountain states show considerable variation in legal regime. *Public* is a dummy variable indicating that the project is a public school. The product *(PWLxPublic)* is an interaction term that equals one for public schools in states with prevailing wage laws and zero in all other cases.

Results

We test our model on two samples—all new schools and new high schools. The high school subsample isolates the largest type of school and allows for a sharper focus on the question whether large schools can generate local "cost storms" either through the number of projects begun in a year or the size of any single project. In both samples we group the independent variables into five categories—economies of scale, type of school (elementary, middle, high school and public vs. private ownership), seasonal start time, market crowding or demand stimulating factors, and prevailing wage regulations. Columns a and c in Table 8 show the estimated coefficients for these variables for each of the samples. The model fits both samples well with adjusted r-square values of .87 and .91 for the all schools and high schools samples respectively. The dummy variables for states are not reported in Table 8. The reference state in both samples is Texas—the omitted state dummy variable.

TABLE 8

ORDINARY LEAST SQUARE REGRESSION RESULTS OF A MODEL EXPLAINING VARIATION IN THE NATURAL LOG OF REAL TOTAL NEW SCHOOL CONSTRUCTION COSTS

		Dependent Variable= Log of the Value of the Accepted Bid in 1999 Dollars Using the CPI-U	Sample 1 All Schools		Sample 2 High Schools	
			Co-efficient	Standard Error	Co-efficient	Standard Error
		Independent Variables:	a	b	c	d
	1	(Constant)	*5.57*	0.09	*5.57*	0.21
Economy of Scale	2	Log of Sq. Feet	*90.6%*	0.01	*91.0%*	0.01
Type	3	Middle School	0.3%	0.01		
of	4	High Schools	*4.6%*	0.01		
School	5	Public School	*15.3%*	0.03	*14.00%*	0.06
Seasonal	6	Bid Accepted in Winter	-2.5%	0.01	-3.30%	0.03
Start	7	Bid Accepted in Spring	-0.1%	0.01	1.50%	0.03
Time	8	Bid Accepted in Summer	-1.5%	0.01	2.20%	0.03
Market	9	Log of State Unemployment Rate	*-21.5%*	0.02	*-20.1%*	0.06
Crowding	10	Log of Number of Projects in a City	*3.6%*	0.01	*6.0%*	0.02
Factors	11	Schools Over 167,773 Sq. Feet	*8.7%*	0.02	*12.00%*	0.03
Prevailing	12	Jurisdictions with a PW Law	-0.5%	0.04	1.60%	0.11
Wage	13	Public School Covered by PW Law	2.2%	0.03	-3.50%	0.08
Regulation	14	Combined Effect of PW Law	1.8%	0.03	-1.90%	0.07
	15	Adjusted R-square	0.87		0.91	
	16	Number of Observationa	4,974		1,029	

ECONOMIES OF SCALE

In both samples the estimated elasticity is .91 indicating that a 100 percent increase in the square foot size of the project (or a doubling of the project size) will, all other things being equal, increase total costs by 91 percent. Thus, if a school district is considering building two new schools of one size or one new school twice that size, our results indicate that, all other things being equal, that the two-school option would cost 4.7 percent more than the one-school option.[8]

8. Example: two 50,000 square feet schools costing $5,000,000 each for a total of $10,000,000 versus one 100,000 square foot school costing $9,550,000 [$5,000,000+(.91 times $5,000,000)]. The additional cost of two schools, $450,000 divided by the cost of one large school, $9,550,000, equals 4.7 percent.

The functional form of our model assumes that economies of scale are constant across the range of school size within our sample. While this may not be so, some support for this assumption comes from the fact that the point estimate for the economy of scale is the same for both the entire sample of all schools and the high school sample that entails, on average, larger schools. In the case of the scale economy coefficients, the standard error is larger for the smaller high school sample compared to the larger all school sample. We attribute this larger standard error to the smaller sample size rather than a fundamentally different economy of scale pattern obtaining for the high school sample.

Type of Schools

In sample 1, the model controls for differences in the cost of elementary, middle and high schools with two dummy variables identifying middle and high schools with elementary schools being the reference. Our results do not find a statistically significant difference between the cost of middle schools compared to elementary schools controlling for other factors such as size of school. However, we do find that controlling for other factors, high schools cost 4.6 percent more than elementary schools. We attribute this difference to differences in the equipment in science labs, computer facilities and other material costs.

We also find that public schools cost 15.3 percent more than private schools, controlling for other factors. This result holds for public schools that are not built under prevailing wage regulations as well as those regulated by prevailing wage requirements. We attribute this sizable cost differential to differences in the specification of public schools.

Seasonal Start Time

Construction work is seasonal, although variation in seasonal work itself varies across the country based on weather patterns. For each new school project, we identify which quarter in the year the bid was accepted. Groundbreaking would begin some time after bid acceptance. We test in both samples whether or not real bid acceptance price in the winter, spring or summer is different from that of the fall. In unreported regressions, we tested all three other possible reference seasons. In no case do we find a statistically significant difference in accepted bid price associated with the seasons. In the all school sample there is some suggestion that bid acceptance in the winter yields lower prices than any other time. The coefficient for the winter dummy variable in the large sample just barely misses statistical significance at the 5 percent level and is significant at 10 percent. If this result is believed, it suggests that a winter bid acceptance yields a 2.5 percent cost savings over a fall bid acceptance. Winter bid acceptances lead to ground-breaking towards spring while fall bid acceptance moves construction towards the winter. We interpret these results to suggest that there may be a premium associated with ground breaking and predominately outdoor construction work that heads into the teeth of winter. We do not find support for the idea that building into the peak season of construction work (the summer) by itself taxes local construction services and through seasonal crowding increases costs.

Market Crowding and Stimulating Excess Demand

We present three separate measures of the potential for increased school construction costs because of tight local construction services markets. The first is the unemployment rate for all workers in the state in which the school is being built. This is meant to capture not only general labor market conditions but also general economic conditions within the state and to which the local construction services market will be tied. The effect of the state business cycle as measured by the state unemployment rate is statistically significant and substantial. The coefficient of .21 indicates that a doubling of the state unemployment rate from (say) 3 percent to (say) 6 percent lowers total school construction costs by 21 percent. We attribute this to a lowering of all locally determined construction costs including labor, materials and contractor margins. Indeed, it may be primarily affected by contractor margins where in bad times contractors may operate at a loss to cover fixed costs and retain key workers. These same contractors may seek to recoup these periods of loss with extra normal margins in tight construction services markets.

The second measure of market crowding is the number of projects begun in a locality in a given year. The locality is a city and the project number includes addition and alteration projects over $750,000 as well as new schools. The hypothesis is that increasing the number of projects in a locality at the same time will create an excess demand for school construction services and increase the cost of new school construction. In the all school sample, we find an elasticity of .04 indicating that a doubling of the number of projects begun will, controlling for other factors, lead to a 4 percent increase in the cost of the new school. The point estimate of this effect is larger in the high school sample indicating a 6 percent increase in total high school cost due to the doubling of the number of projects (of all types) in the local area.

The third measure of market crowding is a dummy variable identifying new schools larger than 167,773 square feet. This demarcation isolates the largest 10 percent of the schools in the all-school sample. The hypothesis here is that large schools will strain local construction services causing excess demand and higher prices. In the all-school sample, we find that controlling for other factors, notably economies of scale due to size and the difference between high school costs and the costs of middle and elementary schools, we find a big school effect of 8.7 percent. This means that building larger enjoys economies of scale but at some point bigness may offset some or all of these scale economies due to market crowding effects.

It may be, however, that our control for high school costs is inadequate. Because schools above 167,000 square feet will predominately be high schools, it is possible that our bigness variable is picking up aspects of high school construction rather than aspects of market crowding. To test this, we look only at the sample of high schools. In this sample we retain this square foot cutoff of 167,773 square feet which ends up including about 30 percent of all new high schools. We retain the absolute cutoff on the theory that it is absolute size that crowds construction services markets rather than the relative size of schools. We find a point estimate of the bigness effect to larger. We estimate in the second sample that building above the cutoff raises construction costs by 12 percent. In both the case of number of projects and size of the project, the point estimates in the two samples tend to fall within each other's 95 percent confidence ranges forestalling the conclusion that these estimates are statistically significantly different from each other.

Prevailing Wage Regulations

Prevailing wage regulations do not cover private schools. Furthermore, in our sample of new schools built between 1991 and 1999, 41 percent of all public schools were not built under prevailing wage restrictions. These variations allow us to test the hypotheses that public schools built under prevailing wage regulations cost more than public schools not built under prevailing wage laws. This test is a two- stage process. First, we employ three dummy variables to identify the four possible situations—1) a private school built in a jurisdiction with no prevailing wage regulation; 2) a public school built in a jurisdiction with no prevailing wage regulation; 3) a private school built in a jurisdiction with prevailing wage regulations; and 4) a public school built in a jurisdiction with prevailing wage regulations. The three dummy or indicator variables are one indicating whether a school is public or private, a second indicating whether the school (public or private) was built in a jurisdiction with prevailing wage regulations, and a third dummy variable identifying public schools built in jurisdictions having prevailing wage laws. These three dummy variables allow for a unique identification of the four possible states with the reference state (where all dummies=0) being a private school in a jurisdiction with no prevailing wage regulation. In the first stage of our test of the effects of prevailing wage regulations on school construction costs, our ordinary least squares regression model estimates these three dummy variables for each sample. The estimates are found in rows 5, 12 and 13 of Table 8.

In the second stage of our test, we ask the question whether a public school in a jurisdiction with a prevailing wage regulation costs more than a public school in a state without such a regulation. Both these sets of schools are public. Consequently, the value of the public school dummy is the same for both and does not account for any potential difference. However, public schools in states with prevailing wage regulations have the value 1 for two dummies that take on the value 0 for public schools in states that do not have prevailing wage regulations. These two dummy variables—-schools (both public and private) in jurisdictions with prevailing wage laws, and public school in a jurisdiction with a prevailing wage law, are in rows 12 and 13 of Table 8. By themselves, neither of these coefficients addresses our question. By adding these two coefficients together we obtain the regression estimate of the increase in school cost over a public school in a no-law state associated with a public school in a law state. This combined coefficient is shown in row 14, columns a and b, for the all-school and high school samples respectively. These combined coefficients of 1.8 percent in the all-school sample and –1.9 percent in the high school sample are not statistically significantly different from a zero coefficient at any standard level of significance.[9] Thus, we conclude that the elimination of prevailing wage regulations in jurisdiction in which they exist will not yield measurable savings on school construction costs.[10]

9. The test of statistical significance is the sum of the estimated coefficients divided by the square root of the variance of the first plus the variance of the second plus two times the covariance. Keller and Hartman find similar results to our all-school sample in their study of Pennsylvania schools. However, relying upon an accounting method rather than a statistical method for measuring the impact of prevailing wages on costs, they cannot estimate the statistical significance of their finding. Edward C. Keller and William T Hartman, "Prevailing Wage Rates: The Effects on School Construction Costs, Levels of Taxation, and State Reimbursements," *Journal of Education Finance* 27 (2001): 713-728.

10. Bilginsoy and Philips found similar results analyzing a Canadian case using a different data set. Cihan Bilginsoy and Peter Philips, "Prevailing Wage Regulations and School Construction Costs: Evidence from British Columbia," *Journal of Education Finance* 25 (2000): 415-432.

Conclusion

Building larger schools is a traditional way of saving on school construction costs and we estimate that a doubling of school size will cut costs by 4.7 percent over two separate schools half the size of the larger one. However, the technical benefits of economies of scale at some point encounter the market problems associated with excess demand caused by large-scale construction. Very large schools may cost from 8 percent to 12 percent more due to the excess short-run demand that they generate among local contractors, suppliers and workers. Economies of scale in school size have additional auxiliary costs and benefits associated with effect of size on administration, commuting costs and pedagogy. Other building cost-saving strategies exist and are worth considering. Two potential strategies do not offer cost saving promise. Seasonal timing of construction may save based on weather conditions, but there does not appear to be savings from strategies that attempt to avoid seasonal market crowding at least in the case of new schools. Prevailing wage regulations raise the hourly wage rate paid on public school construction. But the higher labor productivity that comes with these higher wage rates or other economies associated with better construction management appear to offset the higher mandated wage rates. In any case there is no measurable difference, controlling for other factors, in public schools built with and without prevailing wage regulations. School districts' best option for construction cost savings lie in planning the pattern of new school construction. Specifically, school districts that can build countercyclically can enjoy a buyer's advantage during economic downturns that appears pronounced in the construction industry. A doubling of the unemployment rate can lead to a 21 percent decline in school construction costs. Spacing out projects so that many projects are not begun in the same period also promises to save money. If builders make hay when the sun shines, school districts should build schools in the rain.