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DISCUSSION PAPER 01.11

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Abstract

The effect of the 1992 Fair Wage and Skill Development Policy on construction costs in British Columbia is estimated by an econometric model in which costs are a function of the project's physical characteristics, location, as well as the applicability of the fair wage policy standards. Construction projects funded by private companies and by the Province of British Columbia before and after the introduction of the policy provide the data which were collected from 1989 to 1995. Depending on the measure of construction cost and the model specification employed, the results indicate that while public construction projects are from 26 to 47 percent more expensive than privately funded projects, the fair wage policy did not significantly impact this cost differential. Given the status of construction labor supply in British Columbia at the time, it is unlikely that input substitution can explain all of this result. Rather, it is more likely that the profit margin enjoyed by non-union construction companies absorbed much of the cost of this policy.

1. Introduction

Since March 1992, the Fair Wage and Skill Development Policy (FWSD) has mandated that prevailing wages be paid on construction projects funded by the Province of British Columbia.[1] One goal of this policy was to arrest the decline in apprenticeship participation in the B.C. construction industry with additional benefits related to larger local economic impacts from public construction and an award process based on expertise, efficiency and quality instead of wage costs.[2] However, this policy, like other prevailing wage laws in Canada and the U.S., is controversial because of the presumption that it inflates construction costs on public projects and impacts taxpayers accordingly. Yet, despite a high level of public interest in this issue, surprisingly few studies have empirically estimated the cost impact of these kinds of policies. The few studies that have investigated this issue have suffered from the methodological errors of assuming away input substitution motivated by a fair wage law, failed to completely separate the effects of changes in the state of the industry from changes in construction wage policy, or researchers have confused the cost differential between public and private construction with the cost of a prevailing wage law.

In this paper we estimate the impact of the FWSD on the cost differential between private and public construction costs in British Columbia. Specifically, we find that construction projects funded by the Province of British Columbia prior to the fair wage policy were more expensive than privately funded projects. However, our results indicate that there was no statistically significant change in the public-private cost differential after the introduction of the FWSD. By focusing on the effect of the FWSD on the total cost differential between private and public construction, we avoid the methodological problems that have plagued previous studies. Our findings suggest that, in the case of British Columbia, the benefits of the fair wage policy associated with manpower development, economic impacts and award efficiencies greatly outstrip the costs of the policy.

The remainder of this paper is organized along the following lines. In section 2 we review the literature addressing the relation between fair, or prevailing wage policies and construction costs in Canada and in the U.S. In section 3 we describe the construction cost data from British Columbia

that extends over the period before and after the introduction of the FWSD. In section 4 we describe the regression model used to estimate the cost differential between provincial and private construction projects and to determine if this differential was affected by the requirements of the FWSD. In section 5 we present estimates from the empirical model. We provide an explanation of why the FWSD may not have increased the construction cost differential and discuss implications for future research and policy in section 6.

2. Empirical Cost Estimates of Fair and Prevailing Wage Policies

In 1993 the Quantity Surveyors Society of British Columbia concluded that the FWSD increased construction costs from 6 to 7 percent and cost taxpayers $100 million annually.

The Quantity Surveyors Society study is based on an examination of 7 of the 109 provincial construction projects awarded between March of 1992 and June of 1993 to nonunion contractors and subject to the FWSD policy. The Surveyors estimated the added cost of complying with the FWSD by calculating total labor costs using wage rates from the FWSD and wage rates under open shop conditions. These labor costs were then adjusted to reflect the ratio of labor costs to total costs to arrive at the final estimate of the percentage increase attributed to the FWSD. While this methodology provides a measure of the impact of the FWSD on wages and labor costs, it does not provide an accurate measure of the total cost of this policy because it ignores any changes in labor hours that might result from increased productivity due to managerial efficiency, the substitution of capital for labor, or employing labor with more training. If any of these changes occurred with the introduction of the FWSD, the cost estimate provided by the Quantity Surveyors Society would be too high. Because of the possibility of changes in input utilization and input costs associated with the introduction of the FWSD, it is important to examine the effect of this policy on total construction costs.

There have been two academic studies that have examined the effect of fair and prevailing wage laws on total construction costs. The most recent study by Bilginsoy and Philips (2000)

examines the effect of the FWSD on school construction costs in British Columbia. The empirical analysis is based on construction bid tender data collected by the Construction Labor Relations Association from six school districts located in the southern region of the Province. The data cover 54 new school construction projects tendered and completed between 1989 and 1995. Of the 54 tenders, 25 were received before the introduction of the FWSD while 29 were received after the law. These data allow for a "before and after" test of the impact of the FWSD on the construction costs of a fairly homogenous group, elementary and secondary public schools. Based on a comparison of average real square meter public costs these authors find that public school costs increased by 16 percent after the introduction of the fair wage law. The authors also estimate real square meter costs before and after the FWSD with a model that controls for the construction business cycle, the number of bid competitors, type of school, the school district and time. Solving the estimated equations for a hypothetical school construction project yields a real per meter cost of $1,238 before the FWSD and $1,313 after the law took effect. However, the difference in these construction costs before and after the FWSD are not statistically significant.

The empirical results obtained from the before and after test conducted by Bilginsoy and Philips rely on the accuracy of the price index used to measure changes in construction costs over the period and on the use of time as a measure of the impact of the wage law. Just as substitution behavior on the part of consumers creates a difference between measured inflation and the actual price increases that households experience, the non-residential construction price index used in the study described above may overstate the actual price increases experienced by builders. For example, between 1989 and 1995 construction cost in British Columbia may have increased because of the combined effect of the general increase in prices and the wage requirements of the FWSD. However, if inflation measured by the price index overstates experienced cost increases, the price index may be picking up, and consequently masking some of the cost effect of the FWSD. If this is the case the FWSD cost estimate from Bilginsoy and Philips may be too low.

It is the reliance on the use of time as a measure of the impact of the FWSD that poses a more serious limitation on the interpretation of the empirical results obtained by Bilginsoy and Philips. For example, school construction costs may have changed after March 1992 because of the changes in wage policy and because of changes in the state of the construction industry. For example, in an early estimate of the cost impact of the fair wage law, Casselton (1992) reports that construction projects came in under budget during depressed conditions in the spring of 1992. Consequently, it was difficult for Casselton to assess the impact of the wage law by comparing costs before and after March of 1992 because of changing industry conditions at the time the law became effective. Similarly, changes in the state of the industry may also affect the school construction cost differential reported by Bilginsoy and Philips. These authors attempt to control for the cyclical fluctuation in construction sector activity by relying on the percentage deviation of actual permit values from the values obtained from a fitted linear trend of non-residential building permits. However, this linear fit is based on annual data over the seven-year period and may not capture quarterly or monthly cyclical fluctuations. Consequently, if a depressed industry lowered real construction costs at the time of the introduction of the FWSD, and if the control variable described above did not accurately measure this effect, the cost impact that Bilginsoy and Philips attribute to the FWSD may be biased.

The other study to examine the effect of prevailing wage laws on construction cost was conducted by Fraundorf, Farrell and Mason (1983) who examine the impact of the Davis-Bacon Act on total construction costs in rural areas within the United States. The Davis-Bacon Act is the prevailing wage law in the United States that governs wage determination for federally funded construction projects. The act has been in existence since 1931.[3] Fraundorf et al collected data on 215 buildings constructed in rural areas in 1977 and 1978. Approximately half of these buildings (113) were federally funded construction projects built under Davis-Bacon regulations while the remaining projects (102) were private buildings constructed without these regulations. Fraundorf predicted the log of total construction costs based on the square foot size of the building, dummy

variables for a variety of building materials and regional dummy variables indicating where the building was constructed. Fraundorf's focus variable is a dummy variable indicating whether or not the building was federally or privately financed. The authors found, controlling for other factors, that the total cost of a federal building was from 26 to 38 percent higher than the cost of a comparably sized private structure. The authors attribute this cost differential entirely to the impact of the prevailing wage law.

This finding is substantially higher than the impact provided by other studies that have estimated the cost of the Davis-Bacon Act based on required changes in wage rates and corresponding labor costs. The bulk of these studies indicate that the construction cost increase attributable to the Davis-Bacon wage differential is between 1.5 and 3 percent (Gujarati 1967; GAO 1979, 1983; Goldfarb and Morrall 1978, 1981; Gould 1971; Gould and Bittingmayer 1980; GOA 1979, 1983). On the other hand, Allen (1983) reports a modest Davis-Bacon impact of .3 to .4 percent while Bourden and Levitt (1980) fail to find a wage and corresponding cost effect of this law. Like the Quantity Surveyors' cost estimate of the FWSD, the studies listed above all share the basic technique of using wage rate and labor cost changes as the method of obtaining a measure of the total cost of projects built under Davis-Bacon requirements. As mentioned above, this method ignores input substitution or other actions by management that may offset the higher labor costs of a prevailing wage law. Consequently, this labor cost method can yield an estimate of a prevailing wage law that is too high. Even with this built-in upward bias, this method, applied by a variety of researchers, yields estimates of the Davis-Bacon Act that are surprisingly lower than the estimate obtained in the Fraundorf study.

The Fraundorf result is also surprising given that construction-worker labor costs, including wages, benefits and payroll taxes, as a percent of total construction costs including materials and labor, but excluding land purchases and architect fees in the United States in 1982, was 30 percent.[4] It is unlikely that the total cost of construction would fall from 26 to 38 percent from a regulatory change that was hypothesized to primarily affect a cost component that accounted for only 30

percent of total costs. The above suggests that the Fraundorf estimate of the cost differential between federally and privately funded construction is too high to be entirely attributed to the wage changes required by the Davis-Bacon Act. The most reasonable explanation of this high estimate is that the dummy variable used by Fraundorf captures the effect of the prevailing wage law and other regulations and practices that influence the cost of projects funded by the U.S. federal government. For example, the fittings and components in public buildings may be more expensive. Quality and workmanship specifications may be higher. In general, the fact that public owners are under different economic and political pressures compared to private owners may lead to higher costs differentials associated with public buildings independent of prevailing wage regulations. Unfortunately, the data used by Fraundorf do not allow for the kind of distinctions necessary to separate other influences from the effect of the prevailing wage law.

In this paper we improve on the method used by Fraundorf by separating the cost effect of public ownership from the effect of a fair wage policy. Using construction data for British Columbia before the introduction of the FWSD we are able to determine if a cost differential between government and private construction projects exists in the absence of the fair wage policy. We then determine if the FWSD altered the cost differential between government and private construction projects by examining data after the introduction of the FWSD. This approach also allows us to avoid problems associated with the kind of test employed by Bilginsoy and Philips. Since we focus on changes in the cost differential between public and private projects due to the FWSD, our results are not influenced by the changes in the state of the industry as long as conditions are the same for private as well as public construction activity, or as long as barriers affecting contractor movement between these sectors are absent. Since contractors are qualified and licensed to build public or private versions of the types of buildings included in our sample, there is no barrier that would distort a public-private cost differential if one or both of the sectors were depressed. For example, if the private segment of hospital construction was depressed, the number of projects and the level of bids would fall. Competition for public hospital construction would

increase with the bid price falling in a manner that would preserve the cost difference between public and private hospital construction. The same kind of mobility would preserve cost differentials if both sectors were depressed. In addition, since private and public construction costs are adjusted by the same price index, the results are free from the kind of deviations between measured and experienced inflation that may affect the results of the Bilginsoy and Philips study.

The construction cost data reported in Table 1 can be used to illustrate the differences in the three approaches described above. In Table 1 we report the number of public and private construction projects built in British Columbia before and after the introduction of the FWSD. Our overall sample of 723 projects consists of 173 private and 136 public projects built prior to the FWSD. After 1992, there were 201 private projects and 213 public projects. All of the public projects started after 1992 were covered by the FWSD. Table 1 also reports real square foot construction costs in British Columbia before and after the introduction of the FWSD for public and private construction. The study by Bilginsoy and Philips measures the impact of the FWSD by comparing public construction costs before and after March of 1992. Using this method and the data reported in Table 1 suggests that with the introduction of the FWSD, real public construction costs increased from $142.97 to $157.90, or 10.4 percent, per square foot. However, as stated above, construction costs after 1992 may have been influenced by the FWSD and by changes in the state of the industry. If Casselton's observation, that construction projects came in under bid in a depressed construction industry after 1992, is correct, then the FWSD cost estimate of 10.4 percent is too low.

TABLE 1

Private and Public
Average Real Construction Costs Per Square Foot
Before and After FWSD

Before FWSD	After FWSD
Private Square Foot Cost	Private Square Foot Cost
$96.24 (CAN)	$97.10
(56.3)	(57.7)
N= 173	N= 201
Public Per Foot Cost	Public Per Foot Cost
$142.97	$157.90
(60.4)	(88.58)
N= 136	N= 213

Standard deviations in parentheses

On the other hand, the approach used by Fraundorf relies on a comparison of private and public construction costs during the period when the prevailing wage law is in effect to obtain a cost estimate of the wage legislation. Applying this method to cost data for British Columbia reported in Table 1 indicates that after the FWSD, the difference between public and private real square foot costs is $60.80 ($157.90 - $97.10), or 63 percent. These figures would provide an accurate estimate of the cost of the FWSD if the wage requirements of this law were the sole determinant of the cost differential between private and public construction. However, the data for the period before the FWSD indicates a real square foot cost difference between public and private construction of $46.73 ($142.97 - $96.24), or 48.6 percent in the absence of the fair wage law. This finding suggests that the method used in the Fraundorf study provides an estimate of a prevailing wage law that is too high because factors other than the prevailing wage law contribute to the cost differential between public and private construction. Moreover, these data allow us to examine changes in the public-private cost differential with the introduction of the FWSD. For example, the data discussed above indicate that the real square foot cost difference between public and private construction increased by $14.07, or by 30 percent with the introduction of the FWSD. With this approach we

have controlled for a pre-existing public-private cost differential and, if the state of the industry is the same in both sectors, this method is free of the methodological problems encountered with the other approaches. However, while the average cost data reported in Table 1 can be used for illustrative purposes, they do not provide for an accurate estimate of the cost of the FWSD because they do not control for other factors, such as changes in the distribution of building types before and after the law, that can affect relative costs. In the following sections we describe a method of examining the affect of the FWSD on construction costs, holding many other factors that also affect costs constant.

3. Construction Data for British Columbia, 1989 to 1995

The results of this study were derived from information obtained from Canadata, an organization that collects and disseminates data on construction projects to the industry. These are the most comprehensive data available for analyzing construction costs in British Columbia. These data provide information on construction costs at the start of the project, or bid price, as opposed to final cost, for approximately 13,000 projects built between 1989 and 1995. Since the Fair Wage and Skill Development policy came into effect in March of 1992, we are able to measure the cost difference between government and private projects before and after this period. However, since the cost data are based on the bid price, not the final cost of the project, we are unable to control for differences in add-on cost submissions that low ball bidders may use as a means of padding artificially deflated bids. Using the bid price as a measure of total cost, Fraundorf finds a significant Davis-Bacon Act. However, Fraundorf reports less robust results when the square foot of the bid price is used as the dependent variable. Similarly, Bilginsoy and Philips fail to find a significant fair wage effect based on square meter costs. These findings suggest that the empirical effect of a prevailing wage law may be sensitive to the specification of the dependent variable. To avoid this kind of confusion concerning the effect of the FWSD on construction costs, we report results of estimates based on total and square foot bid prices.

These construction data contain information on detailed structure type, project scale, and technical characteristics of the project such as number of stories, heating type and the date the project was started. In contrast to the data used by the Quantity Surveyors, the advantage of the information provided by Canadata is that it reports a large number of construction projects making it possible to compare construction costs on similar projects in the private and public sectors before and after the implementation of the FWSD. This is essential if one is to sort out the cost differences associated with the 'fair wage' policy from cost differences associated with other factors.

To focus on the changes in the cost differential caused by the FWSD, we have limited these data to only those projects funded by private companies and by the Province of British Columbia (projects funded by the Canadian government are not included). We have also omitted all projects with a value less than $1.5 million (CAN) since projects under this value were not initially affected by the FWSD.[5] As a consequence of these limitations and of removing observations with missing values, we are left with a sub-sample of less than the total 13,000 observations in which to focus on the cost differential between private and provincial construction projects costing $1.5 million or more.

We use two extracts from the data set described above to estimate the empirical results reported below. The first, relatively large extract (n=723) has the advantage of a large number of construction projects funded by private companies and by the Province of British Columbia. This sample is the basis for the data reported in Table 1 and consists of 309 private and 414 publicly funded construction projects. This large extract also allows us to control for a variety of factors, including heating and exterior wall type that influence construction costs. We use OLS to obtain the model estimates reported below (see tables 2 and 3). However, since approximately 25 percent of the project owners (the cross-sectional units) in this sub-sample purchased more than one construction project between 1989 and 1995, the assumption of a constant intercept and slope, particularly among this "pooled" component of the sample, may be unreasonable.[6]

To address this issue we also use a second extract to create a more balanced panel suitable for the estimation of a random effects model (REM).[7] This more balanced panel was created by deleting from the overall sample those project owners (the cross sectional units) that purchased fewer than two construction jobs over the period. While the benefit of employing the REM is increased parameter efficiency with the pooled data, the trade-off is a reduced sample size with altered characteristics. For example, the more balanced panel has 310 total observations of which 45 are privately funded projects (25 before the FWSD and 20 projects started after the law). Unlike the larger extract used to obtain the OLS results, we are not able to control for as many of the factors influencing construction costs such as exterior walls and heating types without reducing the size of this sample further.

A Lagrange multiplier test is used to determine if REM is favored over OLS and the results of this test vary with the definition of the dependent variable. For example, the Lagrange multiplier test fails to indicate a significant group-specific effect, suggesting that REM is not favored over OLS, when total costs are the dependent variable. However, this test indicates a significant group effect and suggests an advantage of REM when total costs per square foot are the dependent variable. Regardless of the estimation technique, or sample extract employed, the results reported below consistently indicate that the FWSD did not significantly increase the cost of public construction relative to the cost of private projects.

The nature of our research question also requires a trade-off involving sample homogeneity. For example, to be able to estimate the cost differential between public and private construction requires some heterogeneity with respect to building type. While our sample contains only building types common to public and private construction, there is not a sufficiently large sample of a single building type to compare public and private costs. As mentioned above, the advantage of the Bilginsoy and Philips study is the homogenous nature of the sample with respect to building type, public schools in this case. However, the construction of private schools during the period of their study was too small for a significant analysis of the impact of the FWSD on the relative costs of

private and public construction. We face the same limitation with respect to sample size. Individually, any building type is too small for the purposes of the comparative question, but collectively this heterogeneous sample provides a suitable size to allow for a comparison between public and private construction costs. Using the data in this way we can focus on how the FWSD affected relative costs and avoid the problems associated with the before and after test employed by Bilginsoy and Philips.

4. Estimating the Impact of the Fair Wage and Skill Development Policy

The following model applies to the two estimation techniques and data extracts described above:

$$\text{Ln TC} = \alpha + \beta_1 \text{ BC Project} + \beta_2 \text{ FWSD} + \beta_3 \text{ BC Project * FWSD} + \beta_4 X + \beta_5 Z + \mu$$

where Ln TC = natural log of total project cost in constant 1995 dollars. BC Project is equal to one if the project was funded by the provincial government of British Columbia and this variable is equal to zero if the project is privately funded. FWSD is equal to one if the provincial project was started after, and covered by the Fair Wage and Skill Development Policy. FWSD is equal to zero for those private and public projects started before the policy. BC Project * FWSD is the product of the BC Project and FWSD variables. X is a vector of building types common to public and private construction in British Columbia over the period. Z is a vector of variables that also affect building costs such as square footage, number of stories, method of heating, industry trends associated with time and whether the project was new or an addition. The X and Z vectors of independent variables are similar to those used in the Fraundorf study which also uses the log of total costs as the dependent variable. The error term is: which contains cross-section and time-series components.

With this specification we can examine several issues relevant to the literature addressing the effect of prevailing wage laws on total construction costs. For example, the coefficient for BC Project (β_1) measures the cost differential between government and private projects independent of the fair wage policy (if FWSD equals zero). There are two ways in which the fair wage policy can

affect construction costs. For example, in a noncompetitive bidding process, the FWSD may have allowed all contractors to pass higher labor costs on to project owners. In this case, FWSD would have a direct affect on costs and the coefficient for the FWSD dummy variable $9(\beta_2)$ would measure this independent effect. However, as mentioned above there were indications that a depressed industry after the introduction of the FWSD could be masking the independent cost impact of the policy. Since the FWSD dummy variable has a time aspect, it may be influenced by the state of the industry after 1992 and by the cost effect of the wage law. Problems associated with the state of the industry can be avoided by relying on the coefficient for the interaction term (β_3) as a measure of the cost impact of the fair wage policy because it measures the change in the cost differential between public and private construction projects after the introduction of the FWSD (if FWSD and BC Project both equal one). Since there is a time aspect to the FWSD, we report results from several specifications with and without measures of time. We also report, or discuss the estimates from models with the log of real square foot costs and nominal total costs as dependent variables.

5. Empirical Results

Regression results, with the natural log of real total construction costs as the dependent variable, are reported in Table 2.[8] This table contains the results of three specifications which include different time and wage policy variables. Regardless of the specification used, the results for BC Project indicate that the costs of publicly funded construction projects, before the introduction of the Fair Wage and Skill Development policy, are from 40 to 43 percent higher than privately funded projects in British Columbia.[9] The results for the interaction between the BC Project and FWSD dummy variables indicate that the cost differential between public and private projects is not significantly affected by the introduction of the fair wage law. Once again, this is the case regardless of the specification employed. The coefficients for the interaction terms from specifications 2 and 3 indicate an additional cost of public projects after the FWSD that is similar to

the estimate provided by the Quantity Surveyors Society (6.1 and 5.9 percent from Table 2 versus 6 to 7 percent from the Surveyors). The Surveyors' study was based on labor costs only and assumed away any input substitution that higher wages would prompt. Since substitution is a long-run process, we may not expect much change in input utilization in the period immediately following the introduction of the fair wage law. In addition, the construction manpower problems in British Columbia at the time would have compounded efforts to substitute. Hence, it is realistic to assume that input substitution would not occur to a significant degree under existing conditions. Consequently, the regression results would be similar to those estimates based on labor costs. However, while the regression results indicate a similar percentage change, they fail to achieve conventional levels of statistical significance suggesting that the introduction of the Fair Wage and Skill Development policy did not have a significant impact on costs.

TABLE 2

OLS Regression Results for Total Construction Costs in British Columbia, 1989 to 1995. Dependent variable is in (Real Total Costs)

Dummy Variable Reference Category	Variable	Specifications: 1 Coefficient	2 Coefficient	3 Coefficient
Funding:	BC Project	0.358** [43.0%]	0.338** [40.2%]	0.339** [40.4%]
Private Project		(7.45)	(6.25)	(6.00)
FWSD:	FWSD Project	---	---	0.010
Not FWSD Project				(.13)
(Interaction)	BC Project*FWSD	0.025 [2.5%]	0.059 [6.1%]	0.057 [5.9%]
		(.61)	(1.05)	(.90)
Census Sub.Div.:				
Not Vancouver	Vancouver	-0.059 -	.057	-.057
Exterior Walls:				
Reinforced	Concrete Block	0.062	0.068	0.069
Concrete	Wood Frame	-0.031	-0.032	-0.032
	Concrete	0.076	-0.079	-0.079
	Steel	0.045	0.043	0.043
Heating Type:				
Unheated	Electric	-0.012	-0.023	-.023
	Gas	-0.005	-0.015	-0.015
	Steam	0.017	0.039	0.038
Building Type:				
Parking Garage	Recreation	0.273**	0.282**	0.282**
	Clinic	0.274**	0.273**	0.273**
	Assembly	0.298**	0.320**	0.320**
	School (K-12)	0.247**	0.253**	0.253**
	Hospital	0.343**	0.358**	.358**
Construction Type:				
New Construction	Addition	-0.072	-0.073	-0.074
Year:	1990 ---		0.038	0.037
1989	1991 ---		0.020	0.020
	1992 ---		-0.061	-0.068
	1993 ---		0.014	0.005
	1994 ---		-0.018	-0.028
	1995 ---		-0.028	-0.0037
Continuous Variables:	Ln(Square Feet)	0.651**	0.650**	0.650**
		(20.46)	(20.34)	(20.34)
	# Stories Above	0.090**	0.091**	0.011**
	Ground	(8.58)	(8.44)	(8.41)
	# Stories Below	-0.002	-0.003	-0.003
	Ground	(-.54)	(-.08)	(-.08)
Constant:		8.012**	8.027**	8.025**
		(23.60)	(22.83)	(22.77)
(Adj) R^2=		70.0%	69.9%	69.9%
F=		89.62	68.05	65.3
N=		723	723	723
Durbin-Watson Statistic =		1.61	1.62	1.62

t-statistics in parentheses for selected variables, percentage impact of selected dummy variables in brackets.
** significant at the .01 level (two-tailed test)
- significant at the .05 level (two-tailed test)

Other results reported in Table 2 indicate that the FWSD did not have a significant independent impact on costs (the FWSD coefficient from specification number 3). Construction costs are not higher in the Vancouver census subdivision, nor are the different exterior walls and heating types, or additions more expensive than the reference categories. However, the building types common to private and public construction are significantly more expensive than the reference category. The signs of the coefficients for the year dummy variables are consistent with a depressed industry after 1992. Building size, measured by square feet and the number of stories above ground, significantly affect costs. Yet, adding stories below ground does not have the same affect. The cost elasticity with respect to project square footage is similar to that reported by Fraundorf suggesting some economies of scale by project size.

There is no theoretical justification for the use of total costs, as opposed to square foot costs, as the dependent variable. To determine if the estimates from British Columbia are sensitive to the measure of construction costs employed, we also report results from a model with the log of real square foot costs as the dependent variable. Results reported in Table 3 are consistent with those reported in Table 2 indicating a higher cost for public projects (ranging from 26 to 29 percent).[10] But, there is no significant increase in the public-private cost differential after the introduction of the prevailing wage law. The remainder of the results reported in Table 3 are similar to those from the estimate of real total cost with respect to significance levels for exterior walls, heating, building types and additions. The time variables (including FWSD) do not consistently suggest significantly different costs after 1992. This specification does not included the square footage of the structure as a right hand side variable and this omission accounts for the lower R^2.

TABLE 3

OLS Regression Results for Total Construction Costs in British Columbia, 1989 to 1995. Dependent variable is in (Real Total Costs Per Square Foot)

Dummy Variable Reference Category	Variable	Specifications: 1 Coefficient	2 Coefficient	3 Coefficient
Funding:	BC Project	0.255** [29%]	0.237** [26.7%]	0.248** [28.1%]
Private Project		(4.97)	(3.97)	(3.92)
FWSD:	FWSD Project	---	---	0.076
Not FWSD Project				(.78)
(Interaction)	BC Project*FWSD	0.029 [2.9%]	0.048 [4.9%]	0.028 [2.8%]
		(.62)	(.72)	(.38)
Census Sub.Div.:				
Not Vancouver	Vancouver	-0.132**	-.129**	-.129**
Exterior Walls:				
Reinforced	Concrete Block	0.114	0.126*	0.128**
Concrete	Wood Frame	0.053	-0.049	-0.049
	Concrete	-0.215**	-0.219**	-0.218**
	Steel	0.048	0.043	0.0042
Heating Type:				
Unheated	Electric	0.067	-0.005	-0.010
	Gas	0.064	0.058	-0.061
	Steam	-0.071	0.063	-0.072
Building Type:				
Parking Garage	Recreation	0.273**	0.276**	0.276**
	Clinic	0.298**	0.295**	0.294**
	Assembly	0.394**	0.400**	0.400**
	School (K-12)	0.331**	0.337**	0.337**
	Hospital	0.314**	0.326**	0.328**
Construction Type:				
New Construction	Addition	0.125**	0.126**	-0.124**
Year:	1990	---	0.084	0.082
1989	1991	---	0.083	0.080
	1992	---	0.028	-0.024
	1993	---	0.088	0.021
	1994	---	0.057	-0.001
	1995	---	0.017	-0.050
Continuous Variables:				
	# Stories Above	0.051**	0.052**	0.052**
	Ground	(5.10)	(5.15)	(5.15)
	# Stories Below	0.002	-0.001	-0.001
	Ground	(-.04)	(-.001)	(-.001)
Constant:		4.25**	4.200**	4.191**
		(36.03)	(30.86)	(30.96)
(Adj) R^2=		32.3%	31.9%	31.9%
F=		20.09	15.12	14.53
N=		723	723	723
Durbin-Watson Statistic =		1.45	1.45	1.45

t-statistics in parentheses for selected variables, percentage impact of selected dummy variables in brackets.
** significant at the .01 level (two-tailed test)
* significant at the .05 level (two-tailed test)

It is possible that the lack of a significant increase in the costs of public projects after the introduction of the FWSD is an artifact of price deflator used in the transformation to real costs. If inflation was the same for public and private construction over this period, it is unnecessary to adjust for inflation since we are examining changes in the public-private cost differential. To avoid potential problems associated with the use of the price index, we also estimated the model using the log of nominal construction costs as the dependent variable. These results, while not reported here, are consistent with those reported in Tables 2 and 3 indicating the FWSD did not increase the relative costs of public construction.[11]

Random effects model estimates, based on the panel extract, are reported in Table 4. We report results from a model similar to specification 1 from tables 2 and 3 (including measures of project ownership, BC Project, and of the effect of the FWSD on the private-public cost differential, BC Project*FWSD). This smaller sample does not include parking garages and recreation buildings among the building types. Also, due to the high number of missing values we are not able to control for heating or exterior wall types. These differences in sample characteristics and model specification may explain the higher estimated cost of public construction reported in Table 4 (approximately 47 percent in either model) . With respect to the real total cost results, the estimated impact of the FWSD on the cost differential between private and public construction is 2 percent, but is not statistically significant. This estimate is comparable to the result for BC Project from the similar specification reported in Table 2 (2.5 percent). The t-statistic for the interaction between BC Project and the FWSD for the real square foot cost results has the highest significance level (p-value = 14.3 percent, two-tailed test) of any of the estimates reported so far, however, the coefficient is negative indicating that the FWSD had the effect of reducing the cost of public relative to private construction by 6.5 percent.

TABLE 4

Random Effects Model Regression Results for Construction Costs in British Columbia, Panel Data Extract, 1989 to 1995.

Dependent variable is ln(Real Total Costs), or ln(Real Total Costs per Square Foot)

Dummy Variable Reference Category	Independent Variable	Dependent Variable in (Real Total Cost)	Dependent Variable in (Real Total Costs Per Square Foot)
Funding: Private Project	BC Project	0.384** [46.8 %] (3.62)	0.388** [47.4 %] (2.98)
Interaction	BC Project*FWSD	0.020 [2.0 %] (.44)	-0.067 [-6.5 %] (-1.46)
Census Sub.Div.: Not Vancouver	Vancouver	-0.053	-0.025
Building Type: Assembly	Clinic	0.197	0.105
	School (K-12)	0.286**	0.232**
	Hospital	418**	0.238
Construction Type: New Construction	Addition	-0.045	0.147**
Continuous Variables:	Ln(Square Feet)	0.718** (22.33)	----
	# Stories Above Ground	0.11** (4.14)	-0.013 (-.53)
	# Stories Below Ground	0.005 (.08)	0.051 (.84)
Constant:		7.166** (21.66)	4.386** (43.02)
Lagrange Multiplier Test Statistic:		2.22	4.57
N=		310	310

t-statistics in parentheses for selected variables, percentage impact of selected dummy variables in brackets.
** significant at the .01 level (two-tailed test)
* significant at the .05 level (two-tailed test)

Other results reported in Table 4 indicate that, from the total cost model, schools and hospitals are significantly more expensive to build than the reference category (assembly building). However, based on square foot costs, only schools are more expensive. Additions are associated with higher square foot costs, but do not have higher total costs. The elasticity of total cost with respect to the size of the project (square footage) is higher that the estimate reported in Table 2 suggesting fewer economies of scale among these building types. The building types included in the panel extract are also more expensive to build as the number of stories above ground increases. The same is not the case for stories below ground.

The Lagrange multiplier statistics can be used in a test of the random effects model against a homoskedastic, non-autocorrelated classic regression model with no group specific effects. Large values of the Lagrange multiplier favor the random effects model. The probability value for the test statistic from the model with the log of real total cost as the dependent variable is .136 (with 1 degree of freedom). This indicates that, only at a low level of statistical confidence, can we say that the REM model is preferred to OLS with respect to group-specific effects in the specification with total cost as the dependent variable. The probability value for the model with the log of real square foot costs as the dependent variable is .033 (with 1 degree of freedom), suggesting significant group-specific effects with an advantage to REM in the estimation of the costs per square foot.

6. Conclusion

In announcing the implementation of the Fair Wage and Skill Development policy in British Columbia, the Labor Minister observed that "...in terms of costs to government there is not much difference between union and non-union companies. Non-union companies bid within a few percent of the union companies but pay their workers in the neighborhood of 20 to 30 percent less." [12] The introduction of the FWSD would have erased this two-tier system and non-union companies would see their labor costs rise with the new requirements, but competition would have prevented the higher costs from being reflected in their bids. This explanation is consistent with our finding that,

while the prevailing wage law increased wages for construction workers, it did not increase the cost of public projects relative to private construction. Whether this type of bidding effect exists in other countries and has a similar affect on prevailing wage laws is the subject for further research.

Other researchers have commented on the distributional aspects of the FWSD. For example, Globerman, Stanbury and Vertinsky (1993) argue that the policy raises the cost of public construction, redistributes income to construction workers, reduces the total amount of public construction undertaken and may have adverse effects on minorities. While our results do not speak to the effect on minorities, they do suggest a distributional effect, but not of the kind implied by Globerman et al. Our results imply a redistribution of income from the owners of non-union construction companies to their employees without increasing the costs of, or reducing the amount of public construction.

The Fraundorf study has received considerable attention in the debate regarding the costs of fair wage policies in the U.S. Our results suggest that the Fraundorf estimate of the impact of the Davis-Bacon Act may be too high and that caution should be used before policy changes are made based on this study. Since the Davis-Bacon Act has been in effect since 1931, the type of before-and-after test conducted here is not possible. However, since many states are considering changes in their "little" Davis-Bacon Acts, future research in the U.S. should focus on the cost differences between those states with and without prevailing wage laws.

NOTES

1. The FWSD established the Schedule for Fair Wage Minimum Hourly Rates for specific construction occupations. The initial Schedule covered the period from March 30, 1992 to August 19, 1993 where the hourly wage rate under the Fair Wage Schedule was typically 88 percent, but ranged from 82 to 94 percent, of the corresponding building trade union rate as of May 1, 1992. Changes to the FWSD with respect to the types of projects covered were made in August 1993, but the fair wage schedule described above was not revised and remained unchanged over the period of this study.

2. The benefits of, and motivation for the FWSD are based on comments made by Moe Sihota, Minister of Labor, British Columbia at the time of the introduction of the policy.

3. The Davis Bacon Act provides for workers on federally subsidized construction projects to be paid the "prevailing wage" which the US Department of Labor has historically interpreted as the union wage. For more detail on this act see Thieblot (1975).

4. 1982 Census of Construction. Also, the 1992 Census of Construction indicates that labor costs as a proportion of total cost in 1992 were 26 percent.

5. Initially, the FWSD wage standards applied to provincial building construction contracts of $1.5 million or more. In August the threshold was lowered to $250,000 or more. For consistency, and to avoid having the changing threshold drive the empirical results, we include only those contracts over $1.5 million before and after the FWSD.

6. While many private owners purchased only one project between 1989 and 1995, a few school districts purchased a project in each year over the period.

7. See Kmenta (1986) pp. 616 to 635 for a discussion of the estimation techniques appropriate for pooled data.

8. The regression results reported in Table 2 have been corrected for heteroscedasticity using the technique developed by Breusch and Pagan (1979). The chi-squared statistics before the correction were 99.4, 108.5 and 108.6 for specifications 1, 2 and 3, respectively.

9. According to Kennedy (1981) the correct interpretation of the percentage change for a coefficient for a dummy variable in a semi-log estimate is given by the transformation: $(e^{\exists i} -1)$.

10. The regression results reported in Table 3 have also been corrected for heteroscedasticity using the technique developed by Breusch and Pagan (1979). The chi-squared statistics before the correction were 61.4, 74.7 and 73.6 for specifications 1, 2 and 3, respectively.

11. These results are available from the authors upon request.

12. See "Government Announces Fair Wage and Skill Development Policy", pp 1.

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