RESEARCH NOTE

IMPROVING AMERICA'S HOUSING

Projecting Home Improvement Spending at the Metropolitan Area Level

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Abstract

While the Joint Center produces regular projections of home remodeling and repair activity at the national level, new analysis of the American Housing Surveys (AHS) suggests that the timing and depth of residential remodeling market cycles vary considerably by geographic location. This research note discusses the development of a model for projecting home improvement spending growth at the metropolitan area level utilizing benchmark data based on AHS estimates for four metropolitan areas: Chicago, Detroit, Los Angeles, and Philadelphia. The result is a model that performs fairly well, explaining two-thirds of the variation in average annual spending growth rates across these areas between 1995:Q4 and 2015:Q4. While the model performed reasonably well in predicting the sign of growth (positive or negative), at times it over- or under-predicted the magnitude of growth. Model inputs, obtained from Moody's Analytics and BuildFax, include retail sales of building materials and garden supplies, single-family house prices, single-family housing starts, single-family home sales, and remodeling permits. Uses, limitations, and possible future refinements to the model are discussed.

Introduction

This research builds upon previous work by the Joint Center projecting growth in home improvement expenditures at the national level (Bendimerad 2007). For over a decade, the Joint Center's Leading Indicator of Remodeling Activity, or LIRA, has provided the remodeling industry with a near-term projection of changes in remodeling activity to signal oncoming upturns or downturns in the national market. Yet remodeling, like all real estate business, is a local activity tied to conditions in the surrounding metro area or region. Both the timing of turning points in the remodeling market and the rate of its growth are expected to vary across different locations, particularly among metropolitan areas exhibiting different economic growth trends. The purpose of this study was therefore to develop a projection methodology to anticipate near-term changes in aggregate improvement expenditures at the metropolitan area level.

Purpose and Design

The Joint Center estimated the value of the national homeowner improvement market to be in excess of $250 billion in 2017, with improvement spending projected to grow at a rate of 7.7 percent in 2018.[1] However, the lack of reliable, timely, and publicly available data tracking remodeling expenditures consistently over time at the metropolitan level has made it challenging for businesses and policy-makers to assess the state of remodeling market cycles for individual locations. The lack of such data was a motivation for this project.

An initial aim of this project was to obtain historical estimates of aggregate home improvement spending for metro areas. As is discussed below, quarterly time-series estimates were developed for five major metropolitan areas—Chicago, Detroit, Los Angeles, New York, and Philadelphia—relying on data from the American Housing Surveys between 1995 and 2015. The ultimate goal was to develop a method for projecting home improvement spending at the metro area level which would indicate the trend of growth (or decline) in home improvement markets in the near term. This was accomplished by testing several metro area-level input variables for correlation with our historical estimates of benchmark improvement spending at varying leads. While continuous historical data with which to test model inputs was available for only a handful of metro areas, the resulting model can be applied to any metro area for which final inputs are available. Details of model development and performance are included below.

Where possible, this research follows the same estimation and projections methodology as detailed in "Re-Benchmarking the Leading Indicator of Remodeling Activity" (Will 2016). Most details of the framework for the metro projections methodology and its rationale can be found there, and are thus omitted from this paper. One important difference between the national LIRA and the projections at the metro area level is that the national LIRA projects both home improvement and maintenance spending for owner-occupied units, whereas the metro projections cover only home improvements. In addition, this research uses only metro area-level variables as model inputs, rather than any national inputs, to focus more narrowly on discerning differential metro area trends. However, the end result is

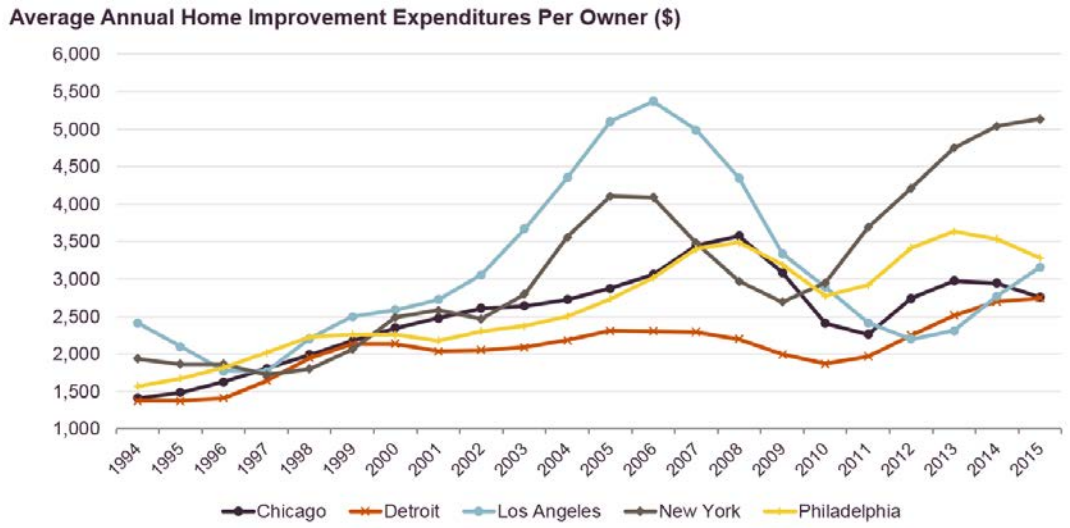
[1] According to the 2018:Q2 release of the LIRA. These figures exclude maintenance and repair spending as well as spending on rental homes.

fundamentally similar to our national LIRA: a near-term projection of home improvement spending for the coming year.

Phase 1: Creating Quarterly Series of Home Improvement Spending

The first phase in developing our model was to generate time-series data on home improvement spending at the metro area level against which to test potential input variables. To begin, biennial data was tabulated for five metropolitan areas—Chicago, Detroit, Los Angeles, New York, and Philadelphia. Between 1995 and 2015, the Department of Housing and Urban Development's biennial American Housing Survey regularly included supplemental cases for each of these metropolitan areas.[2] These two-year estimates were transformed into annual estimates by allocating the two-year expenditures according to the share of same-area aggregate retail sales of building and garden materials that fell into each year.[3] Over the two decades, both aggregate and average per owner improvement expenditures exhibited a high degree of volatility in these metro areas, likely owing to lower sample sizes in years in which certain metro areas were not oversampled.[4] To remedy this volatility, the average per owner spending data was smoothed by calculating a three-year moving average, centered on the middle year. The resulting smoothed data for average annual per owner home improvement spending for the five metro areas is displayed in **Figure 1A** and in the accompanying **Appendix A** (an Excel file).

Figure 1A: Home Improvement Expenditures Per Owner Rose Over the Past Two Decades

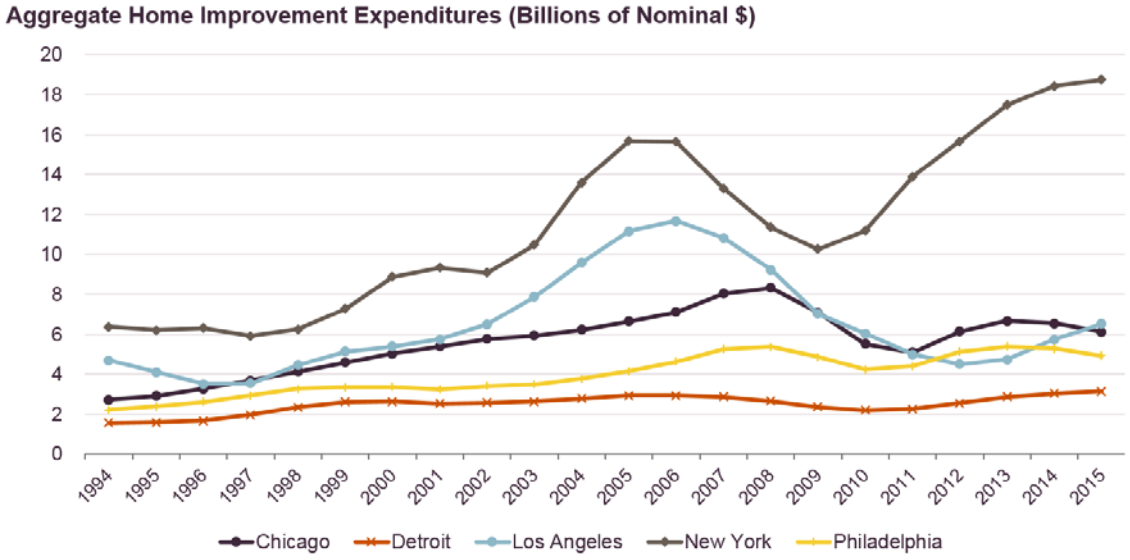


Note: Nominal dollars.
Source: JCHS tabulations of HUD, American Housing Surveys.

[2] For purposes of this study, records from the 1995-2013 AHS for New York and Northern New Jersey were combined into the greater New York metro area, which corresponds more closely to the 2013 Office of Management and Budget (OMB) boundary definitions used in the 2015 AHS.
[3] Again, details of this methodology and its rationale are available in Will 2016.
[4] Specifically, AHS sample sizes for these metros were smaller in 1997, 2001, 2005, 2007, and 2011. The only exception was Los Angeles, which was oversampled in 2011, but was not oversampled in 2009 and 2013.

The next step was to calculate a consistent measure of *aggregate* annual spending for the five metro areas. This was challenging to do with the AHS due to changes in geographic boundary definitions in the survey. Specifically, these five metropolitan areas were based on the 1983 OMB geographic boundary definitions up until the 2015 survey, at which point metro area boundaries were revised.[5] Earlier boundary definition changes also appear to have impacted the New York metro area, where select counties were not always covered in each survey.[6] To mitigate the influence of changing geographic areas over time, we multiplied average annual per owner expenditures in each metro area by independent estimates of the total number of homeowners in each county over time according to the latest 2015 OMB definitions. Homeowner estimates were obtained through Moody's Economy.com based on US Census Bureau data. Our calculations yielded a time series of aggregate improvement spending for homeowners according to the latest boundary definitions **(Figure 1B)**.

Figure 1B: Aggregate Home Improvement Spending Rose Over the Past Two Decades



Source: JCHS tabulations of HUD, American Housing Surveys.

The resulting annual estimates were next converted into quarterly estimates. This was accomplished by applying quarterly seasonal factors to each annual estimate, calculated as the share of national home improvement spending that fell into each quarter on average between 1994 and 2015, using the X-13 ARIMA-SEATS seasonal adjustment program.[7] Quarterly nominal spending estimates

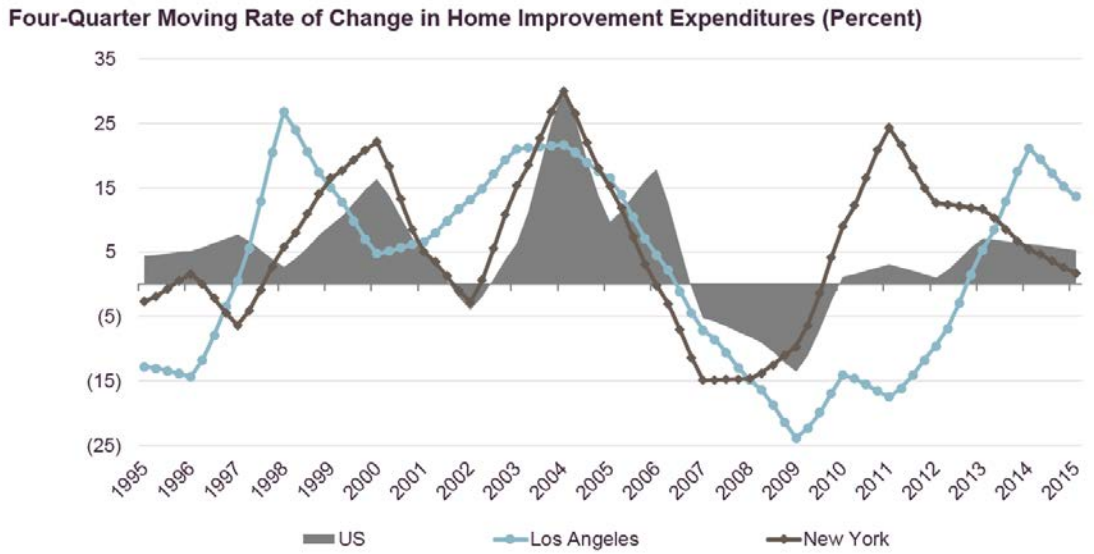
[5] In the 2015 American Housing Survey, six counties were added to the Chicago metro definition (DeKalb, Kenosha, Jasper, Lake, Newton and Porter), three counties were added to Philadelphia (Cecil, New Castle, and Salem), and two were added to the combined New York-Northern New Jersey metropolitan area (Dutchess and Pike) at the same time that one was dropped (Mercer). The Los Angeles metro gained Orange County, while the Detroit metro lost Monroe County.

[6] In the 2009 AHS, for example, the four counties covering the Edison, NJ MD were omitted from the Northern New Jersey MSA, which may impact our spending estimates for the New York metro area.

[7] The specific quarterly adjustment factors were as follows: Q1, 24%; Q2, 19%; Q3, 28%; and Q4, 29%. See Will 2016 for more detail.

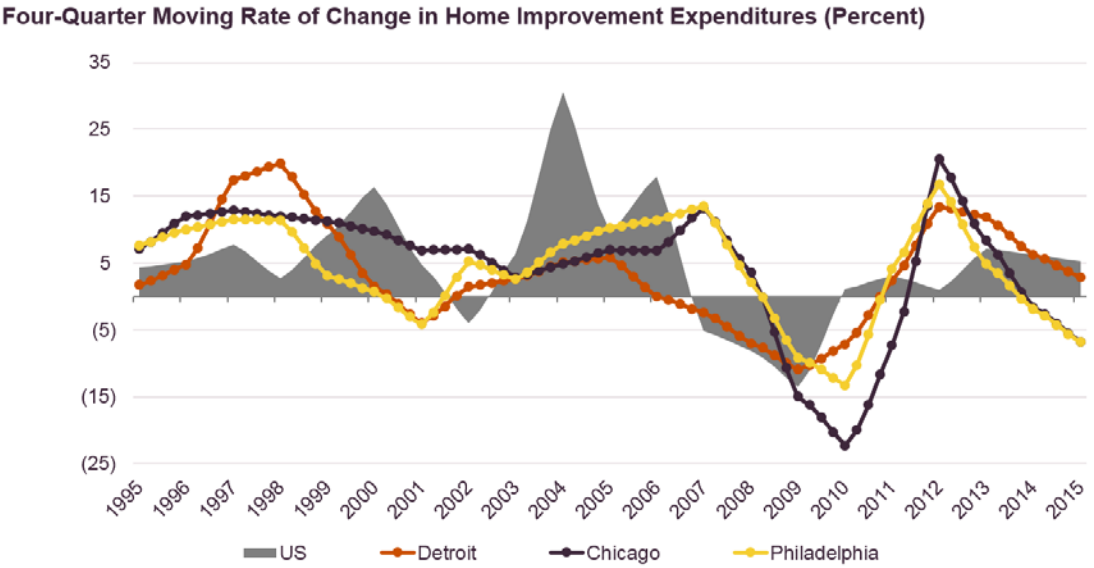
were then summed to four-quarter moving totals (using a trailing sum). Finally, an annual (or four-quarter) moving rate of change was calculated based on this measure. The resulting annual growth rates, calculated between 1995:Q4 and 2015:Q4, are displayed in **Figures 2A and 2B**, and in **Appendix A,** along with corresponding values at the national level for comparison purposes.

Figure 2A: Home Improvement Spending Exhibits More Volatility at the Metro Area Level



Note: Underlying expenditure data is nominal (not inflation-adjusted).
Source: JCHS tabulations of HUD, American Housing Surveys.

Figure 2B: Even in Less Volatile Markets, the Timing of Home Improvement Cycles Varies



Note: Underlying expenditure data is nominal (not inflation-adjusted).
Source: JCHS tabulations of HUD, American Housing Surveys.

The figures show that growth in home improvement spending tends to be more volatile at the metro area level than at the national level. For example, while the standard deviation of spending growth at the national level was just 8.3, it was 14.5 and 11.4 in Los Angeles and New York respectively. Lower volatility at the national level is not surprising when considering that national data are a weighted average of diverse places with both volatile and stable spending patterns. The figures also illustrate that even in markets with relatively low volatility, the timing and direction of market shifts differ from those in the nation as a whole. For example, market volatility in Philadelphia was even lower than in the nation as whole (standard deviation of just 7.1); however, as of 2015, improvement spending in Philadelphia had apparently turned negative while spending in the US as a whole was increasing steadily.[8] These results further motivate the need for a location-specific modelling of home improvement activity.

Phase 2: Projection Model Development

The method for developing metro area projections of home improvement expenditures relies on the method used for the national LIRA. We first identified metro area-level variables that would correlate highly with, and also lead growth in, home improvement spending. Several categories of potential input-variables were explored: housing/construction/remodeling industry conditions, house price appreciation measures, macroeconomic and cyclical measures, mortgage market conditions, income measures, and demographic measures **(Table 1).** Each potential input variable was available at the metropolitan area level and also had some theoretical basis for moving with, or in anticipation of, changes in home improvement activity. Most of these variables were obtained using Moody's Databuffet.com, with the exceptions of the Zillow and BuildFax data. All inputs representing real activity (those not expressed in dollar terms, such as starts, home sales and remodeling projects) were converted to nominal terms using the national CPI-U for all items for consistency with variables expressed in dollars.

[8] For further discussion of the differences in historical home improvement spending cycles and trends in these same metro areas, see Will 2018.

Table 1: Potential Input Variables for Metro Area Model

Description:	Source:	Original Freq.	Begin Date:
Housing/Construction Industry Conditions			
Home Sales: Existing Single-Family (Ths., SAAR)	NAR; Moody's Analytics	Q	1981:Q1
Total Housing Starts (#, SAAR)	Census, New Residential Construction; Moody's Analytics	M	1982:Q1
Single-Family Housing Starts (#, SAAR)		M	1982:Q1
Multifamily Housing Starts (#, SAAR)		M	1982:Q1
Residential Remodeling Permits (#)	BuildFax	M	2005:Q1
House Price Appreciation Measures			
Median Home Price, Existing Single-Family (Ths. $, SA)	NAR; Moody's Analytics	Q	1970:Q1
Real estate: FHFA House Price Index – New & existing	FHFA; Moody's Analytics Adjusted	Q	1983:Q1
Zillow ZHVI (Converted to Quarterly)	Zillow	M	1996:Q1
Zillow Top Tier ZHVI (Converted to Quarterly)		M	1996:Q1
Macroeconomic and Cyclical			
Employment: Total Nonfarm (Ths. #, SA)	BLS, Current Employment Statistics	M	1990:Q1
Labor Force (Ths. #, SA)	BLS, Current Population Survey	M	1990:Q1
Retail sales: Building material & garden equip. & supplies (Mil. $)	Census, Monthly Advanced Retail Trade Survey	Q	1992:Q1
Retail sales: Furniture & home furnish. (Mil. $, SA)		Q	1992:Q1
Gross Metro Product (Bil. $, SAAR)	BEA; Moody's Analytics	Q	1978:Q1
Mortgage Market Conditions			
Mortgage Originations: Purchase (Bil. $, SAAR)	MBA; Moody's Analytics	Q	1990:Q1
Mortgage Originations: Refinance (Bil. $, SAAR)		Q	1990:Q1
Income Measures			
Income: Total Personal (Mil. $, SAAR)	BEA; Moody's Analytics	Q	1969:Q1
Average Household Income ($, SA)	Census; BEA; Moody's Analytics	Q	1970:Q2
Disposable Personal Income (Mil. $, SAAR)	BEA; Moody's Analytics	Q	1969:Q4
Demographic			
Households (Ths.)	Census; Moody's Analytics	Q	1970:Q2

Next, a simple correlation between the four-quarter rates of change in each indicator and the rates of change in homeowner improvements in each metropolitan area was calculated from 1995:Q4 to 2015:Q4 (or in the case of the BuildFax data, from 2006:Q3 to 2015:Q4) at varying leads. Specifically, each potential input was tested at between 1 and 10 quarters lead, and coincident series were also tested. To resolve cases of high volatility in certain potential inputs, both the original and a smoothed version of each input were considered for correlation with growth in improvement spending. Smoothed series were obtained by calculating a four-quarter trailing average in advance of calculating the annual, or four-quarter moving, growth rate. Smoothing was ultimately found to be beneficial for three input variables: remodeling permits, single-family housing starts, and existing single-family home sales.

Table 2: Correlation Coefficients with AHS-Based Improvements Spending Growth, 1995:Q4 to 2015:Q4

Lead in Number of Quarters:		L(0)	L(1)	L(2)	L(3)	L(4)	L(5)	L(6)	L(7)	L(8)	L(9)	L(10)
Retail Sales of Building Materials/ Garden Equip.	Los Angeles	0.73	**0.74**	**0.74**	0.73	0.72	0.70	0.69	0.66	0.64	0.60	0.55
	Chicago	0.45	0.52	0.59	0.65	0.69	**0.71**	0.69	0.65	0.60	0.52	0.45
	Detroit	0.62	0.66	**0.69**	**0.69**	0.68	0.65	0.61	0.58	0.54	0.51	0.49
	Philadelphia	0.42	0.50	0.56	0.59	**0.60**	0.57	0.53	0.47	0.40	0.33	0.27
	New York	**0.70**	0.64	0.55	0.44	0.32	0.18	0.04	-0.08	-0.19	-0.28	-0.34
Remodeling Permits*	Los Angeles	0.56	0.59	0.62	0.64	0.66	0.68	0.71	0.75	0.80	0.85	**0.90**
	Chicago	0.37	0.37	0.39	**0.41**	0.34	0.21	0.05	-0.13	-0.32	-0.51	-0.67
	Detroit	0.10	0.20	0.31	0.43	0.54	0.65	0.74	0.82	**0.86**	0.85	0.79
	Philadelphia	0.37	0.61	0.80	0.92	**0.93**	0.86	0.73	0.55	0.34	0.11	-0.11
	New York	**0.12**	0.07	-0.01	-0.13	-0.25	-0.36	-0.42	-0.43	-0.36	-0.21	0.03
Median Existing Single-Family Home Price	Los Angeles	**0.83**	**0.83**	0.81	0.78	0.73	0.67	0.61	0.55	0.48	0.40	0.32
	Chicago	0.51	0.53	**0.54**	**0.54**	0.53	0.52	0.51	0.49	0.44	0.37	0.28
	Detroit	**0.68**	0.64	0.60	0.56	0.50	0.44	0.37	0.30	0.21	0.13	0.05
	Philadelphia	0.27	0.31	0.34	0.39	0.43	0.46	**0.47**	0.46	0.42	0.36	0.27
	New York	**0.53**	0.50	0.45	0.39	0.31	0.22	0.13	0.03	-0.05	-0.11	-0.16
Single-Family Housing Starts*	Los Angeles	0.28	0.40	0.49	0.55	**0.58**	**0.58**	**0.58**	0.56	0.54	0.52	0.51
	Chicago	0.30	0.38	0.44	0.49	0.53	0.56	0.59	**0.61**	0.60	0.57	0.51
	Detroit	0.28	0.38	0.47	0.54	0.60	0.65	0.67	**0.68**	0.67	0.64	0.58
	Philadelphia	0.23	0.28	0.33	0.37	0.39	**0.41**	0.40	0.38	0.36	0.32	0.25
	New York	**0.52**	0.50	0.46	0.40	0.33	0.24	0.13	0.02	-0.10	-0.19	-0.27
Existing Single-Family Home Sales*	Los Angeles	-0.26	-0.20	-0.13	-0.06	0.03	0.11	0.18	0.23	**0.26**	**0.26**	0.25
	Chicago	0.12	0.17	0.20	0.23	0.26	0.28	0.32	0.38	0.46	0.54	**0.60**
	Detroit	0.16	0.25	0.31	0.37	0.41	0.44	0.46	0.47	**0.48**	**0.48**	**0.48**
	Philadelphia	0.07	0.12	0.16	0.21	0.26	0.31	0.36	0.41	0.46	0.50	**0.51**
	New York	0.45	0.48	**0.50**	**0.50**	0.48	0.44	0.37	0.29	0.20	0.09	-0.02

Notes: * indicates that a smoothed version of variable (four-quarter trailing average) was chosen to reduce the volatility of the input. In every case, the smoothed input registered a higher correlation than the original input, on average. Smoothed remodeling permit data was available during a shorter time period, 2007:Q3 to 2015:Q4. Negative coefficients and those less than 0.3 are displayed in grey font to indicate a weak evidence of a relationship.

Selection of Model Inputs

The resulting correlations were analyzed and compared across each metro area. Many input candidates were dismissed due to weak correlation coefficients. Where smoothed inputs yielded higher correlations than their original versions, the smoothed version was considered preferable. Five final input variables where chosen based on having the highest averaged correlation coefficients at a lead of 4 or more quarters. These were: retail sales of building materials/garden equipment, median existing single-family home prices, single-family housing starts, existing single-family home sales, and remodeling permits. Correlation coefficients of the final inputs in each metro area are shown in **Table 2.** Lead times yielding the highest correlation with the AHS-based improvement data are in bold font.

The table shows that there was considerable variation in the optimal lead times producing the highest correlation with the AHS-based improvement data. The New York metro area, in particular, exhibited consistently low correlation coefficients and anomalous lead times, possibly relating to unique spending patterns there, or even to underlying issues with the benchmark series for New York. Changes in geographic coverage over time, as described above, may also be a contributing factor. In light of these peculiarities, data from New York was discounted when choosing the optimal lead times for the model inputs and ultimately was not used in calculating the final projections model. After comparing leads across the remaining four metros, a single lead was selected for each input (displayed in grey shading on **Table 2**) so as to optimize the correlation averaged across the four metros, while also minimizing the presence of extremely weak correlations across any of the metros.

Retail Sales: Growth in retail sales of building materials and garden equipment exhibited a fairly high correlation with growth in home improvement spending at a 4-quarter lead across most of the metros. The implication is that this variable leads remodeling expenditures fairly reliably by roughly a year. While we generally expect remodeling spending cycles to move in line with purchases of remodeling materials and supplies, the measure appears to be picking up on certain activities that precede an uptick in remodeling, and quite possibly, those related to home-building. Indeed, the retail sales measure, estimated by Moody's Analytics, includes not only materials and supplies used by professional home remodelers, but also those used in the home-building industry as well as those purchased by the DIY home remodeling segment. Given this broad definition of retail sales, and the correlations presented above, a 4-quarter lead was chosen for this input variable.[9]

Remodeling Permits: Of all the drivers, we expected remodeling permits to move most consistently with remodeling expenditures on theoretical grounds since both metrics are closely linked to real remodeling activity. BuildFax, which supplied the permit data, defines the data as a count of unique residential properties in a given month with at least one permit related to home improvements.[10] Perhaps owing to the smaller time period for this input, we found considerable variation among correlations and lead times between remodeling permits and home improvement spending. This variation may also be due to the fact that BuildFax data does not distinguish between improvements to owner-occupied and small renter-occupied homes. Following the Great Recession, for example, the rental market recovery occurred well before owners saw their home values recover; however, activity stemming from both of these markets may be reflected in the permit data. Despite these limitations, three of the five metro areas exhibited fairly strong 4-quarter leads: Philadelphia (0.93), Los Angeles (0.66) and Detroit (0.54). In light of these correlations, and given that the national LIRA relies on a 4-quarter lead for this variable, a lead of 4 quarters was chosen.

[9] Moody's Analytics produces quarterly estimates of retail sales for all US metros (available via Databuffet.com). Their estimating method relies on three different inputs: the Census of Retail Trade (part of the US Census Bureau's Economic Census), the US Census Bureau's Advance Monthly Retail Trade and Food Services Survey, and employment estimates derived from US Bureau of Labor Statistics data. Quarterly revisions are made to the prior 1 to 4 quarters, while annual revisions are also made to benchmarks periodically throughout the year.

[10] Permit counts exclude new construction, and refer to remodeling/repair permits for residential properties only, including single-family homes, condos, and units in small multifamily buildings (less than 5 units). Given differences in data collection among permitting authorities, valuation/job cost data is not uniformly available and therefore properties with remodeling permits are not filtered based on project cost or size.

Home Prices: The correlation of growth in home improvement spending with home price growth, as measured by median single-family home prices from the National Association of Realtors and Moody's Analytics, also varied widely, yielding various lead times. For example, growth in prices was coincident or nearly coincident with growth in home improvement spending in three metros; however, Chicago exhibited a 3-quarter lead, and Philadelphia exhibited a 6-quarter lead. In general, correlations remained relatively high at a 4-quarter lead in several metros (i.e., 0.5 or greater in three of the four metros, excluding New York). In light of this fact, a four-quarter lead was chosen. An added benefit of including home prices in the model is that they tend to be less volatile than other inputs, and they therefore impart a stabilizing influence on projected rates of growth in spending.

Housing Starts: Growth in single-family housing starts, as reported by the US Census Bureau's New Residential Construction branch and Moody's Analytics, is another key input selected for the model. Housing starts should in theory function as a measure of expected near-term demand in the local housing market and general confidence in local housing market conditions, at least in those places where there is space to build. According to the correlations shown above, growth in housing starts led growth in home improvement spending by slightly more than a year in most of the metros. Based on those collective correlation coefficients, a 5-quarter lead was ultimately chosen for this input variable.

Home Sales: Growth in existing single-family home sales also led growth in home improvement spending by more than one year. This input, supplied by the National Association of Realtors and Moody's Analytics, exhibited an approximately 8-quarter lead with home improvement spending across the metros—considerably longer than our national lead. Like housing starts, home sales are an indicator of housing demand and confidence in local market conditions. Home sales also indicate households' capacity to access lending and more generally undertake major investments. Recent sellers and homebuyers have been found to be more likely to undertake home improvements than long-term stayers, which further helps explain why home sales drive remodeling on a lagged basis.

The relationship between all five model inputs and reference spending was visualized for each metro to confirm selection of optimal leads. Examples are provided in the attached **Appendix B** for Los Angles (**Figures 9A-9B**), Detroit (**Figures 10A-10B),** and Philadelphia **(Figures 11A-11B)**, with input variables displayed at their respective quarterly leads against growth in benchmark improvement spending for the same metros. Again, data for the New York metro was anomalous and may have been impacted by changing geographic boundaries. It was therefore de-emphasized for lead selection, and for similar reasons is also omitted from the projection model calculations below.

Weighted Average Approach

As **Figures 9A-11B** show, several input variables (especially starts and sales) exhibited considerable volatility, even after smoothing. The next step in creating a metro improvements projection model was therefore to calculate weights for each model input, the purpose of which was to minimize the influence of inputs with high volatility, while also maximizing the influence of those with higher correlations with AHS-based improvement spending.[11] The methodology for calculating input weights is the same as that used in the national LIRA. For the metro model, input weights were

[11] Given the higher volatility inherent in metro data, variance, rather than standard deviation, was chosen as a measure of volatility given its greater sensitivity to extremes. Ultimately this yielded a set of input weights that produced model estimates with higher correlations between the modeled and benchmark spending.

calculated for each of the four metro areas, and then the resulting weights for each input were averaged among the same metros.[12] The calculation of the final input weights is shown in **Table 3**. Each input variable's final weight is the average of two measures: 1) that input's share of the inverse of the volatility, or variance, across all five inputs (such that inputs with lower variance receive larger weight), and 2) that input's share of the sum of correlations across all five inputs (such that inputs with higher correlations receive larger weight). Model inputs receiving the highest final weights were remodeling permits and retail sales, owing to both their high correlations with home improvement spending and their relatively low volatilities. Meanwhile home sales and starts were assigned the lowest final weights, owing to their lower correlations and relatively high volatility.

Table 3: Calculation of Improvement Projection Weights: Metro Averages

Row	Measure	Retail Sales	Permits	Prices	Starts	Home Sales
	Lead over AHS-based Improvement Spending (# of quarters)	L(4)	L(4)	L(4)	L(5)	L(8)
	Variance of input series	41	58	84	537	184
	1 / (Variance of input series)	0.025	0.037	0.016	0.003	0.007
A	Share of Sum of 1 / Variance	30.8%	38.2%	19.4%	3.4%	8.2%
	Avg. Correlation w/ AHS-based Improvement Spending	0.67	0.62	0.55	0.55	0.41
B	Share of Sum of Correlations	24.0%	21.9%	19.6%	19.6%	14.9%
C	**Final Weights** *(C= average of rows A and B)*	**27.4%**	**30.0%**	**19.5%**	**11.5%**	**11.6%**

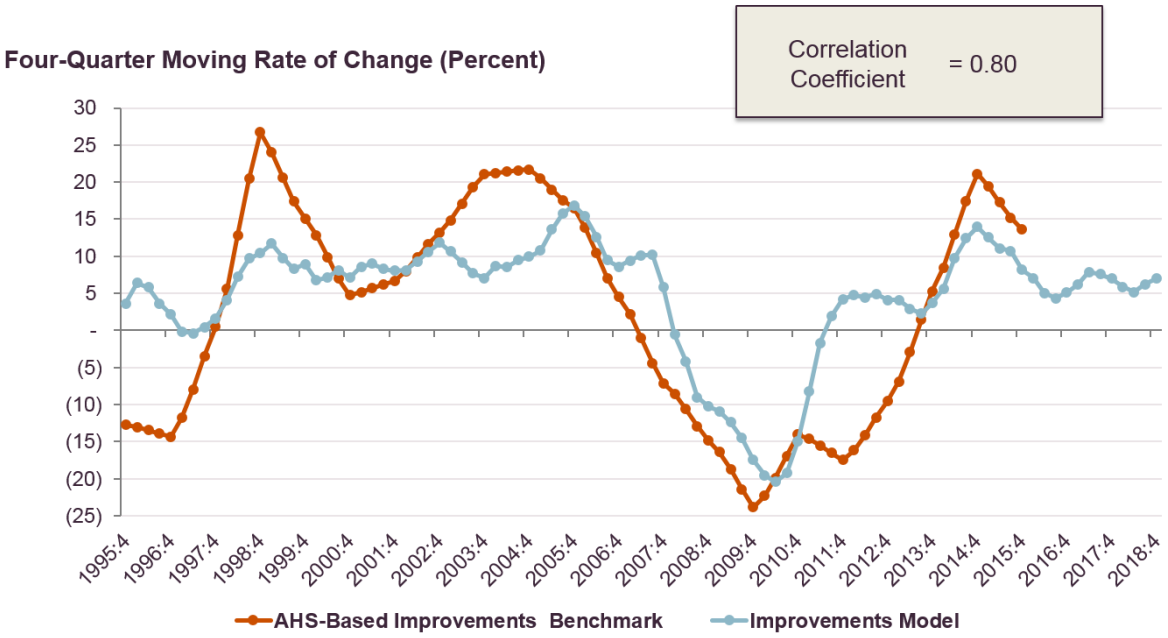
Source: JCHS tabulations.
Note: These figures represent averages over the four metro areas: Chicago, Detroit, Los Angeles, and Philadelphia. The same calculation can be performed for each metro individually, and the resulting weights can be averaged, with equivalent results.

The resulting final weights are used to generate both historical estimates and projections of growth in nominal home improvement spending at the metropolitan area level by taking a weighted average of the annual rates of change in the model inputs at their specified lead.[13] Results of this estimation are shown in **Figures 3 through 7** with home improvement spending projected through 2018:Q4. Results were that the model performed reasonably well, as measured by the correlation of modeled and benchmark spending, at least for the four metropolitan areas used in the weighting scheme. Correlation coefficients between benchmark and modeled growth rates were 0.80 for Los

[12] Again, given anomalies evident in the New York metro area data, information for New York was excluded from the final weight calculation.
[13] To generate historical estimates for earlier dates for which remodeling permit data was not available, a reduced model was used consisting of the remaining input drivers (retail sales, prices, starts, and home sales). The weights for the remaining model inputs were proportionally redistributed to equal 100% in the absence of the remodeling permits input.

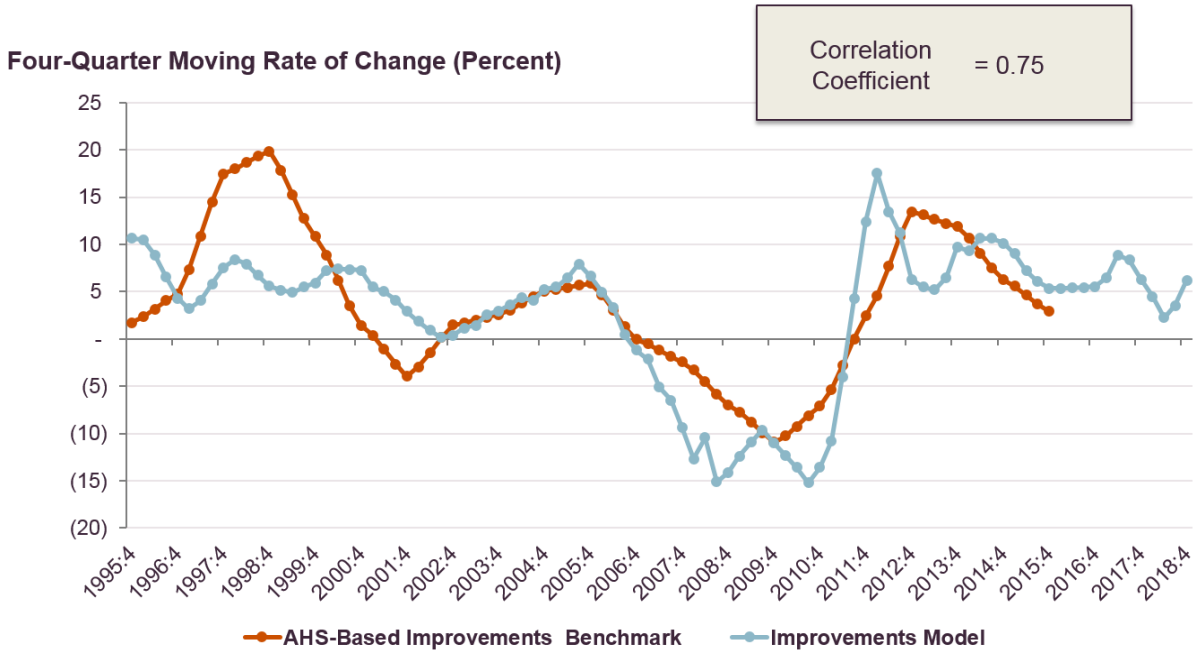
Angles and 0.75 for Detroit, while Philadelphia and Chicago also had relatively high correlations of 0.70 and 0.62 respectively. Meanwhile, as expected, New York's correlation was lower (0.31) given the irregular trends evidenced in that metro area.

Figure 3: Model Performance in Los Angeles Metro Area



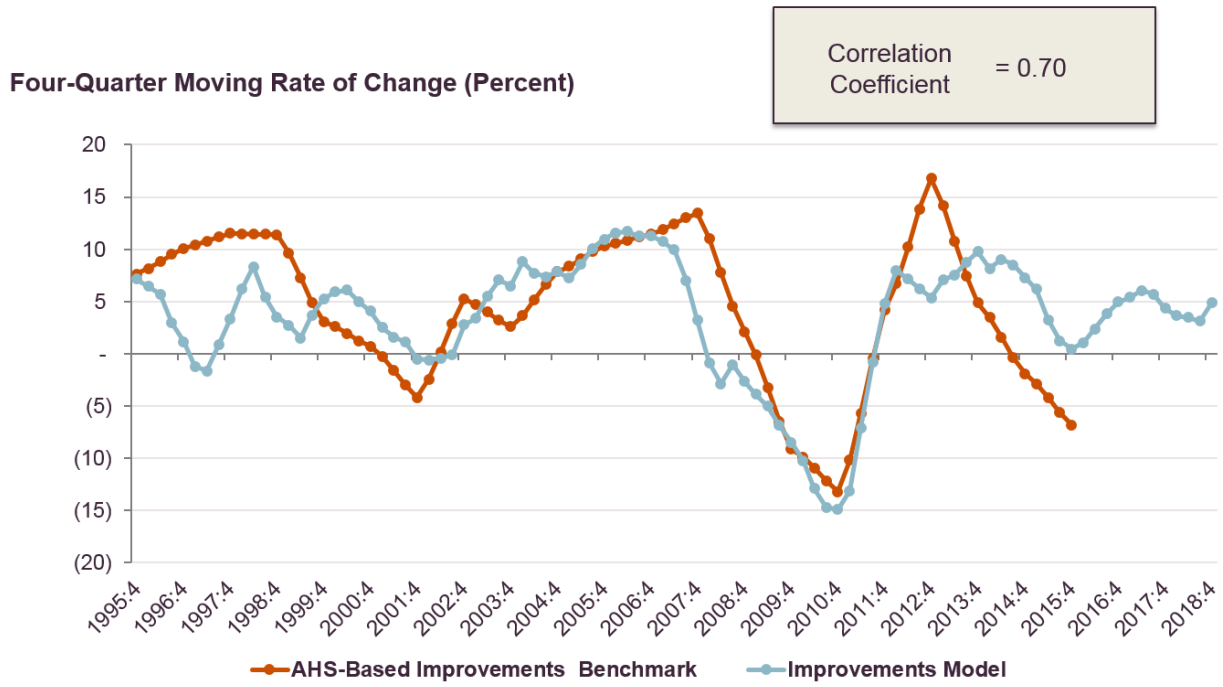
Source: JCHS tabulations of HUD, American Housing Surveys; US Census Bureau; National Association of Realtors; CoreLogic, Inc.; BuildFax; and Moody's Analytics Estimates.

Figure 4: Model Performance in Detroit Metro Area



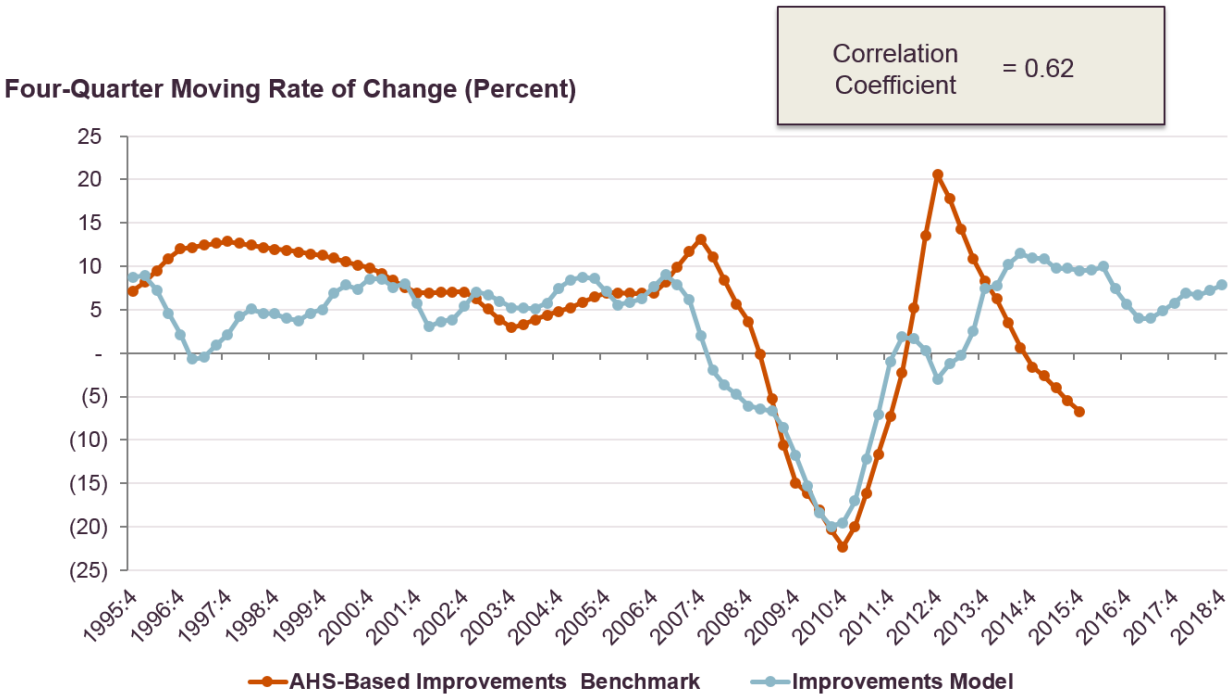
Source: JCHS tabulations of HUD, American Housing Surveys; US Census Bureau; National Association of Realtors; CoreLogic, Inc.; BuildFax; and Moody's Analytics Estimates.

Figure 5: Model Performance in Philadelphia Metro Area



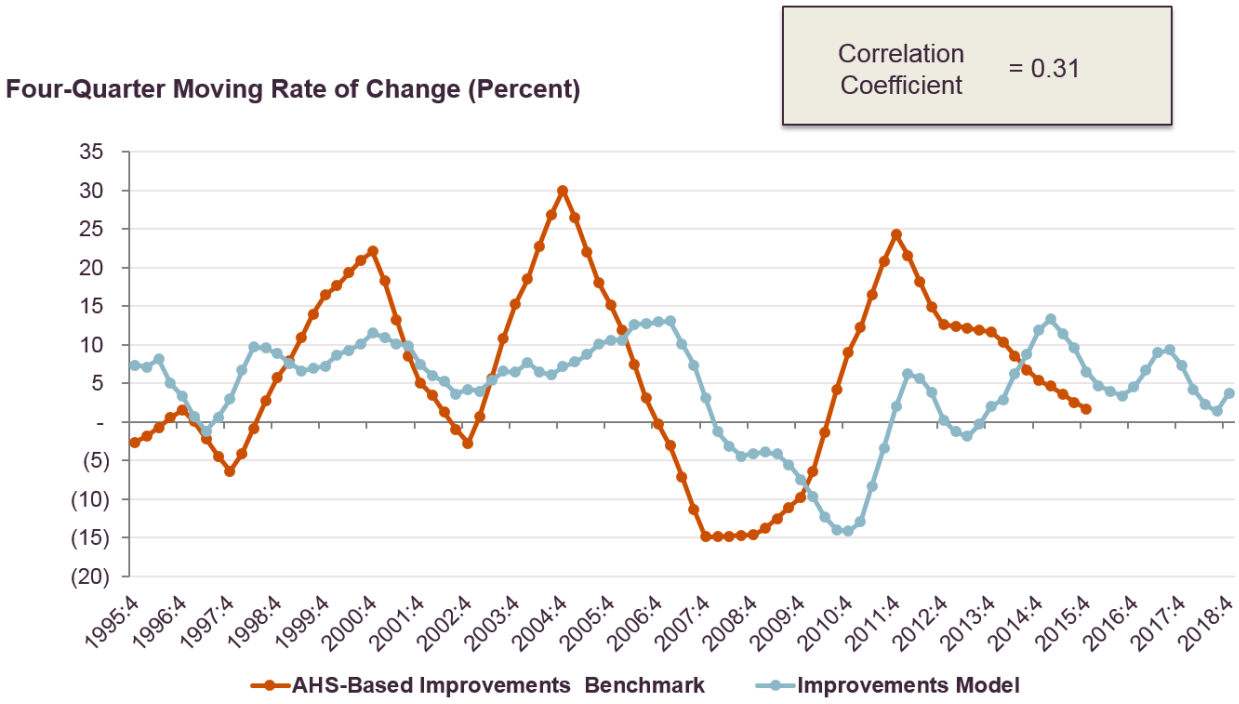
Source: JCHS tabulations of HUD, American Housing Surveys; US Census Bureau; National Association of Realtors; CoreLogic, Inc.; BuildFax; and Moody's Analytics Estimates.

Figure 6: Model Performance in Chicago Metro Area



Source: JCHS tabulations of HUD, American Housing Surveys; US Census Bureau; National Association of Realtors; CoreLogic, Inc.; BuildFax; and Moody's Analytics Estimates.

Figure 7: Model Performance in New York Metro Area



Source: JCHS tabulations of HUD, American Housing Surveys; US Census Bureau; National Association of Realtors; CoreLogic, Inc.; BuildFax, and Moody's Analytics Estimates.

Summary of Projection Results

The method described above yields historical estimates and projections of growth in home improvement spending that correlate reasonably well with our AHS-based benchmark series, except in the case of the New York metro area. **Table 4** summarizes the relationship between actual and modeled improvement spending for all five metro areas, as well as for the four metro areas that were ultimately used to calculate the projections model. The correlation coefficient between the modeled and benchmark home improvement series was markedly higher in the final four metro areas (ranging from p=0.62 in Chicago to p=0.80 in Los Angeles), with a straight average of all four correlation coefficients being fairly high (average of 0.72). Moreover, a simple regression of the averaged projection output across the same four metros on similarly averaged benchmark spending results in an R-squared value of 0.67, which suggests that roughly two-thirds of the average variation, or movement, in those four metro areas' improvement spending benchmark series can be explained by the projections model, on average.

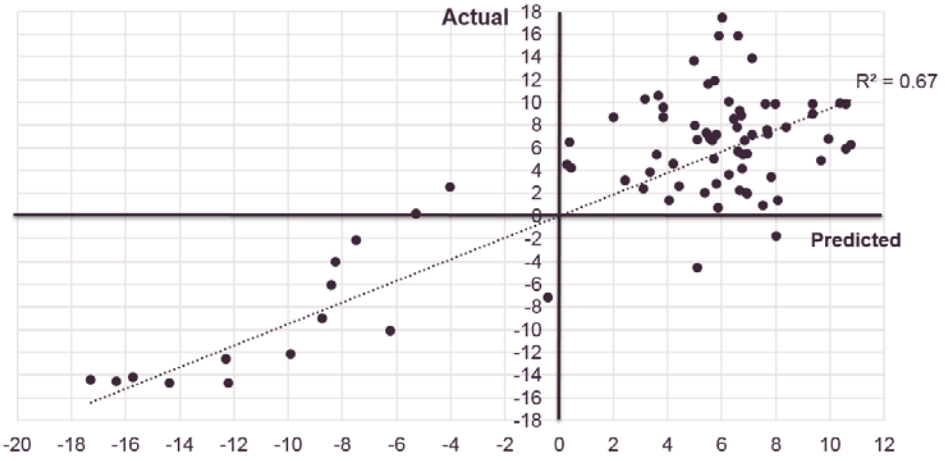
Table 4: Relationship of AHS-based Benchmark to Projected Improvement Spending, 1996-2015

	Los Angeles	Detroit	Chicago	Philadelphia	New York	Straight Average, All 5 Metros	Straight Avg. Excl. New York
Correlation coefficient	0.80	0.75	0.62	0.70	0.31	0.64	0.72
Std. Dev. of Benchmark Series	11.4	7.5	9.3	7.1	11.4	10.0	9.6
Std. Dev. of Modeled Spending	6.7	7.8	7.4	6.2	6.7	7.4	7.5

This relationship is visualized in **Figure 8A**, where each dot corresponds to the averaged growth rates across the same four metro areas at a single time period between 1995:Q4 and 2015:Q4, as well as in **Figure 8B,** which illustrates this same relationship from a time-series perspective. Both figures show that while the model is reasonably good at predicting the sign of growth in spending (positive vs. negative), it does not always accurately predict the degree of growth. For example, the model slightly underestimated growth in a few very high-growth periods (particularly, in 1998), while overestimating the collective degree of growth during 2015, where the AHS-based rate was less than 5 percent.

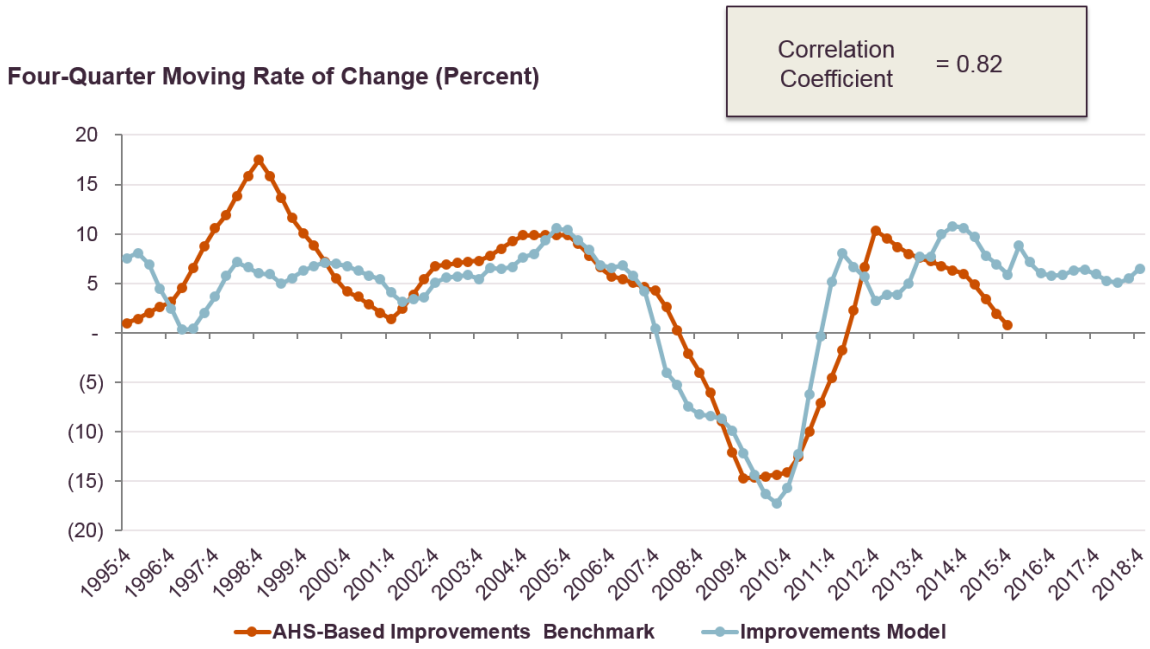
Figure 8A: Model Explains 67 Percent of Variation in Home Improvement Spending Averaged Across Four Metros

Average Four-Quarter Moving Rate of Change in Home Improvement Spending Across the Four Benchmark Metro Areas (Percent)



Notes: Final benchmark metro areas include Chicago, Detroit, Los Angeles, and Philadelphia. Each dot represents a quarter from 1995:Q4 through 2015:Q4
Source: JCHS tabulations of HUD, American Housing Surveys; US Census Bureau; National Association of Realtors; CoreLogic, Inc.; BuildFax; and Moody's Analytics Estimates.

Figure 8B: Historical Comparison of Averaged Benchmark Series vs. Historical Projections



Source: JCHS tabulations of HUD, American Housing Surveys; US Census Bureau; National Association of Realtors; CoreLogic, Inc.; BuildFax; and Moody's Analytics Estimates.

Given the multiple challenges inherent in developing reliable quarterly benchmark data, as already described above (e.g., geographic boundary changes, reduced AHS sample sizes, etc.), it is possible that some of these discrepancies could be due to noise in the AHS-based benchmark series. For example, this appears to be a possibility in 2015, where the AHS results indicated slow or negative growth in several areas, but where our model projected stronger growth. Based on the model described above, as applied to input data from all five metro areas, home improvement activity was projected to rise steadily through the end of 2018, with growth rates ranging from nearly 4 percent to 8 percent. Moreover, in the cases of Chicago and Philadelphia, the model anticipates a reversal of the latest AHS-based trends, which suggested home improvement markets were contracting at last measure in 2015.

Further Application of Metro Model

A major application of this model is to project home improvement spending growth across a wider range of metros. Indeed, we performed these projection calculations using the final inputs and weights described above for 50 of the largest metropolitan areas across the country. Projections through the end of 2018 are included in **Appendix C** (Excel file). As part of this wider projections project, considerable efforts were made to ensure input data quality, particularly in the case of remodeling permits. Notably, only metros with complete time series coverage (back to 2005) for this input were chosen. Smoothing of remodeling permits was also performed in cases where short-term volatility in remodeling permits was known to be caused by anomalous events, such as large apartment renovations or repairs due to storms. Adjustments were also made in cases where a recent decline in remodeling permits was known to reflect a temporary lag in reporting of permits.

The result of this research effort is a near-term indicator of short-term home improvement market trends at the metropolitan level. As these results show, projected growth rates for 2018 ranged from no growth in home improvement spending in Oklahoma City to gains of 13 percent in Kansas City. Fully 41 of the 50 metro areas were projected to see annual growth rates of 5 percent or more this year, and of these, eleven were projected to see growth rates of 10 percent or more. Meanwhile no markets were projected to see aggregate spending decline in 2018. These projections of growth for 2018 are generally in line with our national remodeling projection for the same period, and also suggest how growth trends are expected to play out geographically across the nation.

While the model is designed as a forward-looking indicator, yet another potential application is to analyze modelled growth rates going back further in time, under the assumption that these should broadly reflect past changes in home improvement spending. Modelled growth rates back to 2016:Q4 are available in **Appendix C** for all 50 metro areas. This data may be particularly useful in cases where historical AHS data is not available but estimates of historical home improvement growth are needed.

Finally, while the model enables comparisons of projected growth rates among metro areas, given the limitations of forecasting in general and of metro area data in particular, the resulting model is not expected to accurately predict precise point estimates of spending growth rates in any given area. As is described above, efforts were made to produce the highest-quality benchmark series; however, we faced several limitations that may have impacted our estimates of metro area home improvement spending. Moreover metros at different stages of economic or business cycles may exhibit different spending patterns, and it was not possible to explore these variations given our limited dataset. As of yet, no attempt has been made to vary the estimation model inputs or weights by metro area, or by metro area typology.[14] The resulting projections are designed to indicate the direction and pace of near-term rates of change in home improvement activity and to anticipate turning points in the market.

Additional Testing of the Projections Model

While substantial historical benchmark data were not available for additional metro areas, we were able to test the performance of the model for a handful of other metros covered in both the 2013 and 2015 AHS, including Boston, Houston, Miami, Seattle and Washington DC. AHS-based estimates of home improvement spending for each 2-year period in these metro areas were distributed into annual and then into quarterly spending in the same manner as described above.[15] The rate of change in average annual spending in each metro was then compared against modeled rates of growth. Estimates over this five-quarter period tracked the AHS-based series reasonably well in Houston and Miami. However, it appears that the model underestimated spending growth in Boston, while overestimating growth in Seattle and Washington, DC. These differences may be due to issues with the underlying AHS-based estimates. In particular, sluggish AHS-based growth estimates in Seattle and Washington, DC appear inconsistent with general growth trends in these areas, particularly strong prior growth in home

[14] As noted in Will 2018, metro area remodeling cycle volatility may increase with the level of spending such that metros with higher levels of average annual per owner improvement spending tend to also experience larger swings in average spending over the course of their housing and remodeling cycles, while metros with relatively lower levels of average remodeling expenditure have much more stable remodeling cycles.

[15] These data are available in the attached Appendix Tables.

sales and single-family starts. Beginning with the 2015 survey, the AHS tracks improvement spending for a consistent set of 15 major metropolitan areas, and moving forward, this additional data should provide further opportunities for more robust model testing over time.

Summary and Conclusions

This research note explored the development of a methodology to project home improvement spending at the metropolitan area level. It relied on benchmark expenditures from the American Housing Survey for four metropolitan areas: Chicago, Detroit, Los Angeles, and Philadelphia. While data was also available for the New York metro area, we ultimately decided against using this information in our model calculations due to anomalous trends there as well as changes in geographic coverage over time. After exploring various possible input variables, five were selected which exhibited a reasonably high correlation with home improvement spending at a lead of 4 or more quarters. Due to differences in the various inputs' volatility and degree of correlation with benchmark spending, a weighting scheme was developed to minimize the effects of volatility in the leading inputs while maximizing their co-movement with improvement spending. The result is a model which can be applied to any metro area for which reliable input data is available. The model performed reasonably well, explaining 67 percent of the variation in average home improvement spending trends among the same four metropolitan areas.

Owing to the imprecise nature of forecasting and the uncertainty inherent in our manufactured home improvement spending benchmark data, care should be taken not to over-emphasize point estimates in the projected growth rates. Rather, these projections give a sense of broad comparative trends that are expected to develop in metropolitan areas over the coming year. Modelled growth rates for past periods also suggest how growth may have been trending, whether accelerating or decelerating, over time. Additional AHS-based survey results for the years 2017 and beyond for these and other metropolitan areas will provide further information that could help us to validate and refine the model weighting scheme and measure model performance over time.

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Bendimerad, Amal. 2007. "Developing a Leading Indicator for the Remodeling Industry." Joint Center for Housing Studies Research Note, April.

Joint Center for Housing Studies. 2018. "Robust Outlook for Residential Remodeling Activity Through Mid-Year 2019." Press Release, July 19.

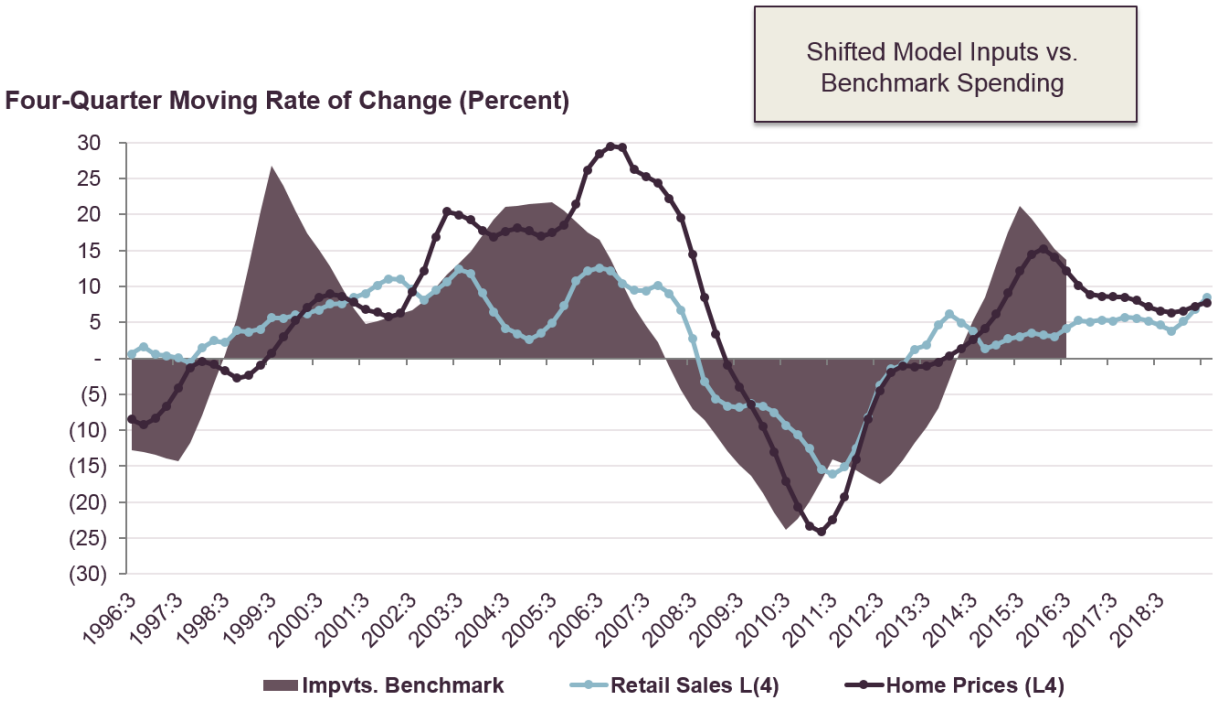
Will, Abbe. 2016. "Re-Benchmarking the Leading Indicator of Remodeling Activity." Joint Center for Housing Studies Research Note, April.

Will, Abbe. 2018. "Investigating Metro-Area Home Improvement Spending Cycles." Joint Center for Housing Studies Research Brief, July.

Appendix A is available as a downloadable Excel file here.

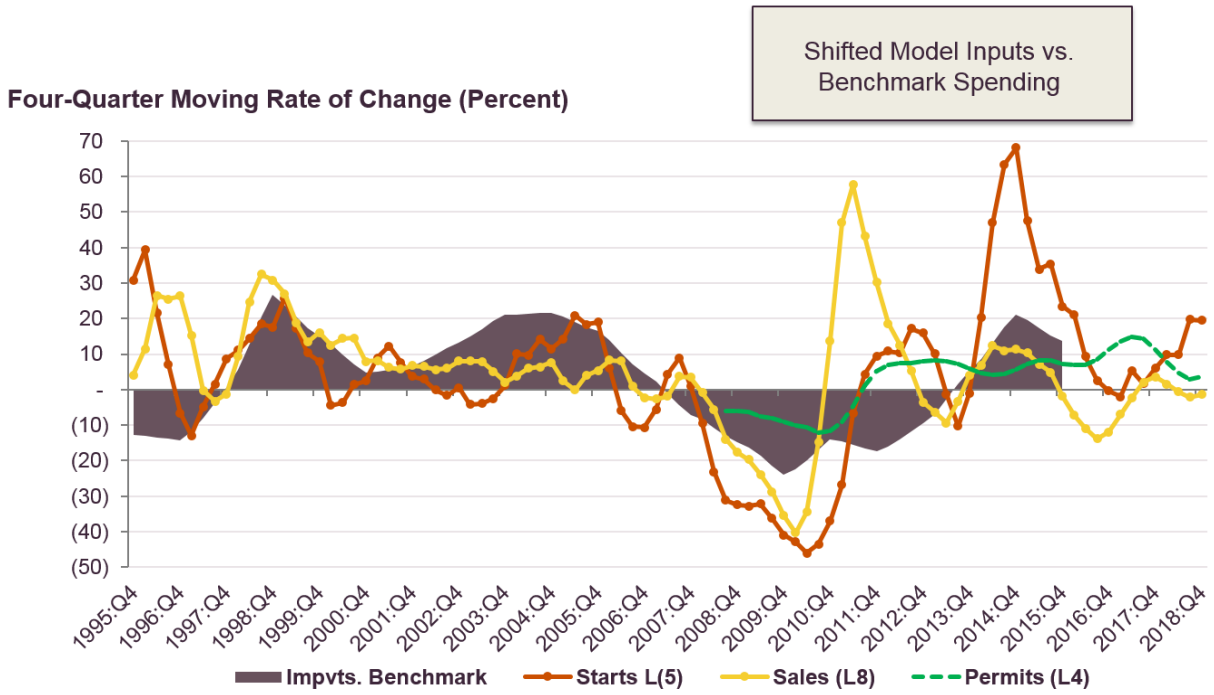
Appendix B: Visual Inspection of Inputs for Select Metro Areas: Los Angeles, Detroit, Philadelphia.

Figure 9A: Los Angeles Metro Area



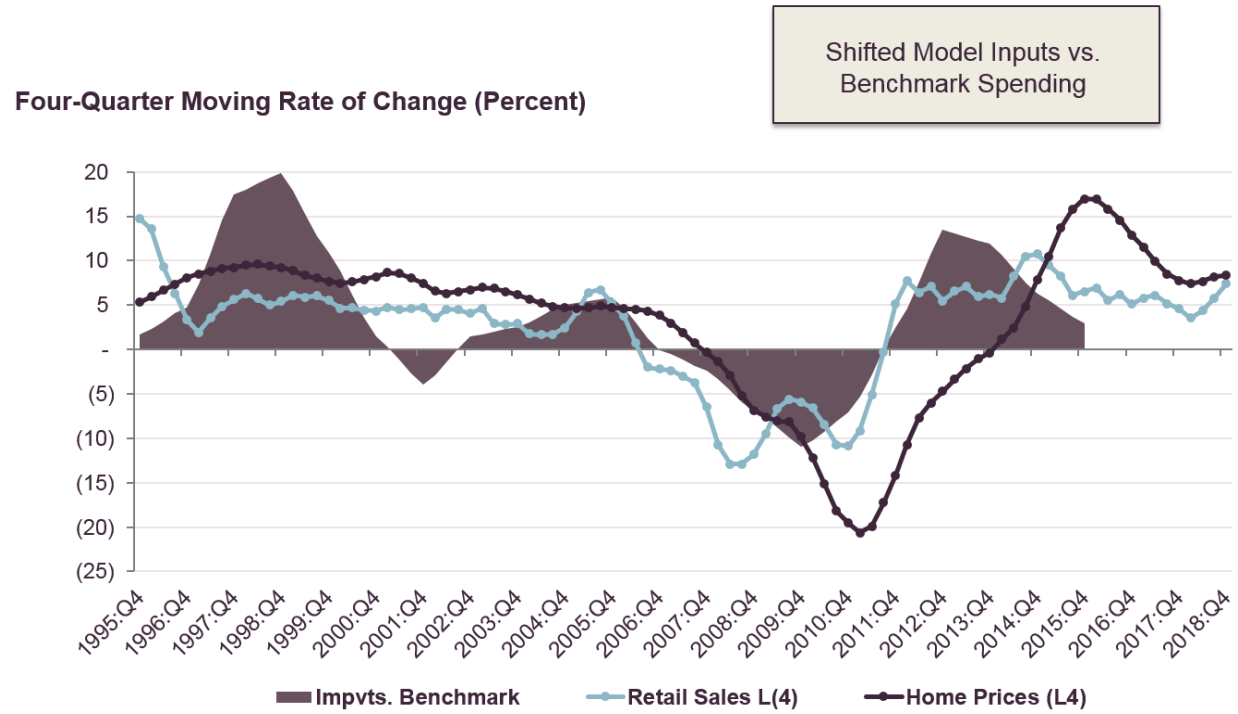
Source: JCHS tabulations of HUD, American Housing Surveys; US Census Bureau, Moody's Analytics Estimates, and BuildFax.

Figure 9B: Los Angeles Metro Area



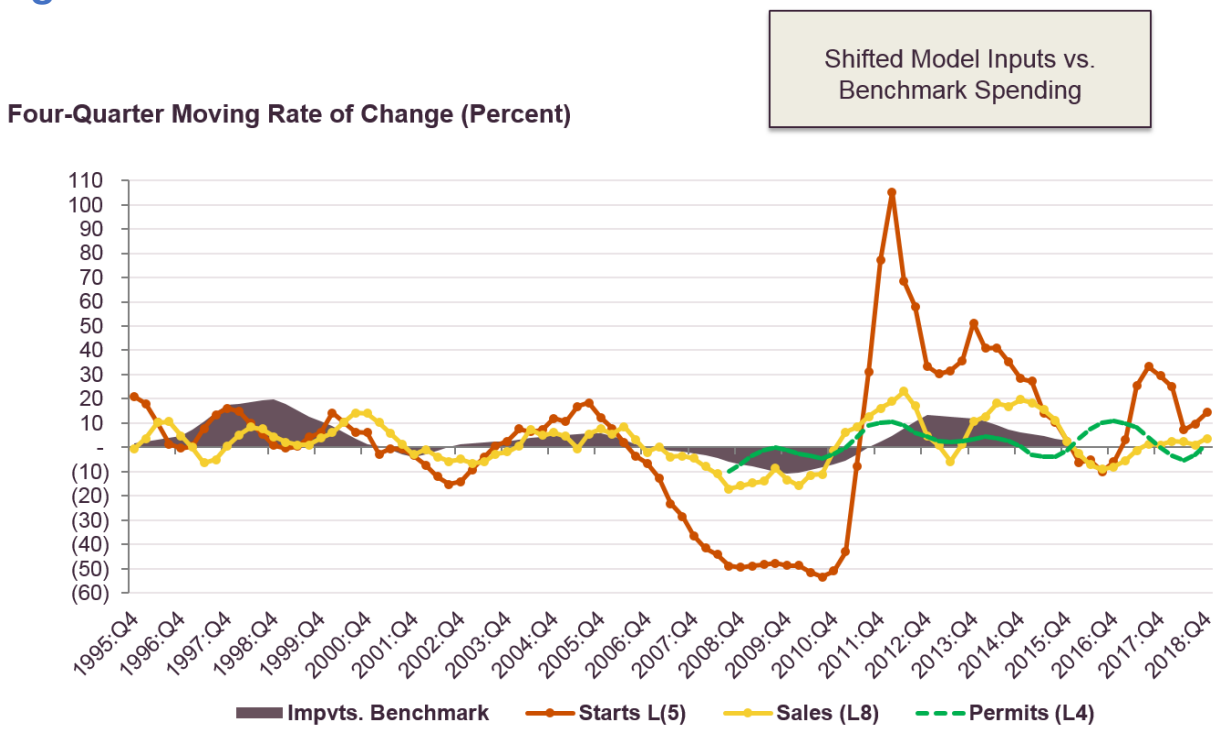
Source: JCHS tabulations of HUD, American Housing Surveys; US Census Bureau, Moody's Analytics Estimates, and BuildFax.

Figure 10A: Detroit Metro Area



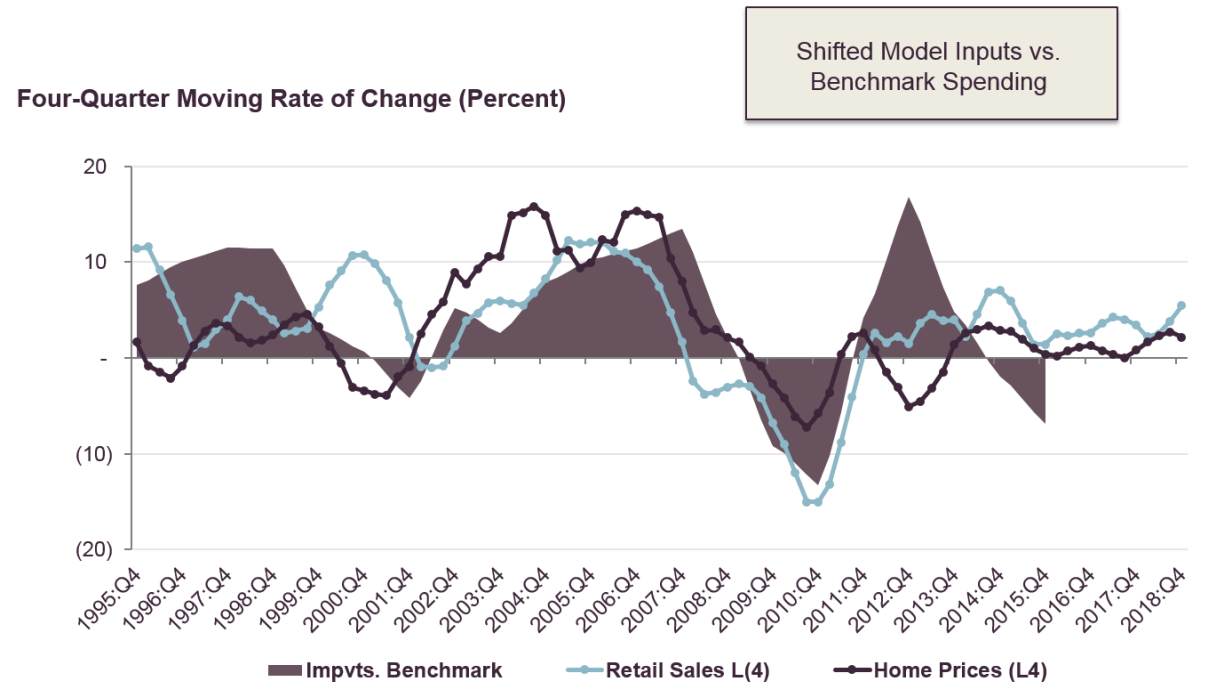
Source: JCHS tabulations of HUD, American Housing Surveys; US Census Bureau, Moody's Analytics Estimates, and BuildFax.

Figure 10B: Detroit Metro Area



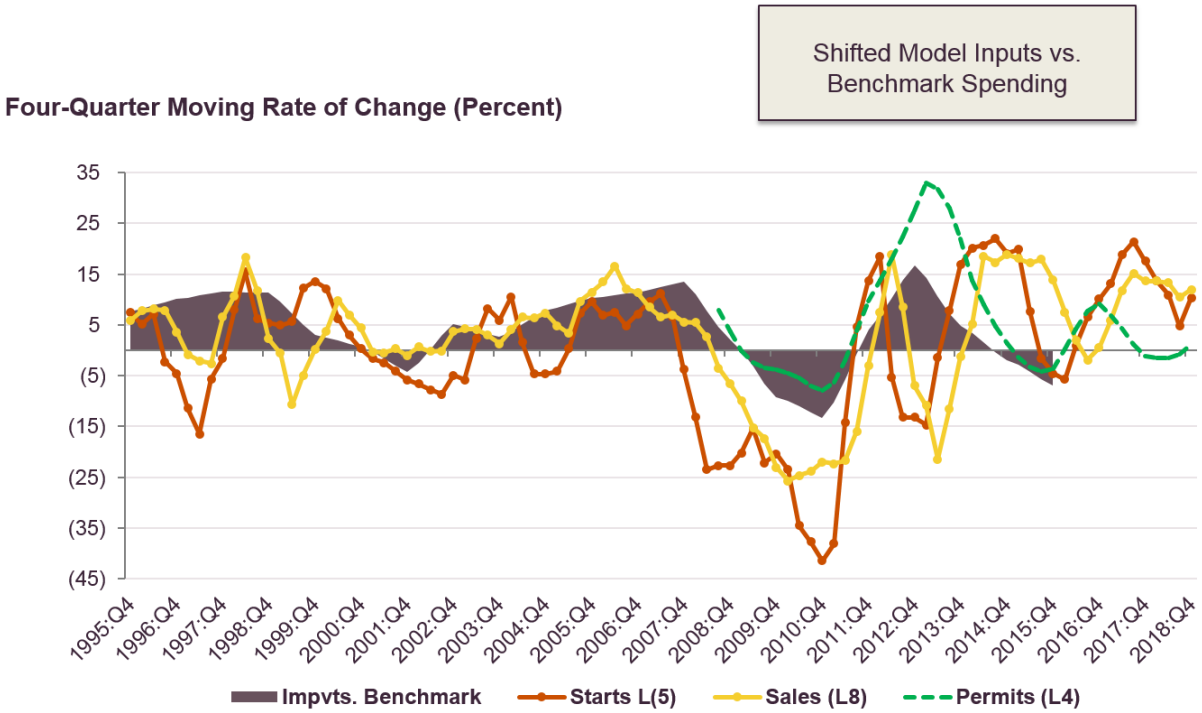
Source: JCHS tabulations of HUD, American Housing Surveys; US Census Bureau, Moody's Analytics Estimates, and BuildFax.

Figure 11A: Philadelphia Metro Area



Source: JCHS tabulations of HUD, American Housing Surveys; US Census Bureau, Moody's Analytics Estimates, and BuildFax.

Figure 11B: Philadelphia Metro Area



Source: JCHS tabulations of HUD, American Housing Surveys; US Census Bureau, Moody's Analytics Estimates, and BuildFax.

Appendix C is available as a downloadable Excel file here.