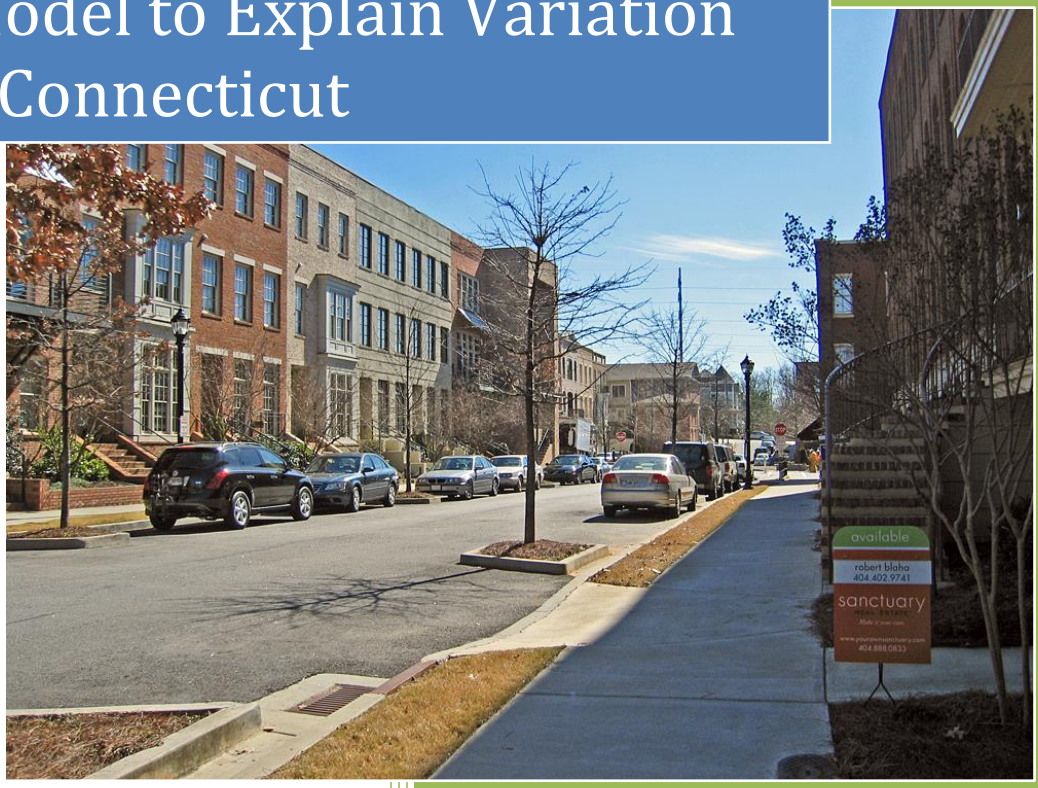
CONNECTICUT HOUSING FINANCE AUTHORITY

2019

Multifamily Development Costs:
Using a National Model to Explain Variation in Project Costs in Connecticut



Christopher D. Brechlin

Planning, Research & Evaluation Department

Originally Completed: March 6, 2019

Contents

Executive Summary

In 2018, the National Council of State Housing Agencies (NCSHA) partnered with the research firm ABT Associates to conduct a national study of the per-unit total development cost (TDC) of projects funded with Low Income Housing Tax Credits (LIHTCs).[1] ABT's study was national in scope, grouping Connecticut with other New England states and making it difficult to understand how CHFA's projects compare to ABT's findings. This analysis replicates ABT's analysis using data from CHFA's multifamily portfolio. Some aspects of ABT's methodology were modified to fit CHFA's data and better understand per-unit TDC at the state and county level.[2]

Most of the findings from CHFA's analysis aligned with ABT's, indicating that the a project's location, the number and size of its units, and whether or not it was a rehab project all have significant relationships with per-unit TDC. However, due to the small sample of Connecticut projects and differences in the data available to CHFA and ABT, not all of the findings are statistically significant enough for a one-to-one comparison with ABT.[3] ABT used two methods to understand per-unit TDC: 1) finding the median per-unit cost and comparing it across years and locations and 2) creating a regression model that can help explain the size of the effect that specific project characteristics have on per-unit TDC.

Median per-unit TDC:

ABT's analysis reported a national median per-unit TDC of $164,757 and a median per-unit TDC of $229,711 in New England. **CHFA's median per-unit TDC is estimated at $192,342.** CHFA's median per-unit TDC has a lot of variation across time, especially when compared with ABT. Table 3 shows that, while ABT's sample has a relatively flat per-unit cost, CHFA's data varies by hundreds of thousands of dollars per year. In 2011, CHFA's median per-unit TDC was $365,096 and in 2016 it was $140,990. Due to the relatively small sample of CHFA projects, a few high-cost projects in a given year have a large impact on the median per-unit TDC for that year. Details about the variation across time and comparison with ABT's sample can be found in Appendix C.

Findings from Regression Analysis:

The variables that ABT used to construct its regression models were not precise enough for an analysis of the cost of affordable housing developments in Connecticut. This analysis replicated ABT's regression

[1] ABT's measure of total development cost includes all hard and soft costs, which also contain associated land costs. The total development cost for all projects was adjusted for inflation using the RSmeans construction cost index before dividing by the number of units to get the per-unit cost.

[2] ABT's analysis used Census regions which group Connecticut with all New England states. Instead of Census regions, CHFA's analysis recreates ABT's methodology using Metropolitan Statistical Areas (MSAs) and counties. In addition, ABT only uses a single year of construction wages at the state level and the poverty rate from a single point in time. CHFA's analysis uses the inflation-adjusted (2017 dollars) annual average construction wages at the county level from the year before a project was placed in service.

[3] To obtain a large enough sample, CHFA's analysis includes projects place-in-service from 2006 through 2018. ABT's data includes projects placed-in-service from 2011 through 2016. In addition, ABT's construction wage and number of financing sources categories had to be adapted to describe CHFA's projects. For more details on CHFA's sample size, refer to Appendix B. To examine the categories used in CHFA's modeling, refer to Appendix A.

model, but reports the results of a model more appropriately tailored to CHFA's projects. For example, ABT's highest construction wage category was greater than $33,000. In Connecticut, the average annual construction wage was approximately $43,400. Specific details about how ABT's model was adapted to Connecticut can be found in Appendix A.

ABT reported three areas where its model identified statistically significant drivers of per-unit TDC. CHFA's regression results reported below are based on the All-projects sample, which includes LIHTC and non-LIHTC projects. Detailed estimates are reported on Model 4 in Appendix A.

- **Location**: ABT found that geography had a significant relationship to per-unit TDC. Their analysis showed that projects in the Northeast and Pacific regions tended to be more expensive. Additionally, projects in difficult development areas and qualified census tracts were found to have higher per-unit TDC. In Connecticut, we did not have enough data to significantly analyze differences across geographic regions. However, our analysis shows that projects in QCTs tended to have higher development costs. Model 4 reports that in Connecticut, projects in QCTs are approximately $13,237 more per-unit than projects not located in a QCT.[4]
- **Project and Unit Size**: Analysis of CHFA's projects aligns with ABT's findings that projects with more units have lower per-unit TDC than those with fewer. ABT found that projects with more than 100 units cost an average of $40,402.50 less than smaller projects. Model 4 shows that in Connecticut, projects with more than 100 units cost $101,736 less than very small projects (less than 25 units) on average. In addition, as project's average bedroom size increases, so does the per-unit cost. Projects with mostly one and two bedroom units cost $79,670 per-unit more than projects with mostly one bedroom and efficiency units.
- **Project Type**: The most significant finding of CHFA's analysis aligned with ABT's study. New construction projects are substantially more expensive than acquisition/rehab projects. ABT found that rehab projects had a per-unit TDC that was $44,000 less than new construction. CHFA's analysis found that rehabs in Connecticut had a per-unit TDC that was $53,400 less than new construction, as shown in Model 4. Model 5 estimates that acquisition/rehab projects cost about 21 percent less per-unit than new construction on average.

Connecticut-Specific Findings

One of the most notable findings in this analysis is that building in Connecticut's suburbs appears to be more expensive than building in its cities. This is counter to ABT's finding that urban areas have higher development costs than suburbs. One of the main reasons for this may be explained by the differences between CHFA's data and ABT's. When we ran models that only included LIHTC projects, it appeared that

[4] Since QCTs are generally high poverty areas, properties in them may be more likely to serve lower-income residents and have higher reserves, which push up the total development cost. In addition, the location of QCTs – in urban areas that may have other land/development challenges – may be skewing the results upward. Since this analysis used the ABT methodology, it is not surprising that it would have a similar finding. However, the Government Accountability Office also produced a LIHTC report and their models, which control for many more variables than ABT, show no significant additional cost associated with QCTs. When GAO controlled for other characteristics of the Census tract, like poverty rate, property values, land, and utility costs, the impact of QCTs on TDC disappears.

urban areas were more expensive than suburban towns. However, when we combined LIHTC with non-LIHTC projects, the results changed in every model. Although not as significant as the finding that rural developments are much less expensive than suburban ones (approximately $75,000 to $94,000), the finding that suburban developments have higher costs may benefit from further investigation. Using the ABT methodology for classifying a development's location as *urban, suburban, or rural*, our sample was approximately 48% urban, 48% suburban, and 4% rural.[5] A different methodology may add more variation and add more precision to our understanding of how location affects per-unit TDC.

CHFA's sample also included additional variables that were not available to ABT. Models 4, 5, and 6 control for the presence of Tax Exempt Bonds (TEBs), Investment Trust Account (ITA)[6] funds, and whether or not the project received a grant targeted for the State-Sponsored Housing Portfolio (SSHP).[7] The three models that used the All-projects sample, reported that projects with ITA funding and SSHP properties are generally less expensive than those without ITA or that are not SSHP, respectively.

Anecdotally, these findings are not surprising. Projects with ITA funding typically are not as reliant on additional sources of funding. Both ABT and CHFA's analysis found that additional sources of funding have a significant impact on the per-unit TDC. SSHP projects have grants and other subsidy that have a similar effect to ITA funds on the overall amount of financing needed for a project. Finally, SSHP projects are more likely to fall into the acquisition/rehab category, which was found to be less expensive.

Projects that used TEBs were shown to be more expensive than those without them in Models 4, 5 and 6. This finding, while imprecise, was consistent across all models used in the analysis. However, when Model 4 was run on the LIHTCs-only sample, the sign on the TEB estimate changed to negative. This result makes sense, given that 4 percent LIHTC projects are paired with TEBs. Including TEBs in the model makes the estimate for the impact of using 4 percent tax credits more precise. The LIHTCs-only results for Model 4 also reported that SSHP projects were more expensive. However, this estimate was again not statistically significant, but anecdotally makes sense. The LIHTC funded SSHP projects were very large and the sample was relatively small. It is likely that with a larger sample, the estimated effect of SSHP projects on per-unit TDC would resemble the All-projects Sample.

Another difference between ABT's sample and the Connecticut sample was the number of financing sources. ABT's largest category of financing sources was *4 or more*, which was too small for CHFA's sample. For Connecticut projects, the average number of financing sources was 5.9. Without looking at ABT's data,

[5] ABT's methodology for defining *urban, suburban,* or *rural* relied on the US Census Bureau's MSAs. A *principal city* (urban) was defined as the primary city or cities in the MSA, which is usually identified by the MSA's name; e.g. New Haven-Milford. *In metro, but not principal city* (suburban) is within a defined MSA, but not a major city within it. A *non-metro* area is one not located within a major MSA; e.g. Torrington. Because Connecticut's MSAs cover large portions of the state, a more subtle, population-based set of definitions may be more suited to an analysis of CHFA's portfolio.

[6] Investment Trust Account (ITA) funds are revenues generated by CHFA's affordable housing programs that are re-used for additional housing programs and are flexible in use.

[7] In 2012, the State made a $300 million commitment to fund moderate rehabilitation of the State-Sponsored Housing Portfolio, which was originally funded and built using money appropriated through State statutory programs.

it is not clear whether more financing sources in Connecticut is a result of less private investment in affordable housing developments, fewer tax credits available, greater availability of public financing sources, or some combination of the three.

Multipliers

While ABT focused on the results of a categorical model, Models 5 and 6, which used continuous variables (rather than the categories like Models 1, 2, and 4), offered more insight into how project characteristics affect per-unit TDC.[8] Some of CHFA's findings are comparable to ABT's model with continuous variables and can be considered potential cost multipliers. Model 6 shows that for every $1,000 increase in the average annual construction wage, the per-unit TDC will increase by approximately $13,130. ABT's national sample showed that the increase in per-unit TDC would be $4,770 for a $1,000 increase in construction wages. Another, more statistically significant finding in Model 6 is that for each additional unit in a project, the per-unit TDC will decrease by $563 on average. ABT found that each additional unit would decrease per-unit TDC by $296.

Limitations of this Analysis

The results in this report can be used as guide posts when estimating project costs without the foresight of specific construction and financing details. Given that many of the estimates changed considerably depending on the model, it is likely that they are not precise enough to draw definitive conclusions about their true relationship to project cost. The small sample size is the greatest challenge to identifying predictors of per-unit TDC. However, Models 4 and 6 provide a good framework for predicting a project's cost without needing detailed project specifications.

Another limitation of this analysis is the relatively small number of projects placed in service each year, which makes it difficult to estimate whether it's predictably more expensive to build in a particular county or whether it was more expensive to build in a particular year.

Ultimately, this report allows CHFA to reasonably compare its per-unit TDC to a national study and to begin building a framework for predicting project cost, without the need for specific project details.

[8] Models 1, 2, and 4 used categorical variables, meaning that a project's per-unit TDC was affected by whether or not it fit into pre-defined categories. For example, it may have been located in a specific geography or had average construction wages within a specific range, such as between $35,000 and $40,000. By contrast, Models 3, 5, and 6 use continuous variables to explain change in per-unit TDC. Rather than a category for construction wages, the actual values are used to add more precision to the model. Other continuous variables were the poverty rate, total number of units, average number of bedrooms, and the number of financing sources.

Appendix A: Regression Results Tables

Due to differences in the data available to ABT and CHFA, we created and tested multiple models to find the one that best fit CHFA's data, while approximating ABT's methodology. Details on how the models compared to each other are included in the *Model Comparison* section of Appendix A. Models 1 and 2 use different geographic groupings to help explain project costs. Model 1 used Metropolitan Statistical Areas (MSAs) and Model 2 used Counties. All subsequent models use counties as the main geographic variable because they are the most effective at explaining variation in per-unit TDC. ABT used Census regions, which are too large to use for an analysis of just projects Connecticut. All models are also reported with robust standard errors, clustered at the geographic level. While ABT did not use this method in its analysis, it was important for CHFA to do so because of its small sample size and relatively similar projects. ABT also uses *Principal City, Non-Metro Area, and in Metro area, but not principal City*, as proxies for urban, rural, and suburban respectively. The following models use this methodology.

Models 1 through 4 are reported first using the LIHTCs-only sample and then using the all-projects sample. The most notable difference between the way that estimates are reported for each sample is that the LIHTCs-only sample compares 9 percent projects to 4 percent projects, while the all-projects sample compares 9 percent and 4 percent deals to projects that did not use LIHTCs. Models 5 and 6 both use the all-projects sample. While estimates are available for both samples, findings are reported from the all-projects sample because the additional variability between LIHTC and non-LIHTC projects improves the overall accuracy of the model.

Model 1: Replicating ABT's model using Metropolitan Statistical Areas

This first model replicates ABT Associates' methodology for analyzing how the year, location, and characteristics of each project affect the per-unit total development cost. Model 1 uses the US Census Bureau's MSAs. Windham and Litchfield Counties are included as part of other MSAs because the US Census Bureau considers them too rural to be part of an MSA. It is generally considered that Windham County is included in the Worcester, MA MSA and Litchfield County comprises the Torrington, CT Mircopolitan Statistical Area.

How to interpret this table:

Each variable in Model 1 is categorical. They are interpreted as relative to projects **not** in that category. The *Estimates* column is the estimated effect that belonging to each category has on the per-unit TDC. For example, a LIHTC project (first column) that was an acquisition/rehab project cost approximately $60,191 less than a LIHTC project that was new construction.

The *std. Error* column is a measure of the precision of the estimates. Smaller *standard errors*, relative to the size of the *Estimates*, indicate that the *Estimates* are more accurate approximations of the true affect that the variable has on per-unit TDC.

The *P-value* is a measure of the statistical significance of the *Estimates*. It indicates whether or not we can reject the null hypothesis that the *Estimate* is equal to zero. Given the relatively small sample size for all models in this analysis, many variables have *P-values* indicating that there is no statistically significant

difference between the *Estimates* and zero. *Estimates* are generally considered significant if the *P-value* is less than 0.05.

Significance codes for each table: *** < 0.001 | ** < 0.01 | * < 0.05 | . < 0.1

Model 1: ABT Regression with All Categorical Variables using Census MSA Regions						
	Just LIHTC Projects			**All-projects**		
Variable	***Estimates***	***std. Error***	***P-value***	***Estimates***	***std. Error***	***P-value***
Intercept	$318,072.60	$80,129.00	**<0.001*** **	$193,262.30	$48,297.40	**<0.001*** **
Place in Service Year (reference = 2018)						
2006	-$34,830.20	$45,161.40	0.443	$16,768.40	$38,837.30	0.667
2007	$72,924.10	$11,260.60	**<0.001*** **	$96,529.50	$24,330.50	**<0.001*** **
2008	-$8,233.00	$46,601.00	0.860	-$2,881.70	$16,888.10	0.865
2009	-$2,676.10	$33,612.60	0.937	-$19,152.10	$27,566.30	0.489
2010	-$25,806.60	$24,210.10	0.290	$16,116.70	$49,708.00	0.746
2011	$60,606.80	$74,353.70	0.418	$81,456.30	$39,727.40	**0.043***
2012	$18,950.70	$17,081.50	0.271	$16,911.30	$29,679.80	0.570
2013	$10,927.60	$21,244.50	0.609	$33,619.10	$26,045.10	0.200
2014	$8,541.60	$44,537.60	0.849	$5,461.60	$29,083.00	0.851
2015	-$28,680.50	$30,644.10	0.353	-$18,951.50	$38,233.40	0.621
2016	-$5,263.50	$56,994.30	0.927	-$24,646.70	$39,244.20	0.531
2017	-$37,121.70	$27,099.30	0.175	-$29,007.30	$7,759.20	**<0.001*** **
Location Characteristics						
Region (reference = Bridgeport-Stamford-Norwalk)						
Hartford-West Hartford-East Hartford	-$53,362.30	$16,674.10	**0.002****	-$42,695.80	$5,469.80	**<0.001*** **
New Haven-Milford	-$20,094.40	$34,189.30	0.559	-$37,154.90	$13,664.50	**0.008****
Norwich-New London	-$60,234.10	$52,104.20	0.252	-$25,440.30	$17,661.00	0.153
Torrington Micro Area	-$53,102.60	$29,716.60	**0.079 .**	-$44,832.60	$23,741.80	**0.062 .**
Worcester, MA-CT	$24,696.80	$72,161.60	0.733	$13,444.20	$33,287.00	0.687
Metro area (reference = in Metro, but not principal city)						
Principal City in Metro	$26,400.70	$16,772.80	0.120	-$9,575.70	$25,393.30	0.707
Non-metro	-$93,426.20	$46,388.80	**0.048***	-$77,996.30	$46,219.80	**0.095 .**
Poverty (reference = 20-30% poverty rate)						
0% - 10% Poverty	$40,408.60	$49,812.90	0.420	-$5,750.30	$51,485.80	0.911
10.01% - 20% Poverty	$33,196.40	$35,678.40	0.356	-$7,054.40	$41,976.70	0.867
30.01% - 40% Poverty	-$14,124.80	$11,697.90	0.232	$2,719.90	$17,823.70	0.879

More than 40% Poverty	$22,296.90	$40,566.20	0.584	$16,664.30	$29,984.40	0.580
	Just LIHTC Projects			**All-projects**		
Variable	***Estimates***	***std. Error***	***P-value***	***Estimates***	***std. Error***	***P-value***
In a QCT	$14,184.40	$72,451.40	0.845	$16,641.80	$48,380.80	0.732
In a DDA	-$1,068.50	$66,520.00	0.987	$18,799.40	$35,007.40	0.592
Annual Construction Wages (reference = $30,001 - $33,000)						
Wages $0 - $30k	-	-	-	$51,977.30	$50,744.80	0.308
Wages over $33k	-	-	-	-	-	-
Project Characteristics						
9% Credit Project	**(reference = 4% credit project)**			**(reference = non-LIHTC projects)**		
	$22,595.70	$37,466.70	0.549	$48,897.70	$31,627.10	0.125
4% Credit Project	-	-	-	$27,847.50	$47,779.30	0.561
Acquisition/Rehab (reference = New Construction)	-$60,191.40	$35,019.60	**0.090 .**	-$56,510.40	$30,759.10	**0.069 .**
Development Size (reference = 26-50 units)						
Up to 25 Units	$62,577.80	$21,112.30	**0.004****	$72,492.40	$23,932.30	**0.003****
51 to 100 Units	-$50,338.00	$65,102.50	0.442	-$37,958.70	$25,951.90	0.147
More than 100 Units	-$74,526.90	$77,534.40	0.340	-$81,676.80	$47,923.50	**0.091 .**
Average Bedroom Size (reference = 0 – 1.249 bedrooms per unit)						
1.25 to 1.749 Bedrooms	$42,003.20	$48,297.10	0.388	$73,595.20	$19,854.10	**<0.001*****
1.75 to 2.499 Bedrooms	$9,319.00	$25,891.10	0.720	$15,804.70	$22,351.40	0.481
2.5 or more Bedrooms	$9,429.00	$32,869.60	0.775	$41,898.40	$43,307.70	0.336
Population Served (reference = families)						
Elderly	-$74,487.20	$22,074.80	**0.001****	-$46,969.70	$16,560.60	**0.006****
Supportive	-$36,981.00	$56,161.90	0.513	$44,467.70	$12,677.10	**0.001****
Nonprofit project (reference = for-profit project)	-$3,761.10	$27,629.10	0.892	-$10,569.80	$24,460.90	0.667
Number of Financing Sources (reference = two sources)						
One Financing Source	-	-	-	-$22,922.70	$31,093.30	0.463
Three Financing Sources	-$1,365.60	$50,448.90	0.978	$63,019.80	$22,033.60	**0.005****
Four or More Financing Sources	$7,120.80	$27,950.30	0.800	$110,609.60	$36,291.40	**0.003****
Observations	104			140		
R^2 / adjusted R^2	0.603 / 0.370			0.657 / 0.513		

Model 2: Replicating ABT's model using Connecticut counties

The second model replicates the ABT's methodology for analyzing how the year, location, and characteristics of each project affect the per-unit total development cost. ABT uses Census regions for its geographic variables and Model 2 uses Connecticut's eight counties instead of using MSAs. The reason for testing counties instead of MSAs is that each of MSAs includes one county, except for Hartford-West Hartford-East Hartford, which contains three counties. With more geographic variation, the models may become more accurate. The table below reports results from a sample exclusively containing LIHTC-funded projects and a sample containing LIHTC and non-LIHTC projects.

How to interpret this table:

Each variable refers to an aspect of each project. Since they are all categorical, they are interpreted as relative to projects **not** in that category. The *Estimates* column is the estimated effect that belonging to each category has on the per-unit TDC. For example, Model 2 estimates that a LIHTC project (first column) that was an acquisition/rehab project cost approximately $61,324 less than a LIHTC project that was new construction.

Model 2: ABT Variables Regression with All Categorical using Counties as Regions						
	Just LIHTC Projects			**All-projects**		
Variable	***Estimates***	***std. Error***	***P-value***	***Estimates***	***std. Error***	***P-value***
Intercept	$295,909.30	$87,572.60	**0.001****	$201,795.84	$47,751.02	**<0.001*****
Year (reference = 2018)						
2006	-$8,625.80	$60,395.70	0.887	$27,043.07	$42,242.46	0.524
2007	$102,862.70	$28,451.00	**<0.001*****	$116,531.63	$41,874.65	**0.006****
2008	$11,895.90	$43,305.60	0.784	$11,248.58	$23,044.84	0.627
2009	$13,680.50	$36,371.60	0.708	$499.27	$30,798.71	0.987
2010	-$14,951.00	$29,234.00	0.611	$21,432.00	$52,816.99	0.686
2011	$72,081.10	$68,477.90	0.297	$86,234.60	$40,701.43	**0.037**
2012	$29,151.90	$20,120.60	0.152	$15,742.88	$31,136.02	0.614
2013	$25,521.60	$32,231.60	0.431	$41,164.36	$30,651.72	0.182
2014	$10,842.80	$56,630.00	0.849	$20,234.41	$31,083.38	0.517
2015	-$17,233.70	$31,080.70	0.581	-$21,413.61	$43,383.01	0.623
2016	-$1,157.30	$54,918.70	0.983	-$33,116.39	$27,563.19	0.233
2017	-$22,640.80	$20,915.00	0.283	-$20,609.50	$14,265.91	0.152
Location Characteristics						
Region (reference = Fairfield County)						
Hartford County	-$64,553.80	$21,864.50	**0.004****	-$50,427.85	$6,380.42	**<0.001*****
Litchfield County	-$65,879.90	$28,138.10	**0.022***	-$64,355.45	$20,299.31	**0.002****
Middlesex County	$27,205.80	$35,245.90	0.443	-$94,864.19	$35,768.22	**0.009****

New Haven County	-$27,264.40	$29,843.90	0.364	-$37,978.18	$11,842.80	**0.002****
	Just LIHTC Projects			**All-projects**		
Variable	***Estimates***	***std. Error***	***P-value***	***Estimates***	***std. Error***	***P-value***
New London County	-$65,378.30	$51,520.10	0.209	-$19,590.07	$19,699.66	0.323
Tolland County	$116.60	$32,426.70	0.997	$52,266.91	$24,130.52	**0.033***
Windham County	-$12,286.70	$60,526.70	0.840	-$15,279.76	$23,478.39	0.517
Metro area (reference = in Metro, but not principal city)						
Principal City in Metro	$25,137.80	$19,518.00	0.202	-$17,722.14	$26,219.20	0.501
Non-metro	-$67,322.60	$42,390.50	0.117	-$53,083.11	$30,932.17	**0.089 .**
Poverty (reference = 20-30% poverty rate)						
0% - 10% Poverty	$25,999.60	$56,796.30	0.649	-$20,384.39	$50,266.00	0.686
10.01% - 20% Poverty	$28,786.50	$36,940.20	0.439	-$4,592.04	$35,157.11	0.896
30.01% - 40% Poverty	-$16,281.10	$14,551.20	0.267	$2,605.65	$18,819.28	0.890
More than 40% Poverty	$24,144.10	$37,554.70	0.523	$13,070.50	$26,093.37	0.618
In a QCT	$14,742.20	$70,522.40	0.835	$28,702.90	$44,335.01	0.519
In a DDA	$4,075.20	$71,397.90	0.955	$27,777.29	$37,859.15	0.465
Annual Construction Wages (reference = $30,001 - $33,000)						
Wages $0 - $30k	-	-	-	$53,755.53	$46,839.14	0.254
Wages over $33k	-	-	-	-	-	-
Project Characteristics						
9% Credit Project	**(reference = 4% credit project)**			**(reference = non-LIHTC projects)**		
	$28,386.10	$34,433.00	0.413	$35,632.99	$27,019.22	0.190
4% Credit Project	--	-	-	$8,116.01	$33,543.42	0.809
Acquisition/Rehab (reference = New Construction)	-$61,324.00	$28,043.00	**0.032***	-$60,486.56	$26,021.14	**0.022***
Development Size (reference = 26-50 units)						
Up to 25 Units	$60,449.00	$27,003.10	**0.029***	$80,865.06	$24,003.17	**0.001****
51 to 100 Units	-$48,371.20	$64,850.60	0.459	-$37,785.96	$25,370.72	0.140
More than 100 Units	-$69,908.90	$73,911.50	0.348	-$76,900.35	$38,458.94	**0.048***
Average Bedroom Size (reference = 0 – 1.249 bedrooms per unit)						
1.25 to 1.749 Bedrooms	$52,689.50	$53,940.10	0.332	$77,861.77	$19,443.85	**<0.001*** **
1.75 to 2.499 Bedrooms	$14,949.90	$32,414.50	0.646	$19,343.47	$23,331.74	0.409
2.5 or more Bedrooms	$18,238.30	$22,422.80	0.419	$51,100.23	$39,113.23	0.195
Population Served (reference = families)						

Elderly	-$72,479.70	$18,557.30	**<0.001*** **	-$39,120.45	$20,556.05	**0.060 .**
Supportive	-$35,067.60	$60,732.80	0.566	$26,449.78	$19,246.49	0.173
	Just LIHTC Projects			**All-projects**		
Variable	***Estimates***	***std. Error***	***P-value***	***Estimates***	***std. Error***	***P-value***
Nonprofit project (reference = for-profit project)	-$1,749.60	$31,321.20	0.956	-$12,533.16	$24,598.85	0.612
Number of Financing Sources (reference = two sources)						
One Financing Source	-	-	-	-$42,789.07	$25,491.53	**0.096 .**
Three Financing Sources	$3,169.40	$53,722.00	0.953	$58,493.52	$21,149.61	**0.007****
Four or More Financing Sources	$14,938.60	$36,094.30	0.680	$111,204.00	$37,517.17	**0.004****
Observations	104			140		
R^2 / adjusted R^2	0.616 / 0.372			0.673 / 0.527		

Model 3: Replicating ABT's model that uses continuous variables instead of categories

The third model replicates the ABT Associates' methodology for analyzing how the year, location, and characteristics of each project affect the per-unit total development cost by replacing some categorical variables with continuous ones. Continuous variables may help to better explain per-unit TDC because there is a broader variation in the actual values used in the regression. Rather than describing the change in per-unit TDC based on whether or not a project fits into a specific category, continuous variables allow us to measure the impact of unit changes. In other words, how does a $1 increase in construction wages or a 1 percentage point increase in the poverty rate affect per-unit TDC. In addition, this model uses counties instead of MSAs because Model 2 showed that counties are better indicators of how geographic variation among projects explains per-unit TDC. The table below reports results from a sample exclusively containing LIHTC-funded projects and a sample containing LIHTC and non-LIHTC projects.

How to interpret this table:

The categorical variables are interpreted as relative to projects **not** in that category. The *Estimates* column is the estimated effect that belonging to each category has on the per-unit TDC. For example, Model 3 estimates that a LIHTC project (first column) that was an acquisition/rehab project cost approximately $59,000 less than a LIHTC project that was new construction. The continuous variables are interpreted as the estimated effect of a one unit increase in the variable on per-unit TDC. For example, Model 3 estimates that, for projects in the all-projects sample, a $1,000 increase in average annual construction wages will increase the per-unit TDC of a project by $15,470.

Model 3: ABT Regression with Continuous Variables using Counties as Regions						
	Just LIHTC Projects			**All-projects**		
Variable	***Estimates***	***std. Error***	***P-value***	***Estimates***	***std. Error***	***P-value***

Intercept	-$478,369.14	$537,645.86	0.377	-$461,456.86	$427,011.78	0.282

	Just LIHTC Projects			All-projects		
Variable	***Estimates***	***std. Error***	***P-value***	***Estimates***	***std. Error***	***P-value***
Year (reference = 2018)						
2006	$10,101.93	$34,049.44	0.768	$73,984.78	$69,187.94	0.287
2007	$129,633.94	$12,203.03	**<0.001*** **	$151,536.04	$43,723.97	**<0.001*** **
2008	$79,165.67	$38,735.48	**0.045***	$42,235.29	$42,024.35	0.317
2009	$58,719.23	$55,600.31	0.295	$37,911.67	$53,982.18	0.484
2010	$18,505.40	$39,691.99	0.643	$69,983.16	$87,156.49	0.424
2011	$140,287.01	$27,661.62	**<0.001*** **	$151,832.80	$38,424.45	**<0.001*** **
2012	$84,698.35	$48,092.68	**0.083 .**	$77,508.08	$49,583.98	0.121
2013	$116,729.79	$44,168.40	**0.010***	$127,367.34	$40,867.04	**0.002****
2014	$70,376.31	$46,051.03	0.131	$60,993.86	$24,949.57	**0.016***
2015	$39,927.54	$37,195.28	0.287	$39,436.17	$39,899.58	0.325
2016	$13,233.56	$50,586.37	0.794	-$31,368.43	$48,198.61	0.517
2017	$13,253.87	$31,898.37	0.679	$8,784.19	$37,145.36	0.814
Location Characteristics						
Region (reference = Fairfield County)						
Hartford County	-$12,647.87	$38,987.56	0.747	-$8,916.56	$29,642.05	0.764
Litchfield County	$91,109.79	$102,569.59	0.377	$95,150.10	$85,610.53	0.269
Middlesex County	$147,346.19	$121,033.43	0.228	$107,699.79	$90,945.10	0.239
New Haven County	$31,807.41	$52,642.92	0.548	$15,906.49	$42,042.16	0.706
New London County	$37,387.12	$97,316.11	0.702	$62,869.62	$66,859.64	0.349
Tolland County	$102,095.53	$70,684.72	0.153	$136,320.65	$51,952.46	**0.010***
Windham County	$249,371.90	$182,346.95	0.176	$219,872.49	$153,105.52	0.154
Metro area (reference = in Metro, but not principal city)						
Principal City in Metro	$6,341.90	$13,641.16	0.643	-$23,181.09	$17,794.91	0.196
Non-metro	-$133,401.54	$56,964.40	**0.022***	-$85,942.87	$33,054.31	**0.011***
Poverty Rate	-$142.72	$1,320.26	0.914	$561.46	$1,021.92	0.584
In a QCT	$39,188.12	$54,311.43	0.473	$47,378.92	$39,747.79	0.236
In a DDA	$28,195.70	$39,652.04	0.479	$7,742.77	$40,716.14	0.850
Annual Construction Wages	$15.47	$10.94	0.162	$13.41	$8.64	0.124
Project Characteristics						
9% Credit Project	**(reference = 4% credit project)**			**(reference = non-LIHTC projects)**		
	$42,134.29	$21,001.75	**0.049***	$35,294.80	$26,918.72	0.193
4% Credit Project	-	-	-	-$17,314.64	$32,649.88	0.597

Acquisition/Rehab (reference = New Construction)	-$59,009.73	$21,524.24	**0.008****	-$51,615.45	$24,609.13	**0.038***
Total Project Units	-$303.28	$221.96	0.176	-$542.90	$154.53	**<0.001*** **
Average Bedroom Size	$10,390.92	$14,700.56	0.482	$13,854.85	$17,905.47	0.441
	Just LIHTC Projects			**All-projects**		
Variable	***Estimates***	***std. Error***	***P-value***	***Estimates***	***std. Error***	***P-value***
Population Served (reference = families)						
Elderly	-$58,694.55	$33,131.03	**0.081 .**	-$34,084.51	$23,669.12	0.153
Supportive	-$16,055.58	$40,275.27	0.691	$86,261.75	$32,824.88	**0.010***
Nonprofit project (reference = for-profit project)	$616.98	$26,489.35	0.981	-$12,623.01	$17,356.45	0.469
Total Finance Sources	$1,368.60	$2,746.67	0.620	$14,479.13	$5,314.66	**0.008****
Observations	104			140		
R^2 / adjusted R^2	0.585 / 0.390			0.631 / 0.512		

Model 4: Replicating ABT's model with categorical variables with adjustments for CHFA projects

The fourth model replicates the ABT Associates' methodology for analyzing how the year, location, and characteristics of each project affect the per-unit total development cost with exclusively categorical variables. However, it uses modified categories that better group the data in CHFA's samples and adds additional variables that are unique to the projects in CHFA's portfolio.

Specifically, ABT's largest construction wage category was greater than $33,000 per year. In Connecticut, the average annual construction wage was over $36,000. So the categories were changed to reflect the different distribution of wages. ABT also capped its financial sources categories at four or more sources. However, CHFA's sample averaged 5.9 financing sources. The categories for sources were adjusted to reflect this difference. CHFA has used ITA and Tax Exempt Bond (TEB) funding which may help explain more of the variation in per-unit TDC. Finally, in 2012, CHFA began updating the State Sponsored Housing Portfolio (SSHP) and a variable flagging those projects was added to investigate whether it added descriptive power to the model.

The table below reports results from a sample exclusively containing LIHTC-funded projects and a sample containing LIHTC and non-LIHTC projects. The goal of this model was to examine the results of a model similar to ABT's, but that used variables specific to Connecticut.

How to interpret this table:

The categorical variables are interpreted as relative to projects **not** in that category. The *Estimates* column is the estimated effect that belonging to each category has on the per-unit TDC, relative to projects not in

that category. For example, Model 4 estimates that a LIHTC project (first column) that was acquisition/rehab, the per-unit TDC was $56,933 less than new construction. Additionally, for LIHTC projects that serve the elderly, the per-unit TDC was $66,128 less than LIHTC projects serving families. The modified wage category did not produce estimates because too many projects fell into that category.

Model 4: Adjusted ABT Regression with All Categorical Variables using Counties as Regions						
	Just LIHTC Projects			All-projects		
Variable	*Estimates*	*std. Error*	*P-value*	*Estimates*	*std. Error*	*P-value*
Intercept	$320,760.70	$106,699.60	**0.004****	$359,294.10	$48,042.90	**<0.001*****
Year (reference = 2018)						
2006	-$11,385.00	$95,717.60	0.906	$3,533.90	$55,451.70	0.949
2007	$141,300.60	$50,242.60	**0.007****	$106,965.70	$61,175.50	**0.084 .**
2008	$7,590.30	$50,157.10	0.880	-$47,846.60	$22,690.40	**0.038***
2009	$24,770.80	$61,535.90	0.689	-$24,896.50	$47,229.60	0.599
2010	-$3,467.50	$22,425.60	0.878	-$17,266.60	$41,609.90	0.679
2011	$82,409.80	$56,548.80	0.150	$70,960.90	$47,842.80	0.141
2012	$42,307.40	$34,924.90	0.231	$14,228.20	$31,132.50	0.649
2013	$28,916.40	$62,126.10	0.643	$38,186.20	$57,389.30	0.507
2014	$30,095.90	$56,843.10	0.599	-$7,249.70	$38,527.80	0.851
2015	-$18,857.90	$35,897.90	0.601	-$20,230.66	$39,170.63	0.607
2016	$6,512.00	$44,087.00	0.883	-$45,999.31	$40,019.45	0.253
2017	-$19,642.90	$21,518.20	0.365	-$33,993.27	$36,770.71	0.358
Location Characteristics						
Region (reference = Fairfield County)						
Hartford County	-$47,696.50	$22,313.30	**0.037***	-$43,514.30	$12,520.60	**<0.001*****
Litchfield County	-$42,241.30	$37,988.70	0.271	-$27,328.20	$41,338.90	0.510
Middlesex County	$19,429.10	$46,311.40	0.676	-$65,572.30	$53,850.80	0.226
New Haven County	$3,545.00	$28,790.30	0.902	-$14,297.60	$23,393.40	0.543
New London County	-$43,791.50	$62,165.30	0.484	-$8,627.70	$24,660.20	0.727
Tolland County	$18,862.30	$44,034.80	0.670	$39,391.20	$34,002.10	0.250
Windham County	$12,170.90	$55,572.90	0.827	$44,846.10	$43,162.40	0.301
Metro area (reference = in Metro, but not principal city)						
Principal City in Metro	$30,118.40	$25,624.60	0.245	-$11,874.20	$19,119.90	0.536
Non-metro	-$77,373.00	$50,382.90	0.130	-$94,342.20	$51,744.60	**0.071 .**
Poverty (reference = 20-30% poverty rate)						
0% - 10% Poverty	$35,647.60	$59,773.00	0.553	-$15,395.80	$40,973.00	0.708
10.01% - 20% Poverty	$31,878.00	$38,951.40	0.416	$9,933.40	$24,071.60	0.681
30.01% - 40% Poverty	-$19,094.30	$17,333.40	0.275	-$6,003.50	$13,058.10	0.647

More than 40% Poverty	$21,232.20	$39,229.90	0.590	$15,931.70	$14,879.40	0.287
In a QCT	$20,454.00	$61,476.20	0.741	$13,237.10	$27,536.20	0.632
In a DDA	-$1,352.20	$88,934.10	0.988	$13,025.70	$53,860.00	0.809
Annual Construction Wages (reference = Wages $0 to $35k)						
Wages $35 - $45k	-$22,672.30	$34,230.50	0.510	-$24,546.90	$22,788.60	0.284
Wages over $45k	-	-	-	-	-	-

	Just LIHTC Projects			**All-projects**		
Variable	***Estimates***	***std. Error***	***P-value***	***Estimates***	***std. Error***	***P-value***
Project Characteristics						
9% Credit Project	**(reference = 4% credit project)**			**(reference = non-LIHTC projects)**		
	-$155.30	$56,666.90	0.998	$21,036.10	$28,803.20	0.467
4% Credit Project	-	-	-	$9,338.90	$30,791.40	0.762
Used Tax Exempt Bonds	-$47,886.20	$36,202.30	0.191	-$20,804.80	$28,776.00	0.472
Used ITA Funds	-$21,998.10	$23,750.60	0.358	-$1,176.30	$23,847.70	0.961
Had SSHP Grant	$54,327.30	$35,037.40	0.126	-$84,080.10	$35,492.30	**0.020***
Acquisition/Rehab (reference = New Construction)	-$56,933.40	$30,843.20	**0.070 .**	-$53,400.00	$25,414.70	**0.038***
Development Size (reference = 26-50 units)						
Up to 25 Units	$55,905.80	$30,382.70	**0.071 .**	$69,210.10	$34,048.10	**0.045***
51 to 100 Units	-$60,248.80	$52,586.10	0.257	-$43,738.40	$30,266.00	0.152
More than 100 Units	-$82,950.30	$71,166.80	0.249	-$101,736.30	$46,099.30	**0.030***
Average Bedroom Size (reference = 0 – 1.249 bedrooms per unit)						
1.25 to 1.75 Beds	$57,827.20	$44,321.10	0.197	$79,670.10	$19,313.90	**<0.001*****
1.75 to 2.5 Beds	$11,932.00	$22,574.80	0.599	$25,308.60	$23,303.30	0.280
More than 2.5 Beds	$21,446.60	$24,547.20	0.386	$43,427.20	$38,799.00	0.266
Population Served (reference = families)						
Elderly	-$66,128.40	$19,808.90	**0.001****	-$32,567.50	$8,964.20	**<0.001*****
Supportive	-$41,832.70	$32,201.50	0.199	$19,201.50	$10,860.20	**0.080 .**
Nonprofit project (reference = for-profit project)	-$7,666.80	$24,769.40	0.758	-$20,536.50	$17,375.60	0.240
Number of Financing Sources (reference = Nine or more sources)						
Up to Four Financing Sources	$3,114.20	$21,354.60	0.885	-$57,556.90	$24,610.40	**0.021***
Five or Six Financing Sources	$15,191.90	$22,246.40	0.497	-$12,689.70	$24,140.70	0.600
Seven or Eight Financing Sources	$41,501.60	$11,292.70	**<0.001*****	$21,498.20	$4,944.60	**<0.001*****
Observations	104			140		
R^2 / adjusted R^2	0.649 / 0.376			0.699 / 0.550		

Models 5 & 6: Regression analysis using variables tailored to CHFA's portfolio

The fifth model uses a log-transformed per-unit TDC as the outcome variable. This changes the interpretation of the estimates to represent the percent change in per-unit TDC when there is a one unit change in the variable or when it belongs to a specific category. The sixth model is the final estimation of a model influenced by ABT's analysis that may be best fit to CHFA's sample. Both models use the same variables, but should be interpreted differently.

How to interpret this table:

Model 5 should be interpreted as the percent change in per-unit TDC cause by a change in each variable. To get the percent, multiply the *Estimate* in the first column by 100 or move the decimal point two places to the right. For example, each additional financing source increases per-unit TDC by approximately 5 percent. Or, projects located in a Qualified Census Tract (QCT) have per-unit TDC that is approximately 8 percent higher than projects not located in a QCT.

Model 6 is interpreted similar to Model 3. For example, each additional financing source increases the per-unit TDC by approximately $11,286. Or, projects located in a QCT are approximately $30,909 more expensive per-unit than those not located in a QCT.

Models 5 & 6: Regressions with Continuous Variables using the Full Sample						
	Model 5: Log(Per-Unit TDC)			Model 6: Per-Unit TDC (USD)		
Variable	***Estimates***	***std. Error***	***P-value***	***Estimates***	***std. Error***	***P-value***
Intercept	$11,412.67	$4.64	**<0.001*** **	-$379,633.43	$428,981.46	0.378
Year (reference = 2018)						
2006	0.43	0.36	0.232	$41,101.81	$70,507.28	0.561
2007	0.70	0.31	**0.028***	$126,084.84	$57,486.81	**0.031***
2008	0.18	0.23	0.447	$18,207.71	$40,291.01	0.652
2009	0.14	0.32	0.667	$21,944.96	$55,283.73	0.692
2010	0.28	0.41	0.505	$42,240.06	$77,418.45	0.587
2011	0.54	0.27	**0.044***	$123,162.91	$39,307.52	**0.002****
2012	0.37	0.23	0.113	$49,334.15	$50,118.79	0.327
2013	0.57	0.30	**0.058 .**	$101,461.59	$45,478.64	**0.028***
2014	0.36	0.20	**0.069 .**	$35,826.10	$30,731.71	0.246
2015	0.19	0.22	0.392	$19,710.26	$37,201.99	0.597
2016	-0.07	0.29	0.795	-$31,360.36	$49,686.22	0.529
2017	0.14	0.23	0.551	-$6,989.04	$35,916.91	0.846
Location Characteristics						
Region (reference = Fairfield County)						
Hartford County	-0.05	0.09	0.617	-$9,697.64	$29,439.13	0.743
Litchfield County	0.38	0.31	0.229	$96,415.83	$90,578.99	0.290

Middlesex County	0.12	0.35	0.725	$71,782.69	$83,301.65	0.391
New Haven County	0.05	0.16	0.739	$16,108.33	$43,562.99	0.712
New London County	0.34	0.25	0.168	$61,234.14	$65,772.58	0.354
Tolland County	0.55	0.22	**0.013***	$105,809.41	$51,187.35	**0.041***
Windham County	1.13	0.59	**0.057 .**	$218,060.38	$164,694.29	0.188
Metro area (reference = in Metro, but not principal city)						
Principal Metro	-0.13	0.06	**0.030***	-$23,783.28	$17,709.45	0.182
Non-metro	-0.56	0.16	**<0.001***	-$75,905.42	$40,119.62	**0.061 .**
Poverty Rate	0.003	0.00	0.482	$465.30	$1,015.11	0.648
	Model 5: Log(Per-Unit TDC)			**Model 6: Per-Unit TDC (USD)**		
Variable	***Estimates***	***std. Error***	***P-value***	***Estimates***	***std. Error***	***P-value***
DDA	0.07	0.14	0.625	$19,026.04	$41,758.64	0.650
QCT	0.08	0.11	0.506	$30,909.57	$40,151.64	0.443
Construction Wages	0.00006	0.00	**0.072 .**	$13.13	$8.95	0.145
Project Characteristics						
9% Credit Project	0.21	0.09	**0.017***	$13,268.26	$29,305.11	0.652
4% Credit Project	0.003	0.17	0.985	-$32,083.89	$37,384.47	0.393
Used Tax Exempt Bonds	0.06	0.23	0.788	-$2,245.50	$39,130.68	0.954
Used ITA Funds	-0.06	0.11	0.614	-$20,073.36	$20,866.10	0.338
Had SSHP Grant	-0.69	0.17	**<0.001***	-$85,087.21	$31,133.11	**0.007****
Acquisition/Rehab (reference = New Construction)	-0.21	0.11	**0.051 .**	-$48,166.92	$24,688.14	**0.054 .**
Total Project Units	-0.0027	0.00	**<0.001***	-$562.97	$133.06	**<0.001***
Average Bedroom Size	0.14	0.08	**0.085 .**	$18,888.87	$13,870.89	0.176
Population Served (reference = families)						
Elderly	-0.10	0.15	0.507	-$23,071.20	$28,441.04	0.419
Supportive	0.38	0.13	**0.004****	$63,388.18	$30,319.77	**0.039***
Nonprofit project (reference = for-profit project)	-0.10	0.06	**0.094 .**	-$15,413.40	$16,449.49	0.351
Total Finance Sources	0.05	0.02	**0.003****	$11,286.68	$4,194.93	**0.008****
Observations	140			140		
R^2 / adjusted R^2	0.732 / 0.634			0.652 / 0.526		

Model Comparison

Given the small sample size use in CHFA's model, many of the estimates in each model were not statistically significant enough to consider as having predictive power. However, there is descriptive value

to many of the estimates. The table below compares each of the models based on their R^2 and adjusted R^2 values, their number of variables, and the number of significant estimates at different levels. The R^2 value demonstrates how much of the variation in per-unit TDC is explained by the model. For example, the table below shows that Model 5 has an R^2 of 0.732, meaning that approximately 73% of the variation in per-unit TDC can be explained using that model. For the models with LIHTC-only and all-project samples, the all-project model is used for comparison.

Conclusion of Model Comparison

As shown in Table 6 below, Models 4 performs the best overall. It combines the second largest R^2 with a larger number of statistically significant variables, and the lowest Mean Absolute Percent Error (MAPE). The MAPE is useful for assessing the predictive power of a model and lower values are optimal. It is possible that, given the relatively small sample size of 140, the models with more variables are over-fit, which leads to a higher R^2 value, but less significant estimates. Models 1 through 3 use the same variables as ABT Associates, while 4 through 6 use variables tailored to CHFA's portfolio. The tailored models perform better than ABT's methodology when analyzing CHFA's projects. Since Models 5 and 6 are inherently different types of regression, they should be viewed as complementary tools for analyzing project cost.

Ultimately, CHFAs best method for explaining and potentially predicting project cost is by using a combination of Models 4, 5, and 6. Model 4 is the currently the best for predicting a project's per-unit TDC. Model 5 can be used to describe the percent of per-unit TDC that is affected by a project's characteristics. Model 6 can be used to estimate the multiplier effects of specific aspects of a development. However, all of these models can be significantly improved with more data, and the inclusion of more project specific variables that differ greatly from those used by ABT.

Table 1: Comparison of Models Based on Significance and Explanatory Power

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
R^2 / adjusted R^2	0.657 / 0.513	0.673 / 0.527	0.631 / 0.512	0.699 / 0.550	0.732 / 0.634	0.652 / 0.526
Number of variables	42	44	34	47	38	38
Number of significant variables	15	16	10	14	17	9
Variables at α = 0.1	4	3	0	4	7	2
Variables at α = 0.05	1	4	3	6	5	4
Variables at α = 0.01	5	7	4	0	2	3

Variables at α = 0.001	5	2	3	4	3	1
MAPE	0.3321	0.3144	0.3658	0.307	0.999	0.3475

Appendix B: Descriptive Statistics of CHFA's LIHTC-only and All-projects Samples

The Connecticut sample was much smaller than ABT's, but included all of the same variables except for geography. The table below compares CHFA's sample to ABT's and breaks out the New England subset of ABT's sample to describe the potential overlap between CHFA's data and ABT's.

CHFA's data is analyzed in two sample groups. The LIHTCs-only sample contains projects that used 4 or 9 percent tax credits. The All-projects sample contains both LIHTCs and non-LIHTCs.

While ABT's national sample is much larger than CHFA's, it appears that CHFA's projects may represent as much as 31 percent of the projects and 49.5 percent of the units placed in service in ABT's data for New England. However, ABT's data came from tax credit syndicators, so it is not clear whether or not 100 percent of CHFA's LIHTC projects placed in service between 2011 and 2016 are included in their sample.

Table 2: Comparison of ABT and CHFA Sample Sizes

Sample	Number of Projects	Number of Units	Years Included
CHFA: LIHTC-only	104	8,406	2006 – 2018
CHFA: All-projects	140	10,755	2006 – 2018
ABT Associates: Full	2,547	162,447	2011 – 2016
ABT Associates: New England Only	183	10,224	2011 – 2016
CHFA: LIHTC-only during ABT's Timeline	57	5,064	2011 – 2016

Table 3: Characteristics of Key Continuous Variables in CHFA's Samples

Variable	Average	Minimum	Median	Maximum
LIHTCs-Only Sample				
Total Units	87.26	18	77.5	373
Average # of Bedrooms	1.7	0.23	1.7	3.06
Poverty Rate in Project Census Tract	24.2	1.2	21.2	58.1

Annual Construction Wage	$43,360	$30,083	$43,867	$49,720
Total Financing Sources	6.55	2	7	14
Total Development Cost	$20,321,716	$7,309,588	$17,787,248	$69,767,907
Per-Unit Total Development Cost	$267,143	$74,999	$253,753	$631,737
All-projects Sample				
Total Units	76.82	6	65.5	373
Average # of Bedrooms	1.64	0.23	1.68	3.06
Poverty Rate in Project Census Tract	22.17	1.2	19.5	58.1
Annual Construction Wage	$43,335	$28,040	$43,927	$49,720
Total Financing Sources	5.91	1	6	14
Total Development Cost	$17,093,174	$764,966	$14,748,199	$69,767,907
Per-Unit Total Development Cost	$250,987	$30,911	$242,168	$631,737

Table 4: Percent of Each Sample that Fit into Key Categories

	CHFA LIHTCs-Only Sample	CHFA All-Projects Sample
Category	**Percent**	
Located in a Qualified Census Tract	47.12%	36.43%
Located in a Difficult Development Area	3.85%	3.57%
Located in a Metro Area	43.27%	47.86%
Located in the Principal City of a Metro Area	54.81%	47.86%
Not located in a Metro Area	2.88%	4.29%
Financing Included Tax Exempt Bonds	42.31%	32.86%
Financing Included ITA funds	24.04%	22.86%
LIHTC Type = 9%	50.00%	37.14%
LIHTC Type = 4%	50.00%	37.14%
Project Type = New Construction	52%	45%
Project Type = Acquisition/Rehab	48%	55%
State Sponsored Housing Portfolio	2.88%	13.57%
Developer Type = Non-Profit	27.88%	37.14%
Developer Type = For-Profit	72.12%	62.86%
Population Served = Family	61.54%	57.14%
Population Served = Elderly	25%	26.43%
Population Served = Supportive	3.85%	8.57%

Appendix C: Descriptive Comparison of ABT and CHFA's Findings

The table below reports findings from a descriptive analysis of per-unit TDC. It is reported by year, sample weighting, and inflation adjustment. Unit-weighted results report the median per-unit TDC across all units; i.e. 8,406 units for the LIHTC-only sample and 10,755 for the all-projects sample. The project-weighted results take the median per-unit TDC across all projects; i.e. 104 for the LIHTC-only sample and 140 for the all-projects sample.

Table 5: Comparing Median Per-Unit TDC by Year, Weighting, and Inflation Adjustment

	CHFA LIHTCs-only Sample		CHFA All-projects Sample		ABT Associates' Sample	
			Inflation-Adjusted			
Placed-in-Service Year	**Unit-Weighted**	**Project-Weighted**	**Unit-Weighted**	**Project-Weighted**	**Unit-Weighted**	**Project-Weighted**
2006	$171,812	$220,906	$171,812	$270,000	-	-
2007	$289,845	$289,845	$289,845	$289,845	-	-
2008	$184,324	$258,898	$184,324	$268,611	-	-
2009	$217,297	$358,522	$217,297	$358,522	-	-
2010	$122,639	$208,301	$122,639	$240,280	-	-
2011*	$209,744	$387,423	$365,096	$387,940	$178,975	$178,975
2012	$175,236	$225,698	$175,236	$233,282	$172,428	$172,428
2013*	$214,707	$307,629	$250,738	$307,629	$173,880	$173,880
2014	$194,345	$202,298	$183,446	$180,880	$184,811	$184,811
2015	$147,736	$165,120	$145,521	$156,428	$172,780	$172,780
2016	$171,738	$233,339	$140,990	$156,364	$176,070	$176,070
2017	$263,619	$280,873	$217,804	$232,406	-	-
2018	$286,950	$286,950	$243,095	$258,414	-	-
All Years	$197,749	$253,753	$192,342	$242,168	$177,153	$177,153
			Un-adjusted			
2006	$122,856	$158,166	$122,856	$193,476	-	-
2007	$218,737	$218,737	$218,737	$218,737	-	-
2008	$147,459	$207,087	$147,459	$214,292	-	-
2009	$180,224	$296,943	$180,224	$296,943	-	-

2010	$108,758	$184,604	$108,758	$212,889	-	-
2011*	$187,402	$345,581	$322,919	$346,113	$147,882	$160,393
2012	$160,534	$209,438	$160,534	$213,511	$143,670	$153,166
2013*	$205,597	$301,592	$238,660	$301,592	$159,182	$164,105
2014	$189,571	$197,328	$178,200	$175,707	$175,490	$177,621
2015	$180,224	$220,200	$176,418	$215,657	$162,680	$163,662
2016	$171,366	$233,379	$141,180	$156,273	$166,817	$166,817
2017	$265,383	$285,842	$219,745	$234,590	-	-
2018	$286,950	$286,950	$243,095	$258,414	-	-
All Years	$122,856	$158,166	$122,856	$193,476	$159,374	$164,757

*Note: Projects placed in service in 2011 and 2013 tended to have much higher per-unit TDC. Those included Metro Green Residences, Quinnipiac Terrace, Elmcrest Terrace, and Marshall Commons.

Table 6: Median Per-Unit TDC by Geographic Region, Weighting, and Inflation Adjustment

	CHFA LIHTCs-only Sample		CHFA All-projects Sample	
	Unit-Weighted	**Project-Weighted**	**Unit-Weighted**	**Project-Weighted**
Metro Areas				
		Inflation-Adjusted		
Bridgeport-Stamford-Norwalk	$263.619	$307.629	$222,238	$273,732
Hartford-West Hartford-East Hartford	$192.342	$212.868	$184,324	$210,640
New Haven-Milford	$170.107	$294.891	$170,107	$288,398
Norwich-New London	$197,778	$202,832	$197,778	$197,778
Torrington	$212.546	$305.620	$119,471	$305,620
Worcester, MA-CT	$125.086	$202.325	$125,086	$125,086
		Un-adjusted		
Bridgeport-Stamford-Norwalk	$229.056	$301.592	$196,721	$273,732
Hartford-West Hartford-East Hartford	$172.488	$195.748	$160,534	$188,487
New Haven-Milford	$169.427	$282,703	$169,427	$236,617
Norwich-New London	$176,418	$180,927	$176,418	$176,418
Torrington	$205.067	$295.809	$114,326	$262,621
Worcester, MA-CT	$99,803	$177.628	$99,803	$99,803
Counties				
		Inflation-Adjusted		
Fairfield	$263,619	$307,629	$222,238	$273,732
Hartford	$184,324	$210,386	$184,324	$202,053
Litchfield	$212,546	$305,620	$119,471	$305,620
Middlesex	$210,250	$210,250	$210,250	$210,250
New Haven	$170,107	$294,891	$170,107	$288,398
New London	$197,778	$202,832	$197,778	$197,778
Tolland	$236,915	$243,095	$236,915	$243,095

Windham	$125,086	$202,325	$125,086	$125,086
		Un-adjusted		
Fairfield	$229,056	$301,592	$196,721	$273,732
Hartford	$160,534	$185,730	$160,534	$182,141
Litchfield	$205,067	$295,809	$114,326	$262,621
Middlesex	$205,086	$205,086	$205,086	$205,086
New Haven	$169,427	$282,703	$169,427	$236,617
New London	$176,418	$180,927	$176,418	$176,418
Tolland	$217,022	$243,095	$217,022	$243,095
Windham	$99,803	$177,628	$99,803	$99,803

Sources:

Project Characteristics and Financial Information: All data on project characteristics was either pull from CHFA's internal multifamily database or from CHFA's records. These include all data not listed elsewhere under sources.

Geographic Boundaries: A project's distribution into a county or MSA, as well as the *Principal City*, *Non-Metro*, and *in Metro, but not Principal City*, was determined using US Census Bureau definitions. The only exception to this methodology was Windham County, which is located within the Worcester, MA-CT MSA. Since it is not a Connecticut-based MSA and is generally considered a rural area when Worcester, MA is excluded, it was classified as *Non-Metro*.

Poverty Rate: 2013 5-year Estimates from the American Community Survey at the Census Tract Level. ABT Associates only used a single ACS year.

Construction Wages: CHFA's calculation of estimated inflation-adjusted wages for Construction Laborers (OCC Code 47-2061) in Residential Building Construction (NAICS 236100) at the county level in the year before a project was placed in service. Bureau of Labor Statistics data from the Occupational Employment Survey years 2012 through 2017 are combined with CT Department of Labor Quarterly Census of Employment and Wage data for 2005 through 2017.