RAND

Research Report

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Project Labor Agreements and Affordable Housing Production Costs in Los Angeles

Revisiting the Effects of the Proposition HHH Project Labor Agreement Using Cost Data from Completed Projects

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About This Report

This report presents results from updated research based on previous RAND research assessing how attaching a project labor agreement (PLA) to Proposition HHH, a large-scale public funding initiative meant to spur the production of permanent supportive housing projects in Los Angeles, affected project costs. PLAs are mandatory contracts covering certain construction projects that require the use of a virtually 100 percent union construction workforce in addition to regulating other important job site characteristics including banning both strikes and lockouts.

The goal of this updated study is to generate rigorous empirical evidence on the trade-offs involved in combining policies aimed at producing publicly subsidized affordable housing with PLAs, a phenomenon that increased over the last decade in multiple jurisdictions in California. Consistent with the RAND Corporation's mission to provide rigorous, objective, nonpartisan research and analysis, all the data and code related to this project is publicly available so that interested researchers may replicate and build on the results presented.

This research was conducted by the Center on Housing and Homelessness (CHH), part of the Community Health and Environmental Policy Program within RAND's Social and Economic Well-Being (SEW) division. The RAND Center on Housing and Homelessness is focused on providing policymakers and stakeholders with timely research and analysis addressing the dual crises of housing affordability and homelessness. For more information, visit www.rand.org/chh.

Community Health and Environmental Policy Program

RAND Social and Economic Well-Being is a division of RAND that seeks to actively improve the health and social and economic well-being of populations and communities throughout the world. This research was conducted in the Community Health and Environmental Policy Program within RAND Social and Economic Well-Being. The program focuses on such topics as infrastructure, science and technology, industrial policy, community design, community health promotion, migration and population dynamics, transportation, energy, and climate and the environment, as well as other policy concerns that are influenced by the natural and built environment, technology, and community organizations and institutions that affect well-being. For more information, email chep@rand.org.

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Summary

This report presents updated estimates of the causal effects of a PLA attached to Proposition HHH in Los Angeles, a 2016 Los Angeles ballot initiative to provide seed funding for the production of up to 10,000 units of PSH for people experiencing chronic homelessness. The PLA required the use of virtually 100 percent union construction labor on projects seeking funding if they comprised 65 housing units or more. A 2021 RAND report found that this requirement led developers to disproportionately propose smaller housing projects that fell below the PLA threshold. The study also found that larger projects that were affected by the PLA had 15 percent higher construction costs per unit, an increase equal to roughly 9 percent in total development costs (TDC).

The 2021 RAND report used estimated cost data provided by developers seeking project funding as virtually no HHH-funded projects were completed when the original study was conducted. This report updates the findings on the cost effects of the HHH PLA by using actual TDC data for completed projects that have been placed in service. Using these updated data indicates that the HHH PLA increased project costs by 21 percent, more than twice the amount originally estimated in the original RAND report.

This report also addresses the findings from a 2024 report released by the UC Berkeley Labor Center suggesting the findings from the original 2021 RAND report were not supported by a reanalysis using actual cost data. The authors estimated large point estimates, but they lacked statistical significance leading the authors to conclude that the hypothesis that the HHH PLA did not increase project costs could not be rejected. I show that this result was driven by errors in the cost data source used by the researchers and provide a replication of their result and revised findings when the incorrect data points in their analysis are either omitted or corrected. Using either method, the findings become highly statistically significant.

Policy Issue

PLAs are contracts between a funding entity (typically a government or a public private partnership) and a consortium of area trade unions governing jobsite requirements. PLAs have been used for large public works projects in many parts of the U.S. for several decades. These agreements stipulate that virtually 100 percent of a project's construction workforce must be union workers in exchange for guarantees designed to enhance the stability of a project (provisions forbidding both strikes and lockouts) and other worksite regulations. In recent years, public funding for affordable housing in Los Angeles including Proposition HHH and, more recently, the voter-approved ballot initiative Measure ULA (City of Los Angeles, 2022), have included requirements for the use of a PLA as a condition of receiving funding (Suzuki et al., 2022).

Advocates of PLAs argue that they do not increase project costs but do lead to more timely completion of projects and higher quality work while increasing the demand for union workers, who enjoy higher pay and better working conditions than non-union workers. Critics of PLAs argue that they increase costs and decrease competitiveness through limiting the pool of contractors bidding on covered projects.

As more public funding is tied to the use of PLAs, it is increasingly important to understand the potential tradeoffs between mandating the use of a union workforce and reducing the total amount of housing produced for a given level of taxpayer resources.

Research Design

This project uses a causal research design that compares cost differences between a sample of 75 completed and placed in service permanent supportive housing projects (50 HHH-funded and 25 non-HHH-funded) that were produced over an 8-year period in Los Angeles. The study uses a regression-based statistical model that draws on aspects of multiple modern, design-based causal inference models to estimate the causal effect of the HHH PLA on project costs. The study additionally compares differences in estimated and actual project costs according to both the HHH funding status and PLA status of housing projects after controlling for important project characteristics. Finally, the study estimates the effect of the HHH PLA on project completion time, a potential mechanism for cost differences for projects subject to the PLA.

Key Findings

The study's key findings include the following (amounts are in terms of 2021 dollars):

- After accounting for project characteristics, the actual total development costs of projects subject to the HHH PLA were $92,700 (21 percent) higher, on average, than non-PLA, HHH-funded comparison projects that had an average cost of $585,000 per unit.
- For smaller, HHH-funded projects not subject to the PLA, actual total development costs per unit were $8,000 lower than estimated costs on average, while actual total development costs per unit for HHH-funded PLA projects were $25,000 higher than original cost estimates on average.
- One potential mechanism for the higher costs of projects affected by the HHH PLA is longer completion time. Estimates indicate that these projects took 8 months (27 percent) longer to complete on average than similar non-PLA projects that were completed in an average of 2.5 years.

Recommendations

The results from this study highlight large financial tradeoffs involved in requiring the use of PLAs in the production of affordable housing. A simple rule of thumb is that the use of a PLA incurs a cost equal to 1 of every 5 affordable housing units that could be produced through funding programs without a PLA. Recommendations arising from these findings include the following:

- Policymakers and voters should incorporate the tradeoff in housing units when weighing the benefits and costs associated with the use of these agreements.
- More research and transparent data including documenting the shares of union workers on PLA and non-PLA developments is needed to better understand the tradeoffs of using PLAs to inform the most effective policies that can address construction workforce goals and the timely, efficient production of affordable housing.

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Chapter 1. Introduction

The 2021 study "The Effects of Project Labor Agreements on the Production of Affordable Housing Evidence from Proposition HHH" (hereafter, "(Ward, 2021)) generated estimates of the causal effects of the addition of a PLA to the voter approved, 2016 ballot initiative, Proposition HHH. This law raised $1.2 billion through a bond fund backed by a special property tax levy to provide funding intended to spur the production of up to 10,000 units of PSH—deeply subsidized affordable apartments with integrated service provision aimed at housing and addressing the needs of individuals with a past history of chronic homelessness. HHH funding was provided through a competitive application process that awarded 25 to 30 percent of a proposed project's development costs. This was meant to be part of a leveraged financing approach where partial funding from HHH was one early component of a larger "capital stack" comprising perhaps four to six funding sources including funding from other bond-backed state and local funding programs and funding from the federal Low Income Housing Tax Credit program (LIHTC).

HHH awards began in 2017 and very early in the process of implementing the funding, the Los Angeles city council added a PLA requirement that applied to proposals for projects comprising 65 or more housing units. A PLA is a pre-bid contract between a funding entity and area construction unions specifying the conditions of construction on a relevant project. A building contractor hoping to win a contract for a covered project must become a signatory to the PLA, which covers topics including hiring authority, worker ratios (both union and nonunion workers and journey- and apprentice-level union workers), limitations on strikes and lockouts, procedures governing grievances and arbitration and, in some cases, incentivizing or requiring targeted hiring of local and/or historically disadvantaged workers. PLA critics suggest the agreements directly increase costs by disincentivizing bidding on projects by nonunion contractors and reducing flexibility over the composition and deployment of the project workforce. PLA advocates argue that PLAs lower costs through timely completion of projects and increase competitiveness by providing a level playing field for union contractors regarding wages, benefits, and working conditions.

Ward (2021) used data on proposed project characteristics and estimated costs that were submitted either to the state of California as part of applications to receive LIHTC funding or, for projects close to or in development, to the California Department of Industrial Relations as part of the wage monitoring process. The study had three main findings. The first was that the PLA added approximately 15 percent to construction costs for projects affected by it, over and above the payment of "prevailing wages" (union level wages required to be paid on all HHH-funded projects). The second was that there was a strong behavioral response among developers using HHH to propose projects just below the 65-unit threshold, leading to fewer units being proposed overall. The third finding used a simulation exercise that combined the cost estimates of the PLA with the behavioral response of proposing smaller projects was that the HHH PLA and the 65-unit threshold used to apply it resulted in approximately 10 percent fewer units overall being produced with HHH funding than would have been produced in the absence of the PLA.

The Motivation for this Report

An important limitation of Ward (2021) that was acknowledged in the original report was the use of estimated cost data versus actual cost data. This was due to the fact that virtually all HHH-funded projects were either in pre-development or development phases when the study was undertaken. Since this time, a large share of these projects have been completed and placed in service. This has made it possible to reevaluate the costs of the HHH PLA using the cost data on finished projects. These data may lead to different conclusions since the estimated cost data represent expected costs, but many factors could lead to differences in actual costs including a project being completed more quickly or more slowly than anticipated, encountering unexpected regulatory barriers, changes in materials or labor costs, and so on.

Data on total development costs (TDC) for both HHH-funded and non-HHH-funded projects have been released and periodically updated by the Los Angeles Housing Department (LAHD). These data do not contain cost breakdown by category—for example, construction costs, which was the outcome used in Ward (2021). Thus, this report uses TDC as the outcome. The use of this outcome required some modest changes to the statistical model used in Ward (2021) that are discussed in more detail below.

Further motivation for revisiting this research arose from the May, 2024 release of a report conducted by researchers at the UC Berkeley Labor Center. "Evaluating the Impact of Project Labor Agreements on the Cost of Affordable Housing Projects: Proposition HHH in Los Angeles" (Lopezlira and Farmand, 2024) revisited the question of the HHH PLA's effects on project costs using these newer data on actual costs from LAHD on the same projects used in the Ward (2021) study and the same statistical model.[1]

This report focused on a smaller subset of the 97 projects (69 HHH-funded projects and 28 non-HHH-funded projects, with 19 of the HHH-funded projects subject to the PLA) analyzed in Ward (2021). LF (2024) restricted analysis to a total of 75 of these 97 projects that had been completed and "placed in service" as of May 2024 (50 HHH-funded projects and 25 non-HHH-funded projects, with 12 of the HHH-funded projects subject to the PLA and 14 of the non-HHH-funded projects comprising 65 units or more). The LF (2024) reanalysis led the authors to

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[1] The release of the Ward (2021) report included the public dissemination of the full data set and analysis code to allow interested researchers to further scrutinize or build on the study's findings. LF (2024) used the code and other data from this report with new data on costs from LAHD.

different conclusions than Ward (2021). Specifically, their analysis found that the estimates for PLA projects lacked statistical significance at the 95 percent confidence level, a common metric used to categorize results as meaningful or not.[2] In more accessible language, this meant that the overall range of variation in the project costs was too large to rule out the possibility that the average cost difference estimated from these data could have occurred by random chance with a certain level of confidence. This lack of statistical significance led the authors to conclude that "updated total development costs for completed projects shows no evidence that the HHH PLA caused an increase in per-unit costs for affordable housing projects developed under Proposition HHH." This conflicting conclusion provided further motivation to conduct a rigorous reanalysis of the cost effects of the HHH PLA. As detailed below, this report shows that the LAHD data used in LF (2024) had a small number of incorrect values that critically affected the report's findings. When corrected, the analysis is consistent with a larger cost effect for the HHH PLA than originally estimated in Ward (2021).

A Brief Overview of the Modeling Approach Used to Generate Causal Estimates

The statistical model developed in Ward (2021) estimated the size of a discontinuity in costs by estimating a regression model that used as the outcome construction costs per unit among a large sample of HHH-funded PSH projects and similar, non-HHH-funded PSH projects. These non-HHH projects were built around the same time period in the same city (Los Angeles) using a similar funding approach that simply did not include HHH as one of the sources in the project's capital stack. Ward (2021) contains further discussion and evidence regarding the comparability of these two subsamples.

The model used the size of these projects measured in numbers of housing units to estimate two distinct regression slopes measuring the average change in cost-per-unit by project size, one slope for projects below the 65-unit PLA threshold and one for projects at or above the 65-unit threshold (while also allowing costs to differ by a fixed amount for all HHH-funded projects relative to non-HHH-funded projects). The model additionally controlled for important aspects of projects influencing cost including the shares of units of different sizes (e.g., studio, one bedroom, two bedroom), the number of stories, the presence of an integrated parking structure and elevators, and the target population of the project (e.g., chronically homeless individuals,

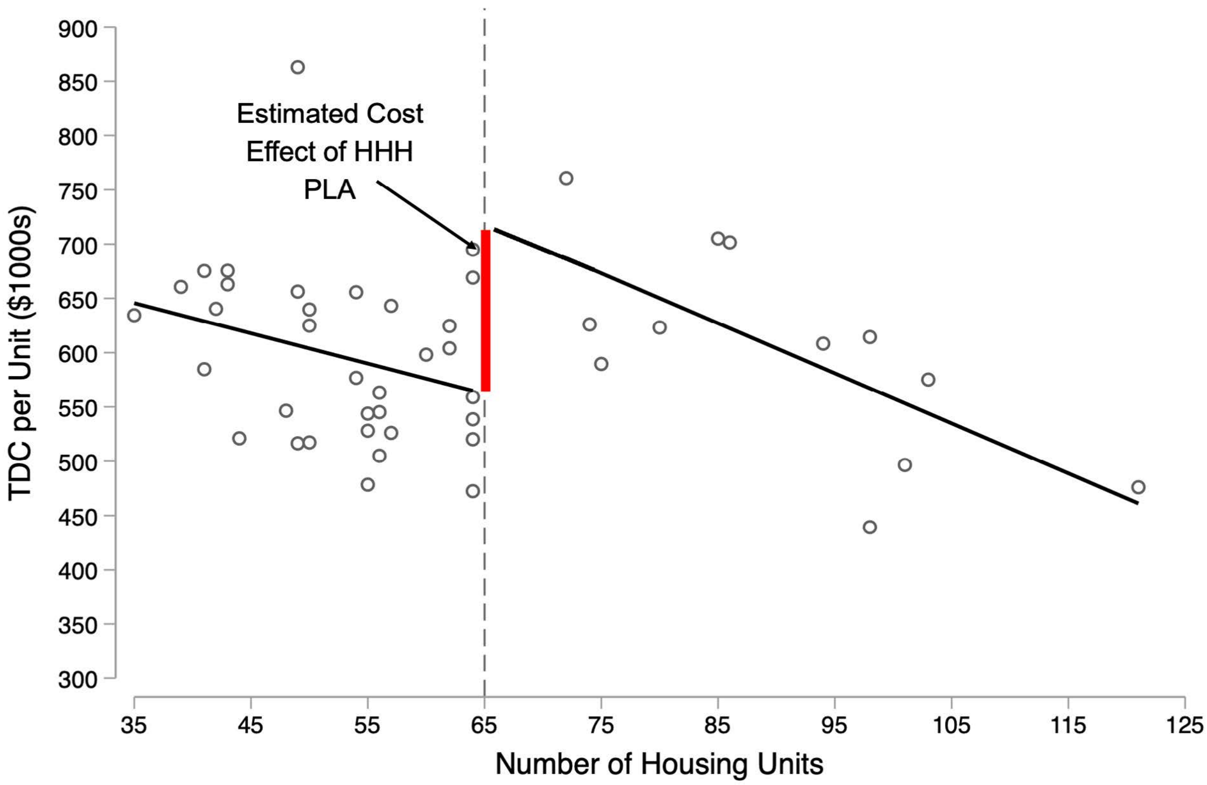
[2] Most empirical research hinges to some degree on the finding of results that satisfy this criteria (the most common threshold is statistical significance at the 95 percent confidence level). However, overreliance on this criteria has been linked with issues of publication bias—not seeking to publish results when they do not meet this threshold—and manipulation of statistical models by researchers to meet this threshold. Concerns over both these issues has been persistent over recent decades in the social sciences (Franco, Malhotra and Simonovits, 2014). There is also a growing concern, expressed in a literature across the social sciences, about the dangers of ignoring statistically non-significant, but economically (or clinically, etc.) important findings because of the failure to reach an arbitrary threshold of statistical precision (Wasserstein and Lazar, 2016; Young, Nickson and Perner, 2020).

seniors, families). Additionally, the model controlled for requirements to pay either residential or commercial prevailing wage levels to workers (these are wage levels that are based on union-level wages that are set and published by the state) and for the year the project was awarded (to allow for changes in the cost of materials and labor over time that could, for example, make later projects look more expensive than earlier ones). The appendix for this report includes more detail and discussion regarding the statistical modeling. For much more detail on the research setting, the data, the modeling approach, and the assumptions that allow for a causal interpretation of these estimates see Ward (2021).

Figure 1.1 presents a very simple graphical representation of the intuition behind the analysis. In the figure, the data points representing TDC per unit are graphed with cost on the y-axis and project size (number of units) on the x-axis. The vertical dashed line is the threshold for projects to be covered by the HHH PLA and the solid black lines are the fitted regression lines (the single slope that best represents the average relationship in terms of per unit TDC between costs and project size for projects on either side of the threshold for the HHH PLA to apply. The gap between these slopes at the discontinuity (the height of the thick red line) is the estimate of the cost effects of the HHH PLA.[3]

[3] This graphical representation is only an approximation meant to convey the conceptual structure of the regression model used to generate causal estimates since it does not control for the many important factors that can drive project costs mentioned above.

Figure 1.1. Graphical Example of the Intuition Behind the Regression Model Used to Estimate HHH PLA Cost Effects



NOTE: Data points used in this figure are cost data from LAHD projects in the analysis sample of 30 units or above with corrections for data errors as described in the text. For the sake of interpretability, this graphical example does not incorporate the controls used in the main statistical model, which would result in a y-axis showing residual costs per unit.

The actual regression model is more complex than this simple example, as it removes HHH-specific cost differences (estimated distinctly for both larger and smaller projects) so that the estimated effect captures cost differences related solely to the PLA. This is accomplished by estimating a set of these regression slope lines above and below the 65-unit threshold separately for HHH-funded and non-HHH-funded projects. The model calculates the difference between the discontinuity in these slopes for HHH-funded and non-HHH-funded projects of fewer than 65 units at the 65-unit cutoff and, second, the difference in the slopes for HHH-funded and non-HHH-funded projects of 65 units or more at the 65-unit cutoff. It then calculates the *remaining* discontinuity between these two sets of differences (analogous to the red line in the figure) after controlling for all the project characteristics discussed above. This results in an estimate of the causal effect of the HHH PLA on project costs.

It is important to note that this statistical model is designed to most accurately estimate a cost difference for projects subject to the HHH PLA in the neighborhood of the 65-unit threshold, where it begins to apply. In other words, the estimates from this model are meant to estimate the additional cost of these projects compared to projects that are close in size (i.e., those just below the cutoff). The implications of this model design for the results are discussed in more detail in Chapter 3 below.

The rest of this brief report proceeds in the following way. Chapter 2 replicates the findings from LF (2024) and then demonstrates the effects of addressing the incorrect data released by LAHD through both omission and correction. This is followed by a brief discussion of modeling issues that arise from the approach taken in LF (2024) of using actual TDC instead of estimated construction costs as the outcome of interest with the original statistical model from Ward (2021). Chapter 3 presents descriptive statistics on the analysis sample and updated model results—iteratively building from a replication of the initial findings in Ward (2021) to updated results using actual TDC incorporating important adjustments to the model related to this change of outcomes—that are the main focus of this report. Chapter 3 also contains supporting analysis focused on the differences between estimated costs and actual costs according to whether or not projects were subject to the HHH PLA and some suggestive results on the potential role played by project completion time in higher costs for projects subject to the HHH PLA. Chapter 4 concludes with a brief review of the report's findings and discussion of their implications for policy.

Chapter 2. Replicating LF (2024) Results and Addressing the Use of Incorrect TDC Data Released by LAHD

In exploring the finding in LF (2024) that the estimated effect of the HHH PLA on costs when using actual TDC data was not statistically significant and, therefore, inconclusive, a key first step was to assess the distribution of values of the per unit TDC (the actual cost data the authors cited as the motivation for the study) in the analysis sample. This led to a discovery that four projects in the sample had unrealistically low values. These TDC per unit values turned out to be based on a reported TDC amount for these projects that was identical to the LAHD funding amount reported. HHH (and all other public funding sources commonly used to develop PSH) is a leveraged funding program, meaning that the award amount provided through LAHD for HHH-funded projects cannot be equal to total project costs—these awards are typically no more than around 25 percent of total costs. Additionally, any TDC amount that exactly equaled the amount of a funding award was immediately suspect, since no completed project could realistically be expected to be produced at the *exact amount* of a funding award. The four projects affected by this reporting error had per unit TDC amounts that were between 11 and 33 percent of each project's actual TDC.[4]

Figure 2.1 presents three results for comparison. The first is the main result from LF (2024) using the four incorrect data points. (This result replicates "model 2" from the report that omits the largest and smallest outlier projects by number of units from the analysis sample, a common practice in estimating localized regression discontinuities (Cattaneo, Idrobo and Titiunik, 2020)).

The top row of the coefficient plot reproduces the original estimate for model 2 in LF (2024). This estimate was that the HHH PLA added $109,000 in additional cost per unit. However, as can be seen from this plot, the 95 percent confidence interval (values in the range of the thick black horizontal line, the measure of statistical significance focused on by the authors), which indicates a range of values that cannot be rejected as very unlikely to have been generated by random chance, includes values that range from -$93,000 all the way up to $311,000.

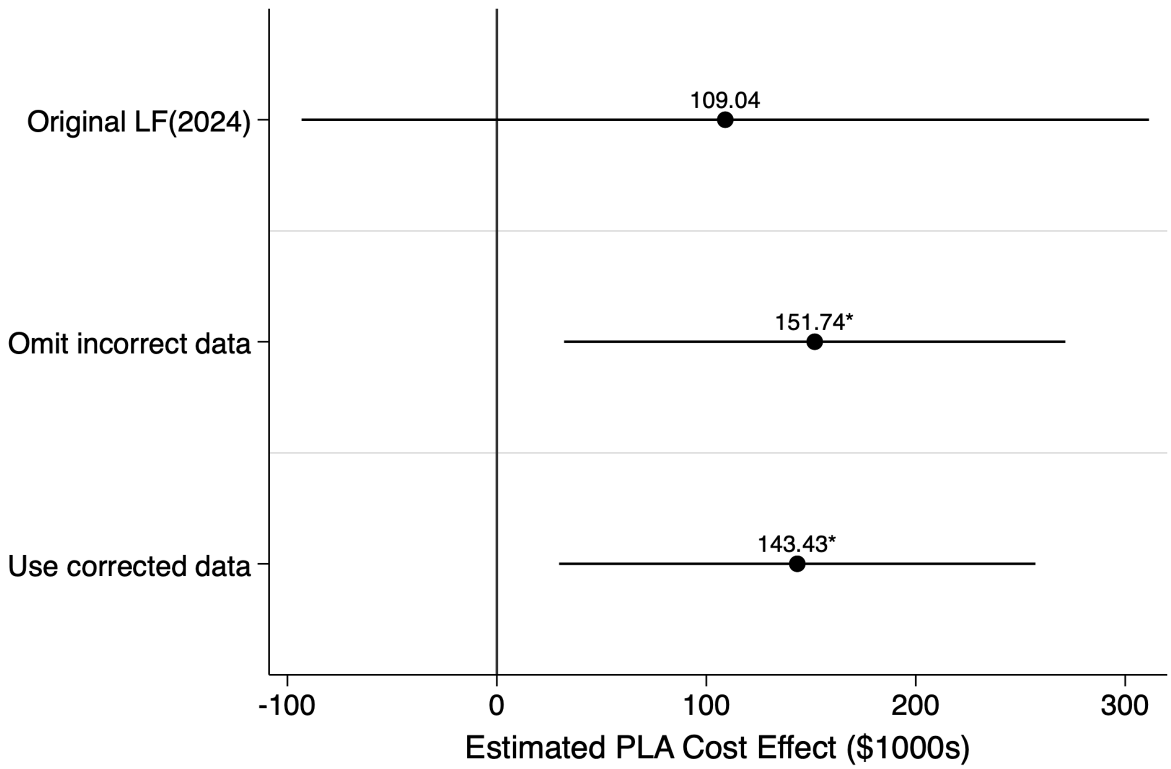
Either removing the four projects (the second row in the figure) or using the actual TDC amounts for them (the third row) resulted in highly statistically precise estimates ranging from $142,000 to $152,000. Notably, both of these estimates have a much smaller range of plausible values in the 95 percent confidence interval, indicating that a HHH PLA cost effect of less than $30,000 per unit can be confidently rejected using this conventional measure of statistical significance. The appendix to this report includes a full table of regression results from this

[4] Additionally, the authors entered the costs of one HHH-funded, non-PLA project as roughly 2.4 times the actual TDC listed in the LAHD data source. I am unable to determine the source of this error. Finally, the authors included a large project covered by the PLA as "in service" that was listed as still under development in the LAHD database. Omitting this project led to only marginally larger estimates.

exercise as well as detailed information on the incorrect data points in the LAHD source data including the corrected values.

These results indicate that the findings in LF (2024) do not represent valid evidence on the cost effects of the HHH PLA and that the use of accurate, actual cost data provide strong evidence that the HHH PLA had large, positive effects on project costs. However, the use of the original statistical model from Ward (2021), as was done in the LF (2024) report is inappropriate in two important ways that likely bias these corrected estimates of the HHH PLA cost effect upward in magnitude, making them inaccurately large. I turn to a discussion of these issues now.

Figure 2.1. Replication of LF (2024) and Alternate Estimates Omitting or Correcting Incorrect LAHD Data



NOTE: Figure shows point estimates (black dot) and 95% confidence intervals (horizontal black line) for the estimated HHH PLA cost effect (in $1,000s) for "model 2" in LF (2024). The first row reproduces the result from model 2 in LF (2024), the second row is the result from omitting the projects with incorrect TDC as discussed in the main text and the third row is the result using corrected values for these projects.
+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Updates to the Statistical Model for this Study

As mentioned above, the switch from estimated construction costs to actual TDC requires some important adjustments to the statistical model. I make two modifications to the modeling approach used in Ward (2021) to address this change in outcome measures. The first is that I directly adjust costs to all be expressed in 2021 dollars using a personal consumption index (PCE) deflator from the U.S. Bureau of Economic Analysis (U.S. Bureau of Economic Analysis, 2024). On average, HHH-funded projects were developed roughly two to three years later than non-HHH-funded projects in the sample. Additionally, the time between a funding award and a project being placed in service ranged between two and five years that ranged over a period of rapid inflation that began around the second half of 2021 and resulted in increases in the price of both goods and services at pace not seen since the early 1980s (Desilver, 2022).[5] More specifically, Table 2.1 below shows that most HHH projects were developed an *average* of roughly 3 to 4 years later than the non-HHH projects, so accounting for these price increases is important since the research design hinges on differences between HHH-funded and non-HHH-funded projects.

The second change addresses an important issue relating to using TDC rather than construction costs as the outcome of interest. To increase the validity of the estimates using TDC, I directly control directly for reported land costs in the regression model. These costs are part of a project's TDC but there is no compelling reason to believe that a PLA could have affected the land costs for a project. Additionally, project size may be "caused" to some extent by land costs in the sense that at higher land prices a project may only be financially viable if it is larger in scale so that these higher land costs can be spread across more housing units.[6] If not directly controlled for, this could be a source of reverse causality where high land costs "cause" the use of the HHH PLA. Descriptive statistics on land cost in Table 3.1 below indicate that average land costs are higher for the larger projects, but they are highest for projects subject to the HHH PLA. In the appendix to this report, I also consider the implications of measurement error for land costs that may be related to the process of obtaining tax credits to fund projects. Specifically, the issue is reporting positive costs for land that was donated or provided for a roughly zero-cost long-term lease. See Reid (2020b) for more discussion on the issue of mismeasurement of land costs.[7]

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[5] In Ward (2021), cost changes were simply accounted for through the inclusion of year fixed effects, which would account for global changes in price given the very steady rates of inflation observed over the period of years during which costs for these projects were estimated. In the current approach with adjusted prices, year fixed effects are still included in the model to account for other common factors that might affect all projects but would otherwise unobservable including, for example, year to year changes in the available workforce or funding availability. To be consistent, in this report I also adjust the estimated cost data used in Ward (2021) according to the year of the funding award to put them into the same context as the adjusted TDC (2021 dollars) for purposes of comparison.

[6] As mentioned previously, this important control was not included in the LF2024 analysis. In the appendix to this report, I include estimates that do not control for land costs and they are considerably larger in magnitude than the results presented below.

[7] Sensitivity analysis of the effect of such misreporting of land costs discussed in more detail in the appendix to this report suggests that it would primarily downwardly bias estimates of the HHH PLA cost effect but that this bias is not sensitive to whether the misreporting occurs disproportionately among PLA or non-PLA projects.

Finally, I also add a control for the number of buildings associated with a given project, a control that was not included in the modeling in Ward (2021). The inclusion of this control slightly reduces the magnitude of the estimates (by around 10 percent) relative to not including it and also modestly reduces the magnitude of the standard errors (i.e., increases the precision of the resulting estimates).

Chapter 3. Data and Results

In Table 3.1 I present updated descriptive statistics for the analysis sample. To provide some context on the ways that both size and HHH status can affect the characteristics of the projects in the sample, I stratify the sample according to both whether a project was funded by HHH and whether it comprised 65 or more housing units.

In terms of actual TDC per unit (in 2021 dollars) there is no economically meaningful difference in per unit cost between HHH projects and non-HHH projects of 64 units or fewer. The sample of larger non-HHH (non-PLA) projects have average costs of around $435,600, $147,000 lower per unit (around 25 percent) than the smaller non-HHH projects. This is consistent with larger projects achieving greater economies of scale, where many fixed costs including land, design services, fixed costs of operating a construction site and the like are spread across more units, driving costs per unit downward. However, this relationship is not present for larger HHH projects subject to the PLA. The average per unit cost for larger HHH PLA projects was $610,300, or around $12,000 greater than the $597,500 per unit cost of smaller HHH projects. Furthermore, relative to larger, non-HHH projects, the average cost was 40 percent higher.

Land costs were modestly lower among smaller HHH-funded projects relative to similar non-HHH-funded projects, due at least in part to the fact that some HHH projects used awarded publicly owned land and were slightly higher among larger HHH-funded projects relative to similar non-HHH-funded projects. This difference can explain a small part of the difference in average TDC, but in the regression modeling below, I control explicitly for land costs to remove this potential source of bias from estimates of the effect of the PLA on costs.

HHH-funded projects were, on average, awarded and built around two to three years later than the non-HHH-funded projects, though there is considerable overlap in the years during which these projects were developed.[8] However, these time differences are also accounted for in the research design discussed below by adjusting estimated cost data for inflation according to 2021 from the year of the funding award and adjusting actual TDC data according to 2021 from the primary year of construction. This adjustment is made in 2021 dollars (as indicated in Table 3.1). I discuss these adjustments in more detail below.

[8] Appendix Figure A.1 contains a figure showing the overlap in these projects by year.

Table 3.1. Descriptive Statistics of Completed Projects in Analysis Sample

	Projects of 64 units or less		Projects of 65 Units or more	
	Non-HHH-Funded Projects	**HHH-Funded Projects**	**Non-HHH-Funded Projects**	**HHH-Funded (PLA) Projects**
Actual TDC per Unit (1000s in 2021 dollars)	582.8 (111.5)	597.5 (80.0)	435.6 (104.0)	610.3 (96.0)
Estimated TDC per Unit (1000s in 2021 dollars)	529.1 (92.1)	596.7 (70.0)	456.5 (83.6)	581.4 (107.7)
Land Cost per Unit (1000s in 2021 dollars)	55.9 (30.9)	52.8 (31.5)	61.6 (21.0)	67.7 (29.2)
LIHTC Award Year	2016 (1.1)	2019 (1.1)	2017 (1.6)	2019 (1.0)
Primary Construction Year	2018 (1.3)	2022 (1.1)	2020 (1.8)	2022 (0.8)
Number of Units	40.8 (12.5)	51.3 (10.3)	94.7 (16.3)	90.6 (14.6)
Number of Stories	4.1 (1.0)	4.6 (1.0)	4.9 (1.4)	5.5 (1.1)
Share Studio Units (Proportion)	0.25 (0.36)	0.57 (0.39)	0.28 (0.33)	0.34 (0.38)
Share One Bedroom Units (Proportion)	0.58 (0.34)	0.30 (0.30)	0.44 (0.30)	0.49 (0.31)
Share Two Bedrooms+ Units (Proportion)	0.17 (0.18)	0.13 (0.20)	0.28 (0.33)	0.17 (0.22)
Share Supportive Housing (Proportion)	0.80 (0.25)	0.87 (0.18)	0.55 (0.32)	0.68 (0.24)
Total Residential Buildings	1.15 (0.38)	1.17 (0.56)	1.14 (0.36)	1.17 (039)
Parking Floor(s) or Structure (Proportion)	0.77 (0.44)	0.53 (0.51)	0.71 (0.47)	0.67 (0.49)
Elevator in Building/	0.92 (0.28)	0.83 (0.38)	0.93 (0.27)	1.00 (0.0)
Prevailing Wage (Proportion)	0.92 (0.28)	1.00 (0.00)	0.71 (0.47)	1.00 (0.00)
N	13	36	14	12

NOTE: Standard deviations in parentheses. Primary construction year was estimated by adding one half of the difference between the award year and the in-service date to the award year. All TDC values are adjusted using the U.S. Bureau of Labor Statistic's PCE deflator to represent all dollar values in terms of 2021 dollars.

Table 3.1 also indicates that HHH funded projects tended to have slightly more units (focusing on projects of fewer than 65 units that comprise the majority of the sample), tended to have a higher share of studio and one-bedroom units relative to larger units, and had higher shares of supportive units. Finally, all HHH projects were required to pay prevailing wages. For the non-HHH projects, around 75 percent overall paid prevailing wages.[9]

Updated Estimates of the Cost Effects of the Proposition HHH PLA

As discussed previously, Ward (2021) did not generate estimated effects of the HHH PLA using TDC, only construction costs. Developing a full picture of the potential effects of the HHH PLA on TDC, rather than only construction costs, requires understanding, first, what sort of overall PLA cost effect was anticipated by developers. Such estimates can be generated using the same estimated cost data used in Ward (2021). Comparing this pre-development estimated PLA effect on TDC with the actual effect of the HHH PLA on TDC using data on completed projects can provide evidence on how well developers anticipated the potential effects of the HHH PLA on project costs.[10]

Figure 3.1 presents results from the updated regression model for specification 2, which excludes the largest and smallest projects from the analysis sample. The first row of Figure 3.1 shows the HHH PLA cost effect using estimated project costs from the tax credit application data: this is what the developers expected the project to cost. These expected costs are important, because they shape what is proposed for development in the first place, as well as the amount of funding needed to build a proposed development. The estimated cost effect of $68,450 is statistically significant at the 90 percent confidence level (p=0.064) and represents an added cost of 15 percent of the average cost of HHH-funded projects with between 50 and 64 units.[11] To place this estimate in the context of the Ward (2021) study, this study found that the HHH PLA increased estimated construction costs by roughly 15 percent (around $45,000 per unit). Construction costs make up around 60 of total costs typically, thus the analogous estimate in Ward (2020) implied an effect on TDC of around 9 percent under the assumption that the

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[9] See the description of control variables in the appendix where there is a discussion of the specific interpretation of the prevailing wage control coefficient for this model. In summary, it reflects a difference in the cost association with prevailing wage payment for non-HHH-funded projects only, since all HHH-funded projects pay prevailing wage and there is an indicator variable for HHH-funding that implicitly controls for this along with any other common, HHH-specific cost differences.

[10] It is important to note that there is strong evidence of selection among the PLA projects that went forward and this may affect the magnitude of any differences between estimated project costs under the PLA and actual costs. If this selection went in the direction of developers with more experience building under a PLA or using union contractors, then such bias would likely mitigate against finding an "unexpected" cost difference. However, this author is aware, through a combination of direct communication with developers and the support of city documents, of at least two HHH PLA projects for which being subject to the HHH PLA was not known until after project funding had already been awarded.

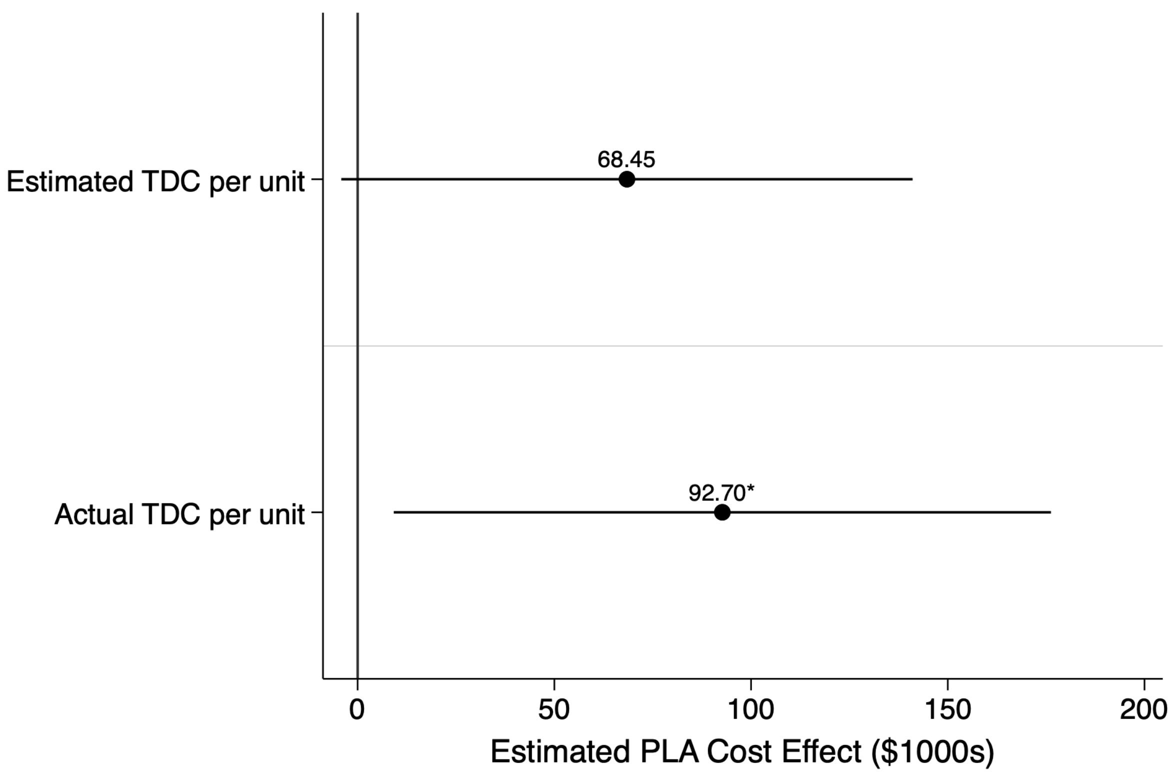
[11] I use this subset of projects for comparisons because it comprises units from the largest HHH-funded projects that were not subject to the PLA and, as discussed earlier in the report, the statistical model is designed such that this is the most appropriate comparison group of projects. An alternative comparison group is larger, non-HHH-funded projects that were not subject to a PLA and were less costly than HHH-funded projects on average ($456,463 for estimated TDC per unit of these projects and $435,650 for actual TDC per unit). Using these lower costs would substantially inflate percent-based estimates of the HHH PLA cost effect.

HHH PLA had no other effects on costs. This difference, which is more than 50 percent larger than the implied PLA effect on TDC using only construction costs, suggests that developers anticipated meaningful non-construction cost effects of the HHH PLA.

The second row of Figure 3.1 shows the estimate using actual TDC. The PLA cost effect estimate grows to $92,700 or more than 21 percent of the average cost of 50- to 64-unit HHH-funded projects. This actual cost effect is more than 35 percent larger the anticipated effect using estimated costs and is statistically significant at the 95 percent confidence level (p=0.03).

The full regression model results for both estimated and actual TDC using three different specifications—the full sample, excluding outlier large and small projects, and excluding projects of exactly 64 units (the subsample of projects most likely to have been proposed to avoid being subject to the PLA)—including all control variables, are presented in appendix tables A.3 and A.4.

Figure 3.1. Regression Results for HHH PLA Cost Effect ($1,000s of 2021 Dollars) Using Both Estimated and Actual Cost Data



NOTE: Figure shows point estimates (black dot) and 95% confidence intervals (horizontal black line) for the estimated HHH PLA cost effect (in $1,000s of 2021 dollars). The complete results from these regressions, including the values of all control variables are in appendix tables A.3 and A.4.
+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Additional Analyses of Differences Between Estimated and Actual Project Costs

The differences between the HHH PLA cost effect using estimated and actual TDC data suggest that even though developers anticipated additional costs for projects subject to the HHH PLA, the realized additional costs exceeded the anticipated additional costs. To provide some additional context on this phenomenon, Table 3.2 presents a simple comparison of the differences in the magnitude of the estimated and actual TDC per unit from HHH-funded non-PLA projects and PLA projects in the analysis sample. In other words, this analysis provides an answer to the question "how much did costs change between the original estimated project costs and the completed per unit costs for each project in the analysis?"

The first column is the raw difference in TDC per unit for the HHH-funded projects used in the LF2024 analysis. The second column is an "adjusted" difference that controls for all project characteristics other than the indicator for being subject to the HHH PLA. Thus, the differences in column two compare the cost changes from planning to completion among HHH-funded PLA and non-PLA projects that remain after controlling for all other project characteristics.

Table 3.2. Average Difference Between Actual and Estimated TDC Per Unit of HHH Projects

	Unadjusted Mean Cost Difference ($1,000s)	Regression-adjusted Mean Cost Difference ($1,000s)	Sample Size
Non-PLA projects	0.9	-8.1	36
	(64.0)	(53.5)	
PLA projects	20.0	24.3	12
	(77.9)	(47.8)	

NOTE: Standard deviations in parentheses. All costs deflated to 2021 dollars using a PCE deflator from the U.S. Bureau of Economic Analysis as described in the text.

These results show that, considering only unadjusted differences between actual and estimated costs, non-PLA projects had essentially no change between estimated and actual costs on average (this average cost was approximately $597,000 per unit) while PLA projects experienced an average increase of $20,000 (the estimated cost per unit for these projects was $581,374 per unit, so this represents an increase of roughly 3.4 percent). However, column 2, which accounts for important differences in the characteristics of projects tells a somewhat different story. After this adjustment, non-PLA, HHH-funded projects experienced an average decrease in costs relative to estimates of over $8,100 (a decline of around 1.3 percent), while PLA projects experienced a larger increase of $24,300 (or 4.1 percent above estimated costs). The total difference in these regression-adjusted cost differences ($32,400, the difference between the two numbers in the second column) is around 130 percent of the difference between the magnitude of the estimates in Figure 3.1.

Considering Differences in Actual and Estimated Project Costs Closer to and Further from the 65-Unit Threshold

One additional important question is how much of the cost effect of the HHH PLA might be related to the choice of the 65-unit threshold for its application. Conceptually, there is reason to believe that the cost effect of the HHH PLA may be due, at least in part, to the fact that the 65-unit threshold for its application was affecting projects that were less likely to realize the potential benefits of using a more highly trained labor force. The most common type of housing proposed under HHH involved a building type commonly referred to as "wood over podium," referring to building a multistory wood building over a single (or perhaps double) cement parking structure (Lee, 2019). Though data on the union share of subcontractors working on these types of projects in Los Angeles is very sparse, anecdotal evidence suggests that it is low. On the other hand, larger, high-rise style, steel and concrete buildings ("Type I" construction) are typically more likely to have a larger share of union workers even absent a PLA requiring them, due to the higher overall level of unionization among these trades (Hirsch, MacPherson, and Even, 2024). This suggests that the differences in the composition of the workforce with or without a PLA—including the ability to use flexible ratios of more and less experienced workers, to use general laborers for more tasks (e.g., receiving and handling construction materials)—could have a greater impact on smaller projects versus large projects where the share of unionized subcontractors on a site is higher on average regardless of PLA status.

Thus, it is important to assess whether PLA projects experienced greater differences between estimated and actual costs according to the size of these projects. In other words, the reasoning above suggests that perhaps smaller projects that fell under the PLA experienced greater unexpected differences than larger projects, where many practices related to a more unionized workforce would have been more predictable. While the sample of completed projects used in this study is too small to be expected to provide statistically precise measures of differences *among* larger projects affected by the HHH PLA using a variation of the main statistical model, we can extend the analysis of average differences between estimated costs and completed costs presented in Table 2.3 to test this intuition that larger projects subject to the PLA may be more likely to achieve economies of scale relative to smaller projects subject to the PLA.[12]

In Table 3.3, I present analogous unadjusted and adjusted differences between estimated and actual costs splitting the subsample of projects larger than 64 units at 90 units. This evenly splits the sample of HHH PLA projects and is also close to the mid-point of the distribution of affected projects (that range from 72 to 121 units with the 90-unit cutoff falling between a project of 86 units and a project of 94 units). This same cut results in 5 smaller "PLA-sized" comparison projects and 9 larger ones among the non-HHH-funded subsample of projects.

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[12] Note that it is not possibly to provide statistically precise measures of this effect using the discontinuity-based approach and the project characteristic controls employed in the main statistical model due to the much smaller sample size.

Table 3.3. Average Difference Between Actual and Estimated TDC per unit of Larger Projects

	Unadjusted Mean Cost Difference ($1,000s)	Regression-adjusted Mean Cost Difference ($1,000s)	Sample Size
Panel A. Non-HHH-funded Projects of 65 units or more			
Fewer than 90 units	36.4	39.7	5
	(42.7)	(40.8)	
90 units of more	-52.6	-38.1	9
	(106.1)	(72.1)	
Panel B. HHH-funded Projects of 65 units or more			
Fewer than 90 units	27.6	1.0	6
	(85.8)	(41.2)	
90 units of more	12.3	47.5	6
	(75.5)	(45.2)	

NOTE: Standard deviations in parentheses. All costs deflated to 2021 dollars as described in text. using a PCE deflator from the U.S. Bureau of Economic Analysis as described in the text.

Considering the results in Panel A for non-HHH-funded projects of 65 units or more, the smaller half of this sample (comprising 5 projects of between 74 and 85 units) saw a substantial positive difference ($36,400 per unit) between estimated and actual costs, and this difference was unaffected by the regression adjustment. By contrast, the subsample of larger projects (9 projects ranging from 91 units to 125 units) had a large, negative difference between estimated and actual costs that declined slightly in magnitude after regression adjustment but that was virtually identical in magnitude to the positive cost difference for the projects from 65 to 90 units. This is consistent with the achievement of substantial, unforeseen economies of scale for the larger projects.

For the HHH-funded PLA projects in Panel B there is a large positive difference between estimated and actual costs for the smaller subset of projects affected by the HHH PLA and a smaller positive cost difference for the larger subset of these projects when not adjusting for project characteristics. This is consistent with achieving a modest level of economies of scale for HHH-funded projects affected by the PLA in that the growth of costs was smaller for these larger PLA-affected projects. However, when adjusting for individual project characteristics, this relationship reverses, with virtually no change between estimated and actual costs for the smaller of the PLA-affected projects (an average of $1,000 per unit) and a large, positive change between these costs for the largest projects affected by the HHH PLA (an average of $47,500 per unit). This provisional evidence suggests that even the largest HHH PLA projects are failing to realize any average gains from economies of scale. However, I note that this finding should be revisited when more HHH-funded projects are complete.

A Potential Mechanism for Increased Costs: Longer Time to Completion

A key question about the findings above is how the HHH PLA is causing the substantial cost differences observed in the data. This is particularly important to understand since all HHH-funded projects pay some form of prevailing wage (state-regulated wages that are based off trade-specific union wage levels and updated annually (State of California Department of Industrial Relations, 2024)). It would be reasonable to think that, conditional on the payment of union level wages, differences in cost should be relatively small, as the payment of prevailing wages has been shown to be associated with roughly 13 percent increases in project costs in recent work focusing on affordable housing development in California (Reid, 2020a). Advocates of PLAs often hypothesize that one of the key benefits of these agreements is a greater probability that projects will be completed on time (Lopezlira and Farmand, 2024; Lund and Oswald, 2001). This would work against finding a positive cost effect of PLAs, since financing and other costs are directly related to project completion time. However, there is little to no credible empirical evidence on this relationship between PLAs and timely project completion.

The growing number of completed and in-service HHH projects provides a setting to examine the evidence on project completion time. I generate project completion times as the difference between the year LIHTC funding was awarded (a key funding source that is typically the last to be secured and, thus, is relatively near to the likely start of project construction) and the year the project was listed as being placed in service by the Los Angeles Housing Department.

In Table 3.4, I consider two differences in project completion time. In the first set of results ("All HHH-funded Projects") I compare differences in completion time between HHH-funded projects of 65 units or more with those comprising fewer than 65 units. These smaller HHH-funded projects were completed an average of 0.42 years faster than the projects subject to the PLA. However, it is important to note that larger projects subject to the PLA may have simply taken longer because of project characteristics. To address this concern, the second set of results compares HHH projects of 65 units or more with non-HHH projects of 65 units or more. Here the difference grows to 0.67 years (or roughly 8 months). Both of these estimates are statistically significant, with the more credible comparison of only larger projects significant at the 95 percent confidence level (p=0.031).

There are few useful estimates of how longer project timelines affect costs but collecting estimates from two available industry sources suggests that a 6-month project delay could increase project costs by roughly 10 percent (Beaty et al., 2016; Construction National, 2018). This length of additional time is around the average of these two estimates and suggests that perhaps half of the HHH PLA cost effect of roughly 20 percent estimated above could be explained by a longer project completion time. It is important to note that it would also be beneficial to revisit this finding when the sample of completed HHH-funded projects has grown larger.

Table 3.4. Differences in Average Time (in Years) from Funding Award to Project Completion

	Non-PLA Projects (64 Units of fewer)	PLA Projects (65 Units or more)	Difference
All HHH-funded Projects	2.75	3.17	0.42+
	(0.69)	(0.83)	
N	36	12	
	Non-HHH Funded (Non-PLA)	**HHH-Funded (PLA)**	
Projects of 65 Units or More	2.5	3.17	0.67*
	(0.65)	(0.83)	
N	14	12	

NOTE: Standard deviations in parentheses. Differences are derived from a bivariate regression of project years on an indicator variable for either being subject to the HHH PLA (upper result) among HHH-funded projects or being an HHH-funded project among projects of 65 units or more (lower result). Differences are statistically significant as indicated with + $p<0.10$ and * $p<0.05$.

Replication Materials

A data set and a Stata do file that replicate the full set of results for this study are publicly available on a RAND GitHub site. See the citation for Ward (2024) in the bibliography of this report or a link on the RAND web page for this report to access these materials.

Chapter 4: Conclusion

This brief research report updates findings from Ward (2021) estimating the cost effects of the Proposition HHH PLA on the TDC of affected projects. This new research represents a step forward in our understanding of this relationship since it uses the actual costs of completed projects rather than the estimated costs used in the prior study. Incorporating these new data and methodological updates to the model to appropriately address both the use of TDC rather than construction costs and the potentially confounding effects of recent high levels of inflation, this study finds that the HHH PLA increased total costs more than twice as much as the original estimates in Ward (2021) (roughly 22 percent versus 9 percent), suggesting that developers substantially underestimated the additional costs associated with the use of a project labor agreement in their original cost estimates. Notably, these estimates are highly statistically precise, despite a sample size of completed projects that is roughly 25 percent smaller than the original sample used in Ward (2021).

A comparison of estimated and actual costs for projects suggests that developers planned well for the costs of HHH-funded projects not affected by the PLA, as the average actual cost of these projects was virtually identical to the estimated costs, while the costs of PLA projects increased substantially relative to the estimated costs used for project planning. These comparisons of cost changes, after adjusting for important project characteristics, suggests that projects subject to the HHH PLA exhibited no evidence of economies of scale as they increased in size, while larger non-HHH-funded projects that were not subject to a PLA did achieve meaningful cost savings from economics of scale.

One potential mechanism for these increased costs is that projects subject to the HHH PLA took roughly 6 to 8 months longer to complete than comparable projects. Crude estimates from a limited evidence base on this topic suggests that this additional time to completion could account for perhaps half of the additional cost caused by the PLA. More research is warranted to better understand the potential mechanisms that may be driving these cost differences, as such knowledge could be used to attempt to address these substantial cost differences for jurisdictions that desire to use mandatory PLAs to produce publicly subsidized affordable housing.

These updated findings on the HHH PLA bear on important ongoing policy debates around expanding the use of PLAs for the construction of affordable housing. As this report is being drafted, the City of Oakland is considering expanding requirements for affordable housing builders to use PLAs on their projects (City of Oakland California, 2024). In November of this year (2024), Los Angeles County voters will be asked to approve a new, higher sales tax to support a wide array of homelessness and housing services as part of the proposed "Affordable Housing, Homelessness Solutions and Prevention Now" ballot initiative, which has language that will potentially require that hundreds of millions of dollars over the life of the resulting program to be used exclusively for housing projects built under a PLA (Our Future LA County Coalition, 2024).

The results of this updated research suggest that there are very large fiscal tradeoffs to producing publicly subsidized affordable housing under a mandatory PLA. Put simply, the estimates in this report, based on actual costs of recently completed projects in Los Angeles, indicate that a mandatory PLA has a cost of 1 of every 5 housing units that could be produced without the use of a PLA while still paying union-level wages to all workers on these projects. To put this simple takeaway at scale, this suggests that if 10,000 units of affordable housing could be built for a total public investment of roughly $6 billion (roughly the average cost of non-PLA, HHH-funded projects) without the use of a mandatory PLA but with the payment of prevailing wages, then applying such a PLA to all of this development would reduce the potential housing output by 2,000 units or, put another way, would require an additional $1.2 billion to produce the same number of housing units.

Better understanding and considering the tradeoffs inherent in future policy proposals requiring the use of PLAs, as well as the implications of PLA requirements that are already a part of current policies such as Measure ULA (which includes a PLA requirement for new housing construction of 40 units or more) is critical to transparent debate and to allowing voters to make informed choices concerning programs directing substantial levels of taxpayer resources towards addressing the profound housing and homelessness crises faced by the Los Angeles region and many other metros across California and the nation.

Appendix A. Supplementary Materials

This appendix includes substantial discussion of the regression modeling used in this report and full results and further relevant details regarding data errors related to the exploration of the results in the 2024 University of California Berkeley Labor Center report, "Evaluating the Impact of Project Labor Agreements on the Cost of Affordable Housing Projects: Proposition HHH in Los Angeles" (Lopezlira and Farmand, 2024) that used both data and statistical code from a RAND report on this subject (Ward, 2021).

Additional Discussion Concerning the Lopezlira and Farmand (2024) Report

As discussed in Chapter 1, the 2024 report, "Evaluating the Impact of Project Labor Agreements on the Cost of Affordable Housing Projects: Proposition HHH in Los Angeles" (Lopezlira and Farmand, 2024), released by the UC Berkeley Labor Center used incorrect data released by the Los Angeles Housing Department on actual TDC for four projects included in their analysis. In this brief appendix, I provide detail on these incorrect data points that led to unsupported conclusions by the authors and provide results that show the effect of either omitting or correcting these data points.

Table A.1. Data Errors in Lopezlira and Farmand (2024) Analysis and Corrected Values

Project Name	HHH PLA Project?	TDC in LAHD Data	Actual TDC	TDC per Unit Used in Analysis	Actual TDC per Unit	LAHD TDC per Unit Relative to Actual TDC per Unit
McCadden Campus Senior (aka McCadden Plaza Senior)	Yes	$12,730,159	$57,800,000	$129,900	$589,796	22%
The Wilcox (fka 4906-4926 Santa Monica)	No	$5,225,000	$39,870,000	$84,274	$643,065	13%
The Quincy (fka 2652 Pico)	No	$3,550,000	$33,158,596	$65,741	$616,286	11%
SagePointe (fka Deepwater)	No	$10,952,000	$33,578,000	$195,571	$599,607	33%

NOTE: Data are from the Los Angeles Housing Department and corrected values were obtained by author via email correspondence with project developers. The last column is the ratio of the actual TDC per unit over the incorrect LAHD TDC per unit value.

These projects were substantial outliers in terms of cost, with TDC per unit amounts that were between roughly 7 and 25 percent of the average TDC per unit of HHH-funded projects in the sample. The lack of statistical precision that was the key finding in the associated report was entirely an artifact of the substantial difference between these values and the range of actual TDC values, which dramatically increased the magnitude of the standard errors in the resulting estimates.

Table A.2 presents five sets of estimates. Each estimate has the coefficient representing the estimated additional cost of the HHH PLA in thousands of dollars then, below each point estimate, an effect size expressed as the percent cost difference over the average per unit cost of non-PLA, HHH-funded projects of 50 to 64 units in the analysis sample.

The first set of results in Panel A exactly reproduce the estimates in LF (2024). As can be seen, neither of these estimates are statistically precise at the 90 percent or higher confidence level, leading the authors to conclude that the results showed “no evidence that the HHH PLA caused an increase in per-unit costs for affordable housing projects developed under Proposition HHH.” LF (2024) did not discuss the magnitude of these estimates, but the point estimate in specification 2 suggests that the HHH PLA added roughly 19 percent to TDC per unit.

Panel B omits the four data points from Table A.1 above, modestly reducing the sample size. With this adjustment the magnitude of both estimates increases substantially (using specification 2, from a 19 percent cost increase to a 26 percent cost increase). Additionally, despite the reduced sample size the standard errors decline (particularly substantially for the second specification) and both estimates reach conventional levels of statistical significance.

Finally, in Panel C, the four data points are used in the analysis with their actual TDC values. Here the estimate from specification 1 becomes smaller in magnitude than the original estimate in LF (2024) and the difference between the magnitude of the estimates across the two specifications all but disappears, with both estimates indicating that the HHH PLA increased TDC per unit by around 25 percent. Again, both of these estimates are highly statistically significant.

While the changes resulting from either the omission of correction of these four data points invalidate the qualitative and quantitative conclusions of LF (2024), it is important to note that, using TDC as an outcome in this statistical model, which was designed to appropriately estimate the cost effects of the HHH PLA using construction costs as an outcome, is likely to lead to estimates that suffer from upward bias due to not controlling for land costs as well as a lack of attention to the differing completion years and adjustments for the rapid inflation witnessed over the construction period of many of these projects.

The estimates in panels D and E adjust the model to address these potential sources of bias. The results in panel D are from a model that adds land costs as a control and also adjusts the year fixed effects from the LIHTC award year to the middle year of the development period (an approximation of the year of primary construction). The estimate for specification 1 is nearly identical but the estimate for specification 2 is around 10 percent smaller in magnitude. Panel E uses these same model changes but also adjusts all costs into 2021 dollars (as in the main results in the text). This adjustment increases the magnitude of each estimate by around 8 percent.

Table A.2. Reproduction of Results from Lopezlira and Farmand (2024) and Alternate Results Omitting or Correcting Incorrect Data Points

	(1) **Full Sample**	**(2)** **Exclude Largest and Smallest Outlier Projects**
Panel A: Results from Lopezlira and Farmand (2024) using incorrect data		
	TDC per unit ($1,000s)	TDC per unit ($1,000s)
HHH PLA Cost Effect Estimate	172.3 (113.1)	109.0 (100.2)
Effect size as % of average cost of 50- to 64-unit HHH-funded projects	29.9	18.9
N	75	67
Panel B: Results omitting the four incorrect data points		
	TDC per unit ($1,000s)	TDC per unit ($1,000s)
HHH PLA Cost Effect Estimate	216.2* (95.2)	151.7* (59.1)
Effect size as % of average cost of 50- to 64-unit HHH-funded projects	37.5	26.3
N	71	63
Panel C: Results with corrected values for the four incorrect data points		
	TDC per unit ($1,000s)	TDC per unit ($1,000s)
HHH PLA Cost Effect Estimate	148.7** (50.6)	143.4* (56.4)
Effect size as % of average cost of 50- to 64-unit HHH-funded projects	25.8	24.9
N	75	67
Panel D: Results with corrected values and land costs and development year fixed effects		
	TDC per unit ($1,000s)	TDC per unit ($1,000s)
HHH PLA Cost Effect Estimate	149.9** (51.4)	133.1* (56.6)
Effect size as % of average cost of 50- to 64-unit HHH-funded projects	26.0	27.1
N	75	67
Panel E: Results with corrected values and land costs and development year fixed effects (2021 $s)		
	TDC per unit ($1,000s)	TDC per unit ($1,000s)
HHH PLA Cost Effect Estimate	161.8** (51.5)	143.1* (56.2)
Effect size as % of average cost of 50- to 64-unit HHH-funded projects	28.0	24.8
N	75	67

NOTE: The percentage size of the cost effect is based on the average cost of HHH-funded projects of between 50 and 64 units included in the analysis: $576,905. Estimated standard errors in parentheses.
+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

I note that there is also a discrepancy in the inclusion criteria of units being included in the analysis sample if they were "placed in service" at the time of the LF (2024) analysis (roughly May of 2024). The LF (2024) sample includes three projects that are listed as "not yet built" on the LAHD Affordable and Accessible Housing Registry website but have "in service" status on the LAHD TDC data source. These projects are 11010 Santa Monica Blvd, Marcella Gardens, and The Lake House. These projects are *not* included in the main analysis sample used for the regression estimates in Chapter 3. LF (2024) also *excludes* three other projects that are listed as in service on the LAHD website. These projects are Hartford Villa Apartments, Marmion Way Apartments, and PATH Metro Villas Phase I and they *are* included in the regression estimates in Chapter 3. This difference in analysis samples is the reason that the model that excludes large and small outlier projects yields 67 projects in the LF (2024) specification but only 66 in the main estimates in Chapter 3 (the size restriction excludes one more project, the PATH project, in the Chapter 3 analysis). The upshot of these sample differences is that using the LF (2024) sample with the final model used in Chapter 3 (which differs from the results in Panel E of Table A.2 by the use of a smaller set of control variables only) is that the estimates in Chapter 3 are modestly smaller than they would be using the exact analysis sample in LF (2024). The estimated HHH PLA cost effect with the LF (2024) analysis sample is $99,650 (p=0.02) relative to the main estimate reported in Chapter 3 of $92,700.

Design of the Regression Model Used in Chapter 3

This study uses a regression model to estimate the cost effects of the HHH PLA that is closely related to a difference-in-differences (DD) research design (Card and Krueger, 1994). The basic idea of DD compares an outcome of interest observed among one or more units of analysis (for example, a person or a municipality, or a state) that has been "treated" with some policy with the same outcome from a one or more comparable units of analysis that were not treated ("control" units). The DD approach generates a causal estimate by, first, measuring the average difference in post-treatment outcomes and, second, by measuring the average difference in pre-treatment outcomes and then, finally, subtracting the pre-treatment difference from the post-treatment difference (this process of estimating the difference between two differences gives rise to the name of the research design).

The key assumption required to make these outcome differences have a casual interpretation says that, in the absence of the treatment of interest, the trend in the outcomes among the treated and comparison units would have been the same. This so-called "common trends" assumption is inherently untestable, since it involves a counterfactual outcome that cannot be observed for the "treated" units. However, a common test providing evidence that the data are consistent with this assumption is a demonstration that outcomes prior to treatment being implemented were on similar trends.

DD regression models have three key components that contribute to the identification of a causal effect. The first is an indicator variable for membership in the treated group of units—what is sometimes called the "main effect." The second is an indicator variable for observations that are in the post-treatment period (often generically called "post"). The third component, which identifies the causal effect in a DD model is the interaction of these two terms.

The model used in this study has one important conceptual difference with this traditional DD modeling approach. Instead of using a change in some treatment over *time*, this model uses a change in treatment *by project size (units)*. In other words, a treatment does not occur at a point in time, it occurs at a point along the continuum of project sizes. This model controls for economies of scale in project size through the inclusion of slope coefficients for the number of units on each side of the 65-unit PLA threshold. The way that these controls are implemented is similar to the idea underlying the regression discontinuity (RD) research design (Thistlethwaite and Campbell, 1960), which uses a "running variable" that controls for a trend in the treatment assignment (the number of units, where the trend is the average change in costs as projects get larger). Appendix B of Ward (2021) provides a lengthier discussion on the hybrid nature of this regression model and other details.

The key assumption required for estimates having a causal interpretation is that the distribution of project sizes among the subsample of HHH-funded projects in the absence of the PLA is well approximated by the distribution of project sizes in the non-HHH-funded subsample of projects. In this alternate DD approach, the main effect is a project being funded by HHH, the post dimension is projects that contain 65 or more housing units, and the causal estimate is the interaction between these two factors (the effect of the PLA—assigned by projects comprising 65 or more housing units—on HHH-funded projects).

To accurately estimate a plausible causal effect of the HHH PLA on construction costs, it is also necessary to control for a variety of potentially important project characteristics that influence costs and that may be correlated with the size or cost of projects. These controls are intended to account for the cost effects of factors such as larger projects requiring more or taller buildings or, for example, appropriately serving the needs of the targeted resident population requiring additional building amenities or common areas. The controls included in the main regression model results in this study are:

- HHH-funding (indicator variable)
- 65 housing units or greater (indicator variable)
- HHH × 65 housing units or greater—the estimated causal effect of HHH PLA costs (indicator variable, called "HHH PLA" in model results)
- number of units (continuous variable)
- number of units × 65 housing units or greater—allows a distinct slope of costs-by-units for these larger projects (

- whether a project is subject to a requirement to pay prevailing wage[13] (indicator variable)
- number of stories (continuous variable)
- number of stories squared (continuous variable, allows for a curved relationship between project costs and number of stories)
- buildings of 6 stories or more—a common threshold for project size requiring use of a different construction type (indicator variable)
- share of housing units of two bedrooms or more in each project (indicator variable)
- share of units in each project that are supportive housing (indicator variable)
- number of residential buildings (continuous variable)
- projects targeted at families experiencing homelessness (indicator variable)
- projects targeted at other special subpopulations of people experiencing homelessness, including survivors of domestic abuse or sexual trafficking, persons with mental illness, seniors, transition-aged youth, and HIV-positive individuals, or veterans (indicator variable).
- land cost reported by project developer on LIHTC application (continuous variable)
- primary year of construction fixed effects (indicator variables)[14]

An important caveat is that the control for land costs may reflect reporting inaccuracies related, for example, to the fact that projects could use donated land but might include the market value of this land in their LIHTC application because these costs can increase the "eligible basis" of the project used to determine award amounts. However, we view the inclusion of potentially inaccurate land costs and much more desirable than excluding these costs since their exclusion demonstrably increases the size of the estimated PLA cost effects, which we believe reflects substantial upward bias.[15]

Ward (2021) used a larger number of control variables since the sample size was roughly 25 percent larger than the sample of completed projects in this study. Among these additional

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[13] All HHH-funded projects are required to pay workers prevailing wages and must submit compliance documents to this effect to the California Department of Industrial Relations. For this reason, the prevailing wage indicator has a unique interpretation: it identifies the *difference* in the effect of paying prevailing wage on costs for non-HHH-funded projects relative to the average cost difference between HHH-funded and non-HHH-funded projects, which includes the effects of paying prevailing wage on HHH-funded projects and *any other cost factors unique to HHH-funded projects*, for example, differences in minimum unit size requirements or other idiosyncratic design-related features.

[14] These fixed effects were aggregated to a single year for projects primarily constructed during 2015 through 2018 to increase the subsample size for "within-year" comparisons induced by the use of such fixed effects. Without making this adjustment there was only one project (from the non-HHH-funded subsample) was from 2015 and only one HHH-funded project from 2018. Aggregating years 2015 through 2018 into a single fixed effect (then using years 2019 through 2022 as single year FEs) provided a total of 18 projects for cost comparison, a group size similar to the other years in the project data.

[15] I tested differences in results according to whether 20 percent of land costs were randomly set equal to zero (simulating the idea of correcting for misreporting in costs on the LIHTC application) only for projects of 64 units or less or only for projects of 65 units or more. In both cases, the upward bias in estimates was substantial but differed very little according to whether this simulated data correction was applied to only smaller or only larger projects. The estimates were $101,600 when randomly setting land costs equal to zero for 20 percent of projects below 65 units and was $104,200 when randomly setting land costs equal to zero for 20 percent of projects of 65 units or more, relative to the main estimate using reported land costs of $92,800).

variables were controls for the presence of an elevator, the presence of a parking structure or subterranean parking, whether or not a project was located in a special "transit oriented development zone" that may have entitled it to certain regulatory relief, more detailed categories of the share of units of different sizes, and specific year fixed effects (versus some aggregated year fixed effects for years with few projects). The variables used in this study were selected based on feedback from an independent external reviewer and through an analysis of the overall effect on explanatory power from removing or modifying the variables used in Ward (2021). More detail about each of the control variables in Ward (2021) and the motivation for their inclusion is provided in Appendix B of that report.

The original analysis in Ward (2021) presented estimates from three different specifications that were designed to assess the sensitivity of the results to projects of certain sizes. In the first model, the full analytic sample was used regardless of project size. In the second specification, the largest and smaller outlier projects in terms of size were excluded from the analysis to reduce the effect that projects very far away from the PLA threshold may have on the slope of the regression lines that determine the estimated cost effect, as the nature of these projects was unlikely to have been significantly affected by the 65-unit threshold due to their substantial distance from this project size. In the third specification, I additionally excluded projects nearest to the threshold to test the extent to which specific manipulation of project size around 65 units may be driving results.

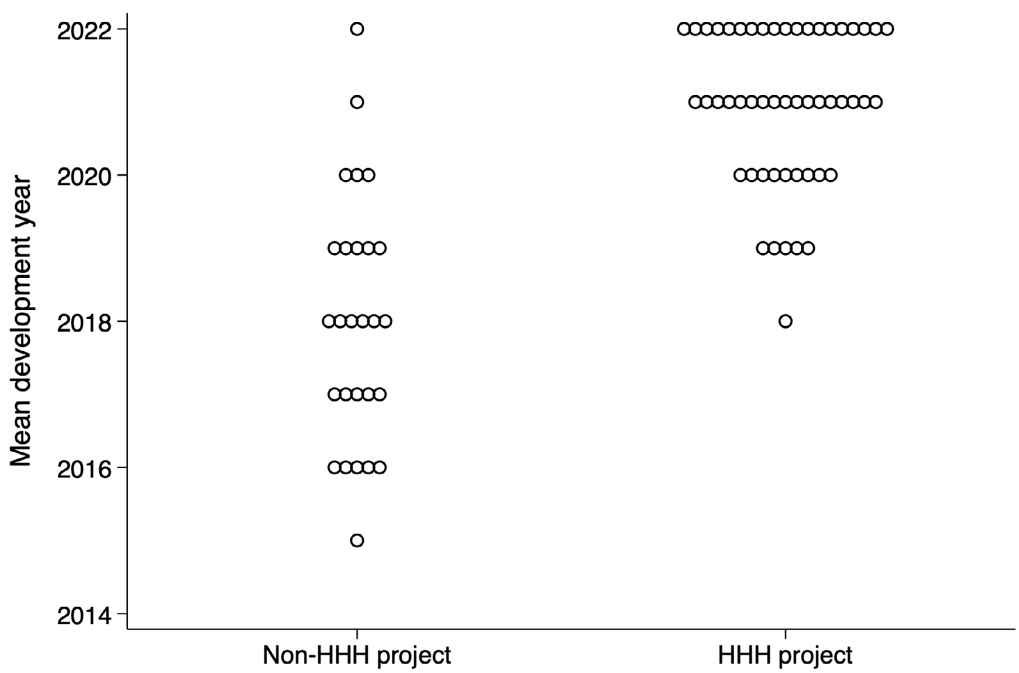
A Specific Note on the Interpretation of the Prevailing Wage Coefficient in this Model

Regarding the control for prevailing wage, this variable has a very specific interpretation given the research setting for this study and the resulting model design. The key issue to be aware of is that *all HHH-funded projects* are required to pay workers prevailing wages. But because there may also be other specific differences between HHH-funded projects and non-HHH-funded projects related to the program requirements of HHH, the model includes a fixed effect for HHH-funded projects. This variable's coefficient includes the effects of paying prevailing wage and *any other cost factors unique to HHH-funded projects*—for example, differences in minimum unit size requirements or other idiosyncratic design-related features. The necessary inclusion of this fixed effect (it is the main effect for the "treated group" of HHH-funded projects in the DD framework discussed above) means that the association between prevailing wage and costs for HHH-funded projects cannot be separately identified from any other common cost drivers among HHH-funded projects. For this reason, the prevailing wage indicator in this model identifies the *difference* in the cost effect of paying prevailing wage for non-HHH-funded projects relative to the overall average cost difference between HHH-funded and non-HHH-funded projects captured by the HHH fixed effect coefficient.

Distribution of Projects by Mean Development Year

As mentioned in the main text, HHH-funded projects were, on average, developed around two years later than non-HHH-funded projects in the analysis sample though there is meaningful overlap in time among these two subsamples. Figure A.1 plots the number of projects according to HHH-funding status and year.

Figure A.1. Distribution of Project Mean Development Year by HHH-Funding Status



NOTE: Mean development year is calculated as the placed in service year minus the funding year divided by two.

Full Results of the Main Regression Models Presented in Table 2.2

Table A.3 presents the regression results from Figure 3.1 using estimated TDC but includes all model coefficients. The main results (the HHH PLA cost effect estimate) are in bold type. Table A.4 presents analogous results for the model using actual TDC.

Table A.3. Regression Model Results Using Estimated TDC per Unit ($1,000s of 2021 dollars)

	(1) Full Analysis Sample	(2) Excluding Outlier Large and Small Projects	(3) Additionally Excluding 64-unit Projects
HHH project	3.401 (33.29)	2.787 (35.33)	4.525 (39.05)
PLA (65+ units)	-42.16 (38.20)	-30.50 (43.53)	-32.13 (52.08)
HHH×PLA	**46.52** **(33.39)**	**68.45+** **(36.06)**	**59.91** **(39.48)**
Prevailing Wage*	30.61 (30.44)	3.259 (33.10)	-1.918 (34.07)
Units	-1.429+ (0.764)	-0.889 (0.975)	-0.648 (1.422)
Units×PLA	-0.689 (1.091)	-2.459 (1.542)	-2.759 (1.891)
Stories	95.58+ (55.88)	76.62 (61.29)	92.14 (64.76)
$Stories^2$	-9.508 (6.113)	-7.301 (6.653)	-9.149 (7.072)
Stories>6	62.43 (38.35)	35.58 (40.11)	48.12 (44.92)
Share 2 BR+	85.12* (38.53)	93.23* (42.80)	85.63+ (44.00)
Share supportive housing units	-94.53** (34.96)	-96.27* (38.58)	-86.63* (40.84)
Number of buildings	69.93*** (15.90)	56.35** (17.16)	51.74** (18.09)
Family	1.450 (22.61)	-2.886 (23.31)	10.80 (26.64)
Special populations	11.87 (15.85)	16.85 (16.13)	11.91 (17.48)
Land costs	0.860** (0.255)	0.785** (0.283)	0.951** (0.316)
Year (2017)	-1.949 (26.80)	15.22 (31.87)	7.831 (34.18)
Year (2018)	35.62 (32.75)	57.81 (35.77)	50.11 (37.82)
Year (2019)	103.6** (33.62)	135.2*** (37.63)	135.1** (43.13)

	(1) Full Analysis Sample	(2) Excluding Outlier Large and Small Projects	(3) Additionally Excluding 64-unit Projects
Year (2020)	107.9**	126.9***	128.1**
	(32.45)	(35.34)	(37.74)
Year (2021)	118.8*	135.8**	122.6*
	(46.52)	(49.84)	(51.91)
Intercept	159.4	234.9	203.9
	(137.8)	(154.3)	(162.1)
N	75	66	59
adj. R^2	0.713	0.741	0.754

NOTE: * Note that due to the design of this model (as discussed in the text), this prevailing wage coefficient reflects the difference in costs related to the payment of prevailing wage for non-HHH-funded projects. Standard errors in parentheses.
+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Table A.4. Regression Model Results Using Actual TDC per Unit ($1,000s of 2021 dollars)

	(1) Full Analysis Sample	(2) Excluding Outlier Large and Small Projects	(3) Additionally Excluding 64-unit Projects
HHH project	-2.595	33.34	21.16
	(38.62)	(42.42)	(42.44)
PLA (65+ units)	-47.62	-16.85	-15.80
	(45.99)	(51.71)	(57.27)
HHH×PLA	**113.7****	**92.70***	**95.23***
	(38.86)	**(41.49)**	**(41.20)**
Prevailing Wage*	6.011	4.416	-5.262
	(37.23)	(39.13)	(38.31)
Units	-2.131*	-2.152+	-2.366
	(0.916)	(1.147)	(1.500)
Units×PLA	-1.110	-1.499	-1.193
	(1.294)	(1.823)	(2.017)
Stories	113.8+	115.9	131.5+
	(66.28)	(74.59)	(76.02)
Stories^2	-11.34	-11.01	-12.83
	(7.238)	(8.079)	(8.280)
Stories>6	60.40	28.58	40.80
	(45.34)	(47.13)	(50.70)
Share 2 BR+	84.00+	54.16	65.23
	(47.19)	(51.25)	(50.37)
Share supportive housing units	-41.99	-81.83+	-49.48
	(38.15)	(42.38)	(43.82)

	(1) **Full Analysis Sample**	(2) **Excluding Outlier Large and Small Projects**	(3) **Additionally Excluding 64-unit Projects**
Number of buildings	85.97***	85.97***	94.56***
	(18.81)	(20.11)	(20.23)
Family	42.68	23.04	26.69
	(27.15)	(28.08)	(30.67)
Special populations	36.34+	36.11+	22.19
	(18.73)	(19.06)	(19.55)
Land costs	0.658*	0.678*	0.816*
	(0.288)	(0.305)	(0.318)
Year (2019)	50.65	16.68	28.71
	(32.68)	(37.40)	(36.75)
Year (2020)	59.72	41.97	40.60
	(35.99)	(39.89)	(39.78)
Year (2021)	83.62*	54.90	69.14+
	(34.92)	(36.85)	(37.60)
Year (2022)	28.56	5.577	19.61
	(35.35)	(38.18)	(38.08)
Intercept	95.97	117.7	49.76
	(165.2)	(186.6)	(190.0)
N	75	66	59
adj. R^2	0.679	0.667	0.703

NOTE: * Note that due to the design of this model (as discussed in the text), this prevailing wage coefficient reflects the difference in costs related to the payment of prevailing wage for non-HHH-funded projects. Standard errors in parentheses
+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Abbreviations

HHH	Proposition HHH funding program
LAHD	Los Angeles Housing Department
LF	Lopezlira and Farmand
LIHTC	Low Income Housing Tax Credit program
PCE	Personal consumption index
PLA	Project labor agreement
PSH	Permanent supportive housing
TDC	Total development cost

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