Revisiting the Costs of Developing New Subsidized Housing: The Relative Import of Construction Wage Standards and Nonprofit Development

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REVISITING THE COSTS OF DEVELOPING NEW SUBSIDIZED HOUSING

The Relative Import of Construction Wage Standards and Nonprofit Development

Scott Littlehale

ABSTRACT

Previous research into the costs of publicly subsidized new housing developments has found that nonprofit developers and program requirements to pay construction workers prevailing wages significantly raise project costs. An extended ordinary least squares (OLS) model is specified that aims to better capture the influence of project-specific variable costs and geographically correlated fixed costs. The model is tested with data from a 2014 State of California-sponsored affordable housing cost study. The OLS models' estimates indicate that prevailing wages are associated with between 5 to 7% higher project costs. The cost effect associated with a developer's tax exempt status is half as large as estimated in prior studies and is not consistently a statistically significant driver of costs. The model revisions help to identify other more important sources of cost variation, including large business cycle effects, fair market rents, average county construction wages, local government impact fees, and above-average architecture and engineering costs.

INTRODUCTION

The federal low-income housing tax credit (LIHTC) program simultaneously has been the lynchpin for below-market-rate (BMR) housing development finance in the United States since the 1980s and an occasional lightning rod in public fora for criticism about costs (Carless 2011; Schwartz, Anderson, and Floyd 2017). This paper aims to identify the sources of variation in the cost of developing and building below-market rate housing in California that is financed in part by tax credits and other forms of public subsidy. Public finance programs contain regulatory requirements that benefit construction workers and extend credit allocation preferences to nonprofit housing developers. To what extent do prevailing wage requirements and development of projects by nonprofits affect the total costs of developing new BMR housing?

This study revisits the data and analysis of the State of California’s Affordable Housing Cost Study (CAAHCS; State of California 2014). At the heart of that study is a dataset of 400 LIHTC-financed residential projects developed in California between 2001 and 2010 that includes project costs and a host of site, project, and developer characteristics. Like other empirical studies of subsidized housing development costs, ordinary least squares (OLS) regression is employed to test the relative influence of hypothetical cost drivers. After replication of the model that the State relied upon in drafting its official report, new specifications were introduced and tested. The new models specify additional, statistically significant variable and fixed drivers

Disclosure

The author is an employee of a labor organization that supports prevailing wage policies and provides financial support to organizations that advocate for public funding of below-market-rate housing. The author’s employer has not reviewed the contents of this study.

1. The dataset, which includes both administrative and developer survey response data, was compiled by the Blue Sky Consulting Group, the consultant retained by four sponsoring State of California housing finance agencies. The author is grateful to the sponsoring agencies and the Blue Sky Consulting Group’s Matthew Newman for providing the dataset subject to restrictions on the public use of the micro-data. The author is grateful to William Pavao and Gina Ferguson of the California Tax Credit Allocation Agency for discussing tax credit allocation regulations and certain elements of the dataset. The author also is grateful to Professors Dale Belman and Kevin Duncan for their econometric modeling suggestions, and to Matthew Palm, Ph.D., for his comments. Any errors are the responsibility solely of the author.
of project costs, reduce model dependence on region fixed effects dummy variables, and produce a superior fit with the CAAHCS data.

The revised models call into question the findings of past studies about the relative importance of housing subsidy program’s preferences for nonprofits and higher construction worker compensation. Estimates of the cost effects of prevailing wage standards for construction workers are statistically significant and between 5 and 7%, a finding that contrasts with previous studies’ OLS estimates that have ranged between 10 and 23%. The tax-exempt nonprofit status of a project’s developer likewise appears to have weaker association with costs and smaller effects than previously estimated.

Estimates of the effects of other variable and fixed cost factors are of greater consequence than prevailing wages or nonprofit developers. Policy objectives that could help reduce the cost of new housing development and construction include:

- Relax parking standards (a floor of structured parking for a four-story building raises costs 7–12%);
- Facilitate greater countercyclical spending on development and construction (after increasing 25% between 2004 and 2007, costs fell about 8% between 2007 and 2009);
- Enable developments to capitalize on economies of scale (doubling a project’s rentable area raises costs by about 85%—average cost per square foot decreases 8%); and
- Reduce the duration and arduousness of local entitlement review (four or more local project approvals during meetings raise costs 7%).

The revised models’ estimates reveal that when observable project characteristics are held constant, high project design costs per square foot are an important predictor of relatively high project costs. An increase of architect and engineer fees of $7 per square foot (the sample interquartile range) is associated with 13–14% higher project costs, ceteris paribus. This increase is disproportionately large, and merits deeper investigation in future research.

**REVIEW OF LITERATURE**

A body of academic and policy research has identified two factors—superminimum wage standards for construction workers (called “prevailing wage”) and developer characteristics—as important sources of higher costs of developing and building below-market-rate, tax credit-subsidized housing. This literature is summarized and critiqued below. The review also summarizes elements of prior empirical models that inform the alternative to the official CAAHCS model.

**PREVAILING WAGES AND NONPROFIT DEVELOPERS AS DRIVERS OF HIGHER LIHTC HOUSING COSTS**

At the inception of the federal LIHTC program, the federal statute mandated that state housing tax credit allocation authorities extend a preference to nonprofit developers. Despite the elimination of the statutory requirement in 2000, many states’ regulations continue to provide some advantages for nonprofit developers (Ballard 2003-2004). One of the earlier quantitative studies of developments financed by the Low-Income Housing Tax Credit focused on a finding that nonprofit developers were associated with higher costs (Cummings and DiPasquale 1999). Regression results indicated that LIHTC projects developed by nonprofits were 20.3% more expensive than projects developed by for-profit firms. The authors hypothesized that nonprofit developers “may bring less experience and less financial capital to a project than larger for-profit developers” (1999, 252).

Subsequent analyses of California LIHTC projects lent some support to Cummings and DiPasquale’s early findings. Dunn, Quigley, and Rosenthal (DQ&R; 2005) estimated that nonprofit developers were associated with 5–13% higher project costs.

Testimony and comments at preliminary public hearings held by the sponsors of the California Affordable Housing Cost Study, indicate that nonprofit versus for-profit tensions remain present in regulation policy making. The regression model that underlays the state-sponsored

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2. The full table of estimates from eight different models of total project costs is found in the data appendix, accessible via http://urbanpolicy.berkeley.edu/publist.htm. Newman, Blosser, and Haycock (2004) specified a model in which a project’s development by a nonprofit was associated with 12% higher costs.

3. E.g., see the transcript of one of several public hearings held in 2011 at the launch of the Cost Study process via http://www.treasurer.ca.gov/rtcac/meeting/staff/2011/20110914/transcript.pdf.
Technical issues and plausibility considerations call into question DQ&R’s IV model-generated upper estimates. IV model estimates were based on weak first stage instruments (Mukhopadhyay, Harris, and Wiseman 2013); effect size estimates changed dramatically depending on the specification, ranging from 19 to 36%. The IV estimates also approached or exceeded the average cost to construction contractors of employing blue collar labor. The Economic Census of Construction data indicate that construction worker compensation is merely 20% of net total construction value, on average. DQ&R found that site and structure construction costs were only 56% of the total project costs in their sample. By arithmetic, for prevailing wage requirements to increase residential construction costs by 20% or more, the standards would have to double labor compensation costs and have zero compensating positive labor productivity effects. To raise project costs by 36%, labor compensation costs would have to triple.

Newman, Blosser, and Haycock (2004) analyzed over 300 California LIHTC projects with an OLS model that varied only slightly from those used by DQ&R. Their resulting prevailing wage coefficients indicated that the requirement is associated with almost 12% higher total project costs. Staff analysts for the New York City Independent Budget Office, using an OLS specification that controlled for fewer project or funding characteristics variables than

7. Of 17 first-stage instruments, most were insignificantly related to whether or not projects required payment of prevailing wages. When the number of instruments exceed 15, a critical value for the first-stage F statistic in the two-stage IV model is 11.5 (Stock, Wright, and Yogo 2002). The value of DQ&R’s first-stage model F statistic of significance was less than three. Weak instruments can lead to large inconsistencies in IV estimates, and the estimates are biased (Bound, Baker, and Jaeger 1995).

8. Total payroll, including white collar employees, for contractors that specialize in apartment construction was only 23% of the net value of apartment construction work in 2007; the earliest year that the Economic Census recorded payroll by end-use specialization. Construction worker payroll was around two-thirds of the total payroll of specialty trade and new multifamily housing construction contractors in 2002, and fringe benefits, on average, were less than 30% of payroll in 2007. Net value subtracts from the value of total receipts work that was subcontracted to others. Payroll and receipts statistics by specialization in types of construction are contained in table EC0723SG06 of the 2007 Census of Construction, available via https://www2.census.gov/econ2007/EC/secctor23/EC0723SG06.zip. Ratios were calculated by the author from table EC0723SG06 of the 2007 Census of Construction, available via https://www2.census.gov/econ2007/EC/secctor23/EC0723SG06.zip. Construction worker payroll as a ratio of total payroll reflects a 73% ratio in the specialty trades (NAICS 238) and a 54% ratio for new multifamily housing construction contractors (NAICS 236116). The latter category accounted for 27% of total annual payroll for contractors that specialized in apartment construction in 2007.

9. DQ&R reported that site and structure costs were 56% of residential project costs, a distinct measure of project cost, but a calculation utilizing results from the authors’ simple regressions of the various cost variables on one another revealed that that was a typographical error. The authors made these supplementary results tables available for download via http://urban政策.berkeley.edu/publist.htm.

4. This review will not touch on hypothetical “wage differential” approaches to estimating project cost increases, which have been applied and published by various public policy research organizations. For a critical review of the wage differential method, see Duncan and Ormiston (n.d.).

5. For recent examples, see Stefanski (2016a), Diaz (2017), and Palm and Niemeir (2017).

6. The wide ranging estimates varied depending on whether the regression was by OLS versus IV, whether the model included dummy variables for geographic region, and whether or not the specification included project characteristics that had failed the authors’ earlier tests of statistical significance. Omission of geographic dummies and inclusion of project characteristics that were poorly correlated with costs resulted in a higher coefficient for the prevailing wage requirement indicator variable.
either DQ&R or Newman et al., estimated that prevailing wage requirements increased total low income housing construction costs by 23% (Stefanski 2016a; Stefanski 2016b). Palm and Niemeier (2017) analyzed nearly 500 more recently developed California LIHTC projects and found that prevailing wage requirements were associated with 15% higher costs. The Palm and Niemeier models, which did not include developer or project funding traits, had inferior R-squared measures of model fit relative to earlier California studies.

To summarize, the small body of extant literature that analyzes the cost of LIHTC-financed housing has found that California project development by a nonprofit entity and prevailing wage requirements for construction workers each raise costs as much as 12%. One recent OLS-based set of findings yielded a higher estimate, but the study did not control for any other regulation-related costs. Past models also have estimated that nonprofit developers are associated with higher costs that are both significant and important relative to other specified cost-drivers.

THE IMPORTANCE OF CONTROLLING FOR VARIABLE AND FIXED COSTS

The models to date have been specified with relatively few continuous project control variables or variables that measure geographically or temporally specific influences. It is conceivable that prevailing wage and nonprofit developer indicator variables are correlated with omitted or latent sources of cost variation.

Two sources of costs that vary across projects that have not yet been considered in research on California low-income housing production include architect and engineer fees and local land-use entitlement fees. The State of Washington (2009), in its review of the costs of investment in affordable housing, found that the fees charged by the design team are strongly related to project costs. Mayer and Somerville (2000) found that a dummy indicator variable for the presence of local impact fees retarded the production of new housing. Ihlandfeldt and Shaughnessy (2004), who were able to employ a continuous measure of impact fees for housing in Dade County, Florida, found that impact fees on net increase total development costs for single family residences and that those costs are passed through to prices of new houses.

Fixed effect variables that control for unobserved sources of cost variation over time and space were the most important—but unexplained—variables in the models reviewed above. Cummings and DiPasquale (1999) found in their early high-N empirical study that LIHTC project cost per unit varied substantially across four highly aggregated regions of the United States. Among DQ&R’s unpublished coefficients for 14 geographic dummy variables, five or six regions had higher average costs relative to the reference region that ranged between 20 and 50%, after controlling for the observed project, developer, and funding factors. The model estimates of Newman, Blosser, and Haycock (2004) indicate that project costs in five of the eight specified geographic regions of California were significantly greater than the rural area reference region, ranging from 21% higher in greater Sacramento to 62% higher in the San Francisco Bay Area counties. With the advantage of having a larger dataset, Palm and Niemeier (2017) used counties, rather than multi-county regions, to instrument for unobserved spatial fixed costs. Project costs (including land) varied across major jobs- and population-center counties by as much as 45%. Geographic fixed effects are important even within New York City. BMR housing developments in Queens, for example, had 13% lower construction costs, other things being equal, than core Manhattan and Brooklyn locations (Stefanski 2016b).

The CAAHCS made the following efforts to control for fixed cost variables:

a. Statewide construction industry labor and materials input price inflation indexes, statewide by year, were used to deflate the published model’s dependent variable, which actually obfuscates the relative importance of input price variation in observed nominal cost trends.

b. Construction industry wages were averaged across all employees by county-year.

c. Business cycle indicators: unemployment rate by county-year; interest rate yields by year; and a set of year dummy variables that can capture unobserved, time-correlated drivers of project costs.

d. Geographic region: a set of 11 dummy variables that indicate regions defined by California tax credit program administrators.

10. The authors made all model output statistics available for download via http://urbanpolicy.berkeley.edu/publist.htm.
Gyourko and Saiz (2006) identified additional geographically fixed cost-drivers in their study of California housing construction costs: regional unionization and rugged terrain have important and statistically significant associations with costs in the authors’ nationwide sample of heavily populated United States metropolitan areas, which spanned the years 1980–2003. DQ&R (2005) included a dummy variable for a project located on an island in their project cost models. Unionization rates were deployed in DQ&R’s first-stage IV models, but were not used in any cost outcome variable regressions.

**EMPIRICAL ANALYSIS**

This study extends the literature about the influence of construction wage standards and preferences for nonprofit developers on below-market-rate housing costs by first replicating and then revising the model that informed the California Affordable Housing Cost Study (State of California 2014). Model revisions are motivated to specify variable and fixed costs factors that may correlate at the level of regions, influence project costs, and that ought to be independent of a project’s requirement to pay prevailing wages. A measure of success of this effort is whether substantial reductions can be made in the magnitude of the cost effect estimates of regional dummy variables.

Following replication of the official cost study model, the first two modified models utilize the same 286 observations. The final pair of model runs relax that constraint and utilize the maximum number of observations for which data were complete.

**DATA AND MODELS**

The State of California sponsored the compilation and analysis of a dataset of 402 LIHTC new construction projects that were placed in service between 2001 and 2011. Of those projects, data for the variables, included in various model specifications, were complete for between 286 and 321 projects. The 321 projects produced 26,375 new residential and nonresidential units within 26.2 million square feet of gross building floor area (excluding parking) at a cost of about $9 billion. The official report, including its appendices, provides documentation of the dataset and summarizes the hypothesized direction of association between various project, developer, financing, and regulatory factors and project costs.

The dependent variable in this study’s regression models is total project development cost, excluding the price of the land, (“project costs”). Total costs and costs for various categories of the project budget were third-party certified after apartments were placed in service. In the replication of the CAAHCS model, project costs were adjusted by the California Construction Cost Index (CCCI), a price index for a basic basket of construction inputs. Subsequent models utilize project costs measured in nominal dollars. Researchers have found that construction cost indexes such as the CCCI can distort more than they clarify trends in the final price of new buildings. Year fixed effects dummy variable coefficients become more important—and more clear indicators of year-to-year price changes—in regression models where project costs are in nominal dollars.

The requirement that workers on a project receive prevailing wages is measured in the CAAHCS with a binomial dummy variable. Dummy variables also measure whether a developer is a government entity, a tax-exempt nonprofit, a for-profit entity, or fall in a residual category that includes joint ventures.

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11. Controlling for other variables, the island-bound project was estimated to have been 46–54% more costly than mainland projects.

12. Unit and floor area square foot totals are the author’s microdata-based calculations based on 323 observations included in the most expansive regression model run in this study. Total project costs are expressed in 2016 dollars, where current dollars were adjusted using U.S. Bureau of Economic Analysis (n.d.) data.

13. The CCCI is based upon two regional building cost indexes calculated and marketed by a private information services company, Dodge Construction. The index is based upon averages of unionized construction hourly wages and the price of a relatively small basket of construction inputs across two regional markets (San Francisco and Los Angeles). The index does not measure either subcontractor markups on their input costs, nor does it measure movement of prices charged to developers or other end-users of construction services by general contractors. Mark-ups exert considerable influence on the final contract price paid by developers and other end-users (Harper 2014). Somerville (1999) concludes that the methodologies and performance of construction input cost indexes like the CCI in analyzing housing markets “are inappropriate for use in housing market research.”

14. Federally-determined and State of California-determined prevailing wages differ in some California counties. Administrative records, however, do not indicate which regulations applied to each “prevailing wage” project. Prevailing wage levels vary around California by county and by construction craft (Newman, Blasser, and Haycock, 2004). Prevailing wage rates also can vary within a county and for a given craft depending on whether or not the project is a structure with four or more stories. A dummy variable cannot capture those variations.
California’s Tax Credit Allocation Committee (TCAC) divides the state geographically into twelve regions.15 Dummy variables for these regions capture geographic fixed cost effects. The regions vary in character, both in relation to one another and internally.16 The possibility that intra-regional diversity may contain important, previously unobserved, variation in variable and fixed cost-drivers motivates the extensions in the CAAHCS model described below.

Year dummy variables utilized in the CAAHCS model were based on the year when project construction commenced. After replicating this model, year dummies subsequently represent the year that the project applied for tax credits.17 In the final version of the revised model, year dummies are discarded; the chain-type price index for private fixed investment in new structures, a continuous variable indexed to 2001, is used in their place.

Several additional project-specific variables were created with the CAAHCS dataset: site acreage, average residential square feet per unit, nonresidential building area as a percent of rentable building area, the ratio of the area of structured parking to rentable building area, local government permit and impact fees per square foot of gross rentable building area, architect and engineer fees per square foot, the number of loans that finance a project (a greater number of loans could increase overhead and other transactions costs), and a dummy variable for project duration that surpasses 24 months. Architect and engineer fees per square foot are intended to capture both relatively high development service input prices and to serve as a proxy for otherwise unobserved project complexity.

Supplemental fixed cost variables are the following: similar to DQ&R’s “island” control variable, a dummy indicator variable indicating that a project is located where snow depths accumulate to greater than or equal to one foot;28 a substitute measure for county-average construction pay, based on specialty trade contractors instead of general contractors;29 and HUD-established fair market rents (FMRs) for a two bedroom unit in a given area, in current dollars (the maximum rent that can be collected constrains a project’s financing).30

Some concepts identified as potentially important for housing production costs must await future research or applied to datasets with a national scope. Census tract-level measurement of topographical features could be fruitful.31 Due to small sample sizes in US Census surveys, construction industry unionization measures are impractical where the geographical unit of analysis is the county or metropolitan area and rural regions are included.

Estimates from five OLS regression models are presented in table 2. The dependent variable in all models is the natural logarithm of project costs, excluding the cost of land. Modifications to the baseline CAAHCS model are introduced serially in order to identify areas of notable change in the coefficients of the prevailing wage and nonprofit developer indicator variables. The progression of model modifications is as follows:

1. The official California Affordable Housing Cost Study (40 explanatory variables plus four omitted reference categorical variables).

2. CAAHCS model with modified year fixed effects: the set of fixed effects variables for capturing unobserved temporal cost-drivers is changed from the year a project broke ground to the year the project was awarded tax credits.

3. Alternative model (46 variables, after dropping eight variables and adding 14 new variables). The model is run on the same observations as Models 1 and 2.

4. Alternative model (44 variables, after dropping two survey response variables): the model is run on all observations for which data are complete (N=321).

5. Alternative model (27 variables, excludes year and region fixed effects dummy variables): The most parsimonious of the five models, a continuous interest rate measure and nationwide price index for new structures serve as measures of the temporal fixed effects; geographic fixed effects are captured solely by two continuous county-level variables and a dummy indicator for projects that contend with significant snow accumulation.

15. California Tax Credit Allocation Committee region definitions have changed since 2010. The City of Los Angeles now is designated as a region distinct from the rest of the county of Los Angeles. Model runs that altered the definition of TCAC regions did not alter the results reported below substantially.

16. For example, the City and County of San Francisco is its own region; the North and East Bay regions, on the other hand, include six diverse counties and a great diversity of communities, ranging from the highly urbanized, San Francisco Bay-shutting city of Oakland to the Central Valley agricultural belt community of Dixon. Palm and Niemeier’s (2017) models find that LIHTC project costs are 33-40% lower in Solano County than in Alameda County.

17. This choice was made ex post, informed by preliminary findings that the models’ measures of fit improved as a result of substituting project year for construction year. One rationale is that dynamics leading up to the application, which comes towards the end of the project’s process of assembling the major components of necessary financing, exerts a stronger influence on project budgets than the period of time that follows application.
The baseline replication model of project costs produces estimates very similar to the CAAHCS model for project costs-per-unit. The model fit for 286 project observations is good, though not as strong as Dunn, Quigley, and Rosen- thal’s (2005) OLS model of total project costs for 205 observations. Model 2, which substituted the LIHTC application year for the construction year and switched the dependent variable to nominal costs, improves overall model signif- icance and fit. Prevailing wage requirements are associated with 10–12% higher project costs; nonprofit developers are associated with 10% higher costs. The size of these effects is important relative to other variable costs in the model. The only project-specific variables with comparable effect sizes are project height and the project developer’s opinion that local government design review increased project costs by at least 5%. The model estimates effect sizes, respectively, of 9–10 and 7–8% higher costs.21

18. Snow accumulation can impact a project’s design as well as shorten the window of time for certain stages of construction and lengthen weather-related delays. The author used an average city snow depth of one foot in January 2017 for coding the variable (https://www.ndec.noaa.gov/snow-and-ices/daily-snow/CA-snow-depth-201701.csv). Five out of 323 projects, located in the cities of Bishop, Mammoth Lakes, and Truckee, fit the criteria. Bishop is a borderline case. No other projects were in cities with snow accumulations that approximated the one foot threshold. All five projects were developed by for-profit developers and all five required the payment of prevailing wages.

19. The measure used is county average specialty trade contractor annual pay during the project tax credit application year, expressed as a percent of the California statewide average for the project year. Specialty trade contractors make up the majority of hours worked to produce apartments.

20. Historical Fair Market Rents from 1983 to the present may be downloaded via https:/ /www.hudus

21. Gyourko and Saiz (2006) found terrain ruggedness and unionization to be influential. Ruggedness, as measured in the U.S. Department of Agriculture’s Natural Amenities Scale dataset, is aggregated at the county level, which can lead to misleading ratings for particular housing projects. For example, the city of Fresno, which lies at the heart of California’s Central Valley, would be coded by the Natural Amenities Scale with a “rugged” rating due to mountains in the eastern portion of the Fresno county and high hills in the western portion.

22. Descriptions of effect sizes are based on calculations of the anti-log of the model results coeffi- cient. For continuous variables, illustrative effect sizes are based on the interquartile range of the variable’s sample values.

23. The average developer assessment of project quality, despite its relatively large coefficient and assertions in the text of the CAAHCS, does not have a large effect. Movement across the interquartile range of the quality measure is associated with only 3% higher project costs.
### TABLE 2: OLS MODELS OF PROJECT COSTS (EXCLUDING LAND) (CONT)

#### DEPENDENT VARIABLES IN LOGARITHMS [t-ratios in parentheses]

| VARIABLE COSTS | CA AHCS REPLICATION | REV. 1 | REV. 2, N=321 |
|----------------|----------------------|--------|---------------|
|                | Input price-deflated $ | Nominal $ | Nominal $ | Nominal $ |
| Year fixed effects |                      |         |             |           |
| Yr Constr       |                      |         |             |           |
| Yr Awarded Tax Credits |                |         |             |           |
| Yr Awarded Tax Credits |                |         |             |           |
| BEA chain-type index |                |         |             |           |

| Housing Type / Resident Target (reference: Large/family) | CA AHCS REPLICATION | REV. 1 | REV. 2, N=321 |
|--------------------------------------------------------|----------------------|--------|---------------|
| HT_NonTarget                                           | 0.02 (0.29)          | 0.01 (1.14) |             |
| HT_SRO                                                 | 0.01 (0.29)          | 0.01 (1.14) |             |
| HT_Senior                                              | 0.19 (5.44)          | 0.18 (5.50) |             |
| HT_Special Needs                                       | -0.09 (1.71)         | -0.10 (1.98) |             |

| Res SF per Unit (100s) | CA AHCS REPLICATION | REV. 1 | REV. 2, N=321 |
|------------------------|----------------------|--------|---------------|
| Year fixed effects     |                      |        |              |
| Yr Constr              |                      |        |              |
| Yr Awarded Tax Credits |                      |        |              |
| BEA chain-type index   |                      |        |              |

| Includes Non-Res Area | CA AHCS REPLICATION | REV. 1 | REV. 2, N=321 |
|-----------------------|----------------------|--------|---------------|
| Year fixed effects    |                      |        |              |
| Yr Constr             |                      |        |              |
| Yr Awarded Tax Credits|                      |        |              |
| BEA chain-type index  |                      |        |              |

| SqFt Non Res: NonParking | CA AHCS REPLICATION | REV. 1 | REV. 2, N=321 |
|--------------------------|----------------------|--------|---------------|
| Year fixed effects       |                      |        |              |
| Yr Constr                |                      |        |              |
| Yr Awarded Tax Credits   |                      |        |              |
| BEA chain-type index     |                      |        |              |

| Permit & Impact Fees | CA AHCS REPLICATION | REV. 1 | REV. 2, N=321 |
|----------------------|----------------------|--------|---------------|
| Year fixed effects   |                      |        |              |
| Yr Constr            |                      |        |              |
| Yr Awarded Tax Credits|                    |        |              |
| BEA chain-type index |                      |        |              |

| Log Permit & Impact Fees/SF | CA AHCS REPLICATION | REV. 1 | REV. 2, N=321 |
|-----------------------------|----------------------|--------|---------------|
| Year fixed effects          |                      |        |              |
| Yr Constr                   |                      |        |              |
| Yr Awarded Tax Credits      |                      |        |              |
| BEA chain-type index        |                      |        |              |

| Log Lenders (Total) | CA AHCS REPLICATION | REV. 1 | REV. 2, N=321 |
|--------------------|----------------------|--------|---------------|
| Year fixed effects |                      |        |              |
| Yr Constr          |                      |        |              |
| Yr Awarded Tax Credits |                |        |              |
| BEA chain-type index |                      |        |              |

| Duration 24 Plus | CA AHCS REPLICATION | REV. 1 | REV. 2, N=321 |
|-----------------|----------------------|--------|---------------|
| Year fixed effects |                      |        |              |
| Yr Constr        |                      |        |              |
| Yr Awarded Tax Credits |                |        |              |
| BEA chain-type index |                      |        |              |

### TABLE 2: OLS MODELS OF PROJECT COSTS (EXCLUDING LAND)

#### DEPENDENT VARIABLES IN LOGARITHMS [t-ratios in parentheses]

| VARIABLE COSTS | CA AHCS REPLICATION | REV. 1 | REV. 2, N=321 |
|----------------|----------------------|--------|---------------|
|                | Input price-deflated $ | Nominal $ | Nominal $ | Nominal $ |
| Year fixed effects |                      |         |             |           |
| Yr Constr       |                      |         |             |           |
| Yr Awarded Tax Credits |                |         |             |           |
| Yr Awarded Tax Credits |                |         |             |           |
| BEA chain-type index |                      |         |             |           |

| FIXED COSTS | CA AHCS REPLICATION | REV. 1 | REV. 2, N=321 |
|-------------|----------------------|--------|---------------|
| Year fixed effects |                      |        |              |
| Yr Constr       |                      |        |              |
| Yr Awarded Tax Credits |                |        |              |
| Yr Awarded Tax Credits |                |        |              |
| BEA chain-type index |                      |        |              |

| log GC Avg Pay (CPI-adjusted/nominal) | CA AHCS REPLICATION | REV. 1 | REV. 2, N=321 |
|--------------------------------------|----------------------|--------|---------------|
| Year fixed effects                   |                      |        |              |
| Yr Constr                             |                      |        |              |
| Yr Awarded Tax Credits                |                      |        |              |
| BEA chain-type index                  |                      |        |              |

| Const Subs Wage (238): State Avg | CA AHCS REPLICATION | REV. 1 | REV. 2, N=321 |
|---------------------------------|----------------------|--------|---------------|
| Year fixed effects              |                      |        |              |
| Yr Constr                        |                      |        |              |
| Yr Awarded Tax Credits           |                      |        |              |
| BEA chain-type index             |                      |        |              |

| log Fair Market Rent (2BR) | CA AHCS REPLICATION | REV. 1 | REV. 2, N=321 |
|----------------------------|----------------------|--------|---------------|
| Year fixed effects         |                      |        |              |
| Yr Constr                   |                      |        |              |
| Yr Awarded Tax Credits      |                      |        |              |
| BEA chain-type index        |                      |        |              |

| Project Snow | CA AHCS REPLICATION | REV. 1 | REV. 2, N=321 |
|--------------|----------------------|--------|---------------|
| Year fixed effects |                      |        |              |
| Yr Constr       |                      |        |              |
| Yr Awarded Tax Credits |                |        |              |
| BEA chain-type index |                      |        |              |

| Region (reference: Central) | CA AHCS REPLICATION | REV. 1 | REV. 2, N=321 |
|-----------------------------|----------------------|--------|---------------|
| Year fixed effects          |                      |        |              |
| Yr Constr                   |                      |        |              |
| Yr Awarded Tax Credits      |                      |        |              |
| BEA chain-type index        |                      |        |              |

| Rural                     |                      |        |              |
| Capital/Northern          |                      |        |              |
| North & East Bay          |                      |        |              |
| South & West Bay          |                      |        |              |
| San Francisco             |                      |        |              |
| Central Coast             |                      |        |              |
| Inland Empire             |                      |        |              |
| Los Angeles               |                      |        |              |
| Orange County             |                      |        |              |
| San Diego                 |                      |        |              |
| Interest 10-year Rate     |                      |        |              |
| Unemprate                 |                      |        |              |
TABLE 2: OLS MODELS OF PROJECT COSTS (EXCLUDING LAND) (CON’T)

### DEPENDENT VARIABLES IN LOGARITHMS (t-ratios in parentheses)

| CA AHCS REPLICATION | REV. 1 | REV. 2, N=321 |
|---------------------|-------|--------------|
| Year fixed effects  |       |              |
| Yr Constr           |       |              |
| Yr Awarded          |       |              |
| Tax Credits         |       |              |
| 2002                |       |              |
| Const               | -0.073| 0.027        |
| Yr Awarded          | 0.040 | 0.049        |
| Tax Credits         |       |              |
| 2003                | -0.008| 0.071        |
| Yr Awarded          | 0.059 | 0.063        |
| Tax Credits         |       |              |
| 2004                | 0.031 | 0.136        |
| Yr Awarded          | 0.179 | 0.198        |
| Tax Credits         |       |              |
| 2005                | 0.062 | 0.202        |
| Yr Awarded          | 0.343 | 0.337        |
| Tax Credits         |       |              |
| 2006                | 0.156 | 0.247        |
| Yr Awarded          | 0.392 | 0.397        |
| Tax Credits         |       |              |
| 2007                | 0.230 | 0.325        |
| Yr Awarded          | 0.411 | 0.420        |
| Tax Credits         |       |              |
| 2008                | 0.149 | 0.304        |
| Yr Awarded          | 0.357 | 0.364        |
| Tax Credits         |       |              |
| 2009                | 0.166 | 0.309        |
| Yr Awarded          | 0.361 | 0.341        |
| Tax Credits         |       |              |
| 2010                | 0.097 | 0.282        |
| Yr Awarded          | 0.439 | 0.420        |
| Tax Credits         |       |              |
| New Structures Price Index | 0.009 | (14.60) |
| Constant            | 8.75  | 9.79         |
| N                   | 286   | 286          |
| R-squared           | 0.927 | 0.933        |
| F                   | 98.7  | 128          |

Unobserved geographic fixed effects captured by the region dummy variables are associated with cost variations that dwarf other variables in the model. Project costs in eight out of ten regions exceeded costs in the reference region, the Central Valley, by 15–62%. In contrast, a change of county residential general contractor average pay from the 25th percentile to the 75th percentile is estimated to have only a 3% response in costs. Unobserved drivers of regional costs—whether they truly are fixed or are instead variable costs that correlate with certain regions or time periods—clearly are important. The geographic dummies, in other words, do a lot of work to help the model fit the data, but beg questions about what factors underlie the huge cost differences.

The year dummies indicate that the California projects built from 2006–2009 cost 17–26% more than projects built during the 2001 baseline year, having taken into account inflation of prices of labor and material inputs measured by the CCCI. The year dummies in Model 2 should be interpreted as capturing year-over-year increases to nominal budgeted costs. Using the anti-logs of the coefficients of Model 2, one can calculate that Total Development Costs (excluding land) increased 21% just between 2004 and 2007.

The addition of variable and fixed cost factors in Model 3 yields improvements in both the F-test of joint significance and the R-squared measurement of explained variation of project costs. The revisions succeeded in reducing the importance of the geographic dummy variables, indicating that the revised model captures effects of previously unobserved variable and fixed cost-drivers that are correlated with region. The coefficients for prevailing wages and nonprofit developers are significantly lower than those of the baseline model, suggesting that the unobserved cost-drivers in the CAAHCS were correlated with the presence of a prevailing wage requirement or nonprofit developer.

Model 3, which has a better and more statistically significant fit with the data from 286 projects than Model 2, yields lower estimates of prevailing wage and developer type cost effects. The introduction of the new variable cost- and fixed cost-drivers reduces the effect size to 6%, which is about half of the effect size estimated by the CAAHCS model. Estimates of nonprofit developer cost effects drop even more, from 10% in Models 1 and 2 down to 5% in Model 3.
ers relative to other variable and fixed project costs also shrink. Considering variable costs first, Model 3 estimates that a one-to-four ratio of parking structure area to rentable building area is associated with 12% higher costs compared to projects with zero structured parking. Bigger average unit sizes and higher proportions of the total building area taken up by nonresidential uses decrease total project costs significantly. Economies of scale for producing housing mean that nearly doubling the floor area of a project’s buildings is associated with project cost per square foot savings of approximately 8%. Local government permit and impact fees that are almost $10 per square foot higher increase project costs by 4%.

Architect and engineer fees per square foot exert an outsized effect on project costs. The indicator is intended to serve as a proxy for project complexity and variable pricing over space and time of key real estate development service inputs. Higher design and engineering fees are correlated both with prevailing wage requirements as well as with projects that were developed by nonprofits. It is plausible that a latent factor or factors are at work that concurrently influence design and other development and construction input costs and increase the probability that a project will require payment of prevailing wages. Investigation of the correlates and causes of higher design costs warrants additional research in the future.24

Estimates for the two new fixed cost variables added in Model 3 show that it is possible to observe and estimate specific geographic correlates of costs. Project costs significantly correlate with regional rents and construction wages: Project costs are estimated to be 10% higher if HUD-regulated fair market rents for a two-bedroom apartment in the area are $1,350 as opposed to $800. Average county wages for specialty trades contractors that are 19% higher than other counties’ wages are associated with nearly 7% higher project costs. This effect size is more than two times greater than the effect estimated in California’s official cost study.

The robustness of the findings of Model 3 are put to a mild test in Models 4 and 5. Dropping two developer survey response variables that had higher rates of non-response—“average project quality” and the self-reported import of local government design review—expands the maximum number of observations in the regression models from 286 to 321 projects. Exclusion from Model 5 of the region and year dummy variables reduces the problem of having specific regions and years where there is little variation in the prevailing wage or nonprofit indicator variables.25

Estimates produced by Models 4 and 5 help to confirm that prevailing wage requirements and nonprofit developers have less of an influence on costs than previous studies have concluded. The coefficient for the nonprofit developer indicator loses statistical significance in Model 4, only to regain it in Model 5 once geographic dummy variables are dropped. Similarly, the effect size of prevailing wage first drops to 5%, then regains 1.5 percentage points when geographic dummy variables are omitted from the model.

Models 4 and 5 also help to solidify the case for including the variable and fixed cost indicators introduced in this paper in future research on housing costs. The variable cost factors—design costs, structured parking as a proportion of residential area, project scale, local government fees, and project duration—do not exhibit radical changes in significance or in effect size. The fixed cost factors of maximum allowable, fair market area rents, construction wages, and topographical-climatic challenges enhance our understanding of why projects vary in cost.

LIHTC-financed project cost escalation over the turbulent ten year period for housing markets covered in this study was not radically out of step with average nationwide movements in final prices paid for new structures of all types. Costs did escalate beyond national price indexes during the boom years, but the project year dummy effect sizes in Models 3 and 4 correlated strongly with the nationwide price index for private investment in new structures (included in Model 5).26 Deeper research is required to uncover whether the boom-year cost peaks in the sample data were unique to the production of income-restricted housing or were observed in the final price of structures throughout California’s real estate development sector.

24. Preliminary experiments with OLS models that include an interaction term, treatment effects models, and probit models indicate that architect and engineer costs per square foot exert an important independent influence on construction costs, project costs, and on the probability that a project will include a prevailing wage requirement.

25. For example more than 90% of the projects included in the sample that fall within the three TCAC regions that make up the San Francisco Bay Area were prevailing wage projects. In the Sacramento “Capitol North” region, 80% of the projects did not require prevailing wages. Prevailing wage projects were 63% of the overall sample of 321 observations.

26. The values of Pearson’s correlation coefficients between the modeled effect sizes of the year dummies and the yearly BEA new structures price index values are .94 and .95 for Models 4 and 5, respectively.
CONCLUSION

The requirement to meet state-regulated prevailing wage standards is associated with approximately 5–7% higher costs for California projects that received low-income housing tax credits between 2001 and 2010. Nonprofit developers are associated with 3–5% higher costs, but caution with those estimates is warranted, given that the indicator variable’s coefficient dropped below conventional thresholds of statistical significance when the sample size increased to include 35 additional projects. The estimates for both prevailing wage and nonprofits are half (or less) of the magnitude estimated in prior efforts to model LIHTC-financed housing project costs.

The revised models tested in this paper, which performed better than the model that underlay the official State of California Affordable Housing Cost Study, reveal that other factors are more important to determining costs and therefore warrant examination for cost control opportunities. Significant reductions of structured parking can lower project costs by more than 10%. Crafting funding and land-use regulations that increase opportunities to double the scale of LIHTC projects, which tend to be small, could yield per-square-foot total cost savings of up to 8%. Streamlining local government project approvals could save 5–7%. Containing the growth or expansion of local government permit and impact fees could reduce costs by 4%.

Most studies of prevailing wage influence on capital project costs have analyzed traditional public works projects (e.g., schools or highways). The preponderance of those studies found that prevailing wage cost effect estimates fail common threshold tests of statistical significance (Duncan and Ormiston, Prevailing Wage Laws: What Do We Know 2017). The findings in this study, which demonstrate that prevailing wages are significantly related to moderately higher costs of developing and building new housing, open up some new lines of inquiry. To what degree are wages and fringe benefits for privately financed residential construction workers lower than total compensation for nonresidential construction workers? How do prevailing wage standards impact the labor market outcomes of residential construction workers?

This study makes a contribution to future research on low-income housing development in so far as it reveals previously unobserved factors that appear to have been behind important, but unexplained, cost variations across California’s diverse regions. Those factors—maximum allowable rents, average wages of employees of specialty trades contractors, and a topographical indicator—can be measured and tested for significance and importance in models of low-income housing production costs anywhere in the United States.

Further research is needed to delve into the relationships between higher design and engineering costs, prevailing wage requirements, and total project costs. Architect and engineer’s fees per square foot exert a strong effect on project costs, but the model itself does not explain the disproportionate size of the associated cost increases. The findings resurface a challenge of causal inference that was first posed by Dunn, Quigley, and Rosenthal:

> If projects located in higher-cost areas (for example, in highly urbanized areas) were more likely to be required to pay prevailing wages ... then simple ordinary least squares regression models would falsely attribute these higher costs to the payment of prevailing wages (DQ&R 2005, p. 149).

Projects that otherwise cannot close funding gaps tap state or local subsidy sources that entail regulatory requirements such as payment of prevailing wages. Nonprofit developers may choose to tackle developing projects on challenging sites that require more complex design, engineering, and more costly construction. The result is a distribution of prevailing wage requirements across new, publicly subsidized housing developments that decidedly is not random, as shown in Table 3.

### TABLE 3: SELECTED STATISTICS BY REGION

| REGION            | Number of Projects | Const Wage (Percentage of State Average by year) | NonProfit (Percentage of Region’s Projects) | PW (Percentage of Region’s Projects) | Stories 4 Plus (Percentage of Region’s projects) |
|-------------------|--------------------|-----------------------------------------------|---------------------------------------------|-------------------------------------|-----------------------------------------------|
| San Francisco     | 8                  | 130%                                          | 58%                                         | 100%                                | 100%                                          |
| North & East Bay  | 43                 | 118%                                          | 74%                                         | 91%                                 | 23%                                           |
| Los Angeles       | 50                 | 98%                                           | 88%                                         | 84%                                 | 48%                                           |
| Orange County     | 6                  | 104%                                          | 36%                                         | 50%                                 | 0%                                            |
| San Diego         | 31                 | 97%                                           | 61%                                         | 37%                                 | 21%                                           |
| South & West Bay  | 31                 | 131%                                          | 42%                                         | 97%                                 | 39%                                           |
| Rural             | 16                 | 80%                                           | 13%                                         | 63%                                 | 0%                                            |
| Central Coast     | 31                 | 94%                                           | 34%                                         | 52%                                 | 16%                                           |
| Inland Empire     | 33                 | 85%                                           | 31%                                         | 39%                                 | 0%                                            |
| Central           | 45                 | 81%                                           | 50%                                         | 53%                                 | 0%                                            |
| Capital & North   | 41                 | 76%                                           | 12%                                         | 27%                                 | 2%                                            |
As discussed above, Dunn, Quigley, and Rosenthal’s attempt to instrument for prevailing wage requirements did not manage to meet critical tests of statistical significance that produce unbiased estimates. That should not deter exploration of alternative research designs and statistical estimation techniques besides OLS regression in order to grapple with the problem of endogeneity of variable cost-drivers.

The analysis in this paper also brought into sharp relief the dramatic project cost implications of the up-swing of the 2000s housing business cycle, which raised current dollar prices of new structures nationwide by 46% and California LIHTC project costs by even more. These increased costs surpassed rates of inflation for construction wages and housing material prices, suggesting that contractors, architects, and others who sell services to housing developers came to possess and wield pricing power. This phenomenon is worth deeper exploration.

Improving the ability of affordable housing developers to be able to build more during business cycle troughs and less during booms would help subsidy dollars for new housing go farther (as well as have ancillary counter-cyclical benefits for employment in an industry). Unfortunately, production of LIHTC-financed new housing has been more pro-cyclical than counter-cyclical. Over the five years of the 2004–2008 construction boom, tax credits were allocated to 618 new housing projects in California that delivered 46,600 BMR units (U.S. Department of Housing and Urban Development 2017). In contrast, between 2009–2013, when the national price index increased a mere 8%, 527 California projects receiving credits contained 28% fewer total BMR units.

The decline in California low income housing production between 2009 and 2013 would have been greater had the State of California not been able to provide direct grants and loans to develop and rehabilitate low income housing. Availability of additional state funds was in part the product of ballot box approval of the Housing and Emergency Shelter Trust Fund Act of 2006, which provided $1.35 billion in state-issued bond proceeds for a wide variety of housing-related development projects and $580 million in funds dedicated specifically for state multifamily housing support programs. Opportunities to capture the savings of producing subsidized new housing during the next building bust rather than boom will depend on the ability of local, state, and federal policymakers to amass and husband funds for the future.

27. The nationwide employment cost index for construction employee compensation rose 30% from 2001 to 2008. The general building prevailing wage (hourly wage and fringe benefit compensation) for Los Angeles county and Alameda county carpenters rose 35% and 40%, respectively, according to archived federal Davis-Bacon Act prevailing wage determinations (available for download via http://www.wdol.gov/).

28. Examination of the Project Credit Allocation Year dummy variables in Model 4 (see above) suggests that California LIHTC project costs rose 33% on average over the same period, controlling for other variables besides time that affect costs.

29. California LIHTC-financed BMR units from 2009–2013 versus 2004–2008 did not decline by as great a percentage as was experienced on average nationwide (U.S. Department of Housing and Urban Development 2017b).
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