

**Joint Center for Housing Studies  
Harvard University**

**Addendum to Research Note N07-1:  
Re-Benchmarking the Leading Indicator of Remodeling Activity**

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N08-1**

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## **Introduction**

This addendum to Research Note N07-1 provides an explanation of new changes to the benchmarked data series for the Joint Center for Housing Studies' Leading Indicator of Remodeling Activity (LIRA).<sup>1</sup> These changes were necessitated by the recent discontinuation of the U.S. Census Bureau's Survey of Residential Alteration and Repairs and consequently the Bureau's publication of the quarterly Residential Improvements and Repairs Statistics (C-50). Not only did the C-50 serve as the historical reference series for the LIRA estimates, it was also an integral part of the weighting methodology and estimation of the LIRA model. Fortunately, a fairly comparable substitute for the C-50 data was found in the Bureau's Construction Spending statistics, also known as the C-30 series. However, the C-30 only provides estimates of homeowner improvement spending, whereas the C-50 estimated both improvements and maintenance and repairs to owner-occupied units, as well as rental units. Consequently, the major difference between the former and re-benchmarked LIRA is that the former LIRA provided estimates of trends in homeowner improvements *and* maintenance and repair spending, while the re-benchmarked LIRA only tracks changes in owner improvement expenditures.

The home remodeling industry is closing in on \$300 billion a year in improvement and repair expenditures, yet this industry continues to struggle for timely and consistent data on current market size estimates and trends.<sup>2</sup> Although the C-50 was designed to measure national expenditures for residential improvements and repairs on a quarterly basis, the estimates exhibited unusual volatility and inconsistency and were subjected to numerous revisions through the years including a change of survey methodology. To further exasperate the industry's desire for quality data, the release of C-50 estimates lagged the reference period by fully four months. Recognizing the need for more timely and accurate assessments of the industry, the Joint Center's Remodeling Futures Program developed the Remodeling Activity Indicator (RAI) in 1998.<sup>3</sup> Released only two weeks after the end of the reference period, the RAI provided the industry with much timelier estimates of current changes in homeowner remodeling activity at the national level. While the

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<sup>1</sup> See Amal Bendimerad, "Developing a Leading Indicator for the Remodeling Industry," Joint Center for Housing Studies of Harvard University, Research Note N07-1, April 2007.

<sup>2</sup> For historical market size estimates see "Foundations for Future Growth in the Remodeling Industry," *Improving America's Housing 2007*, Joint Center for Housing Studies of Harvard University.

<sup>3</sup> See Alvaro Martin-Guerrero, "An Improved Method for Estimating Homeowner Improvement and Repair Activity Through Revisions to the Remodeling Activity Indicator," Joint Center for Housing Studies of Harvard University, Working Paper W04-4, April 2004.

RAI helped the industry measure current remodeling activity, the industry still lacked a forward-looking indicator that could project market size and trends in the near-term.

In April 2007, the Remodeling Futures Program replaced the RAI with the LIRA. The LIRA not only provided estimates of current homeowner improvement and repair activity, but it also provided a short-term projection of remodeling activity with a horizon of three quarters. The significant difference between the RAI and the LIRA is that, as a leading indicator, the LIRA is intended to signal major turning points in the remodeling cycle in the near future. Like the RAI, the LIRA is constructed as a composite measure of several economic indicators that tend to impact remodeling activity levels. Also, both the RAI and the LIRA used the C-50's measure of homeowner improvements and maintenance and repair spending as a point of reference in producing near-term estimates of quarterly expenditure levels. With the release of the final C-50 estimate in May 2008, the continuation of the LIRA depended on re-benchmarking to an alternative source of national remodeling estimates.

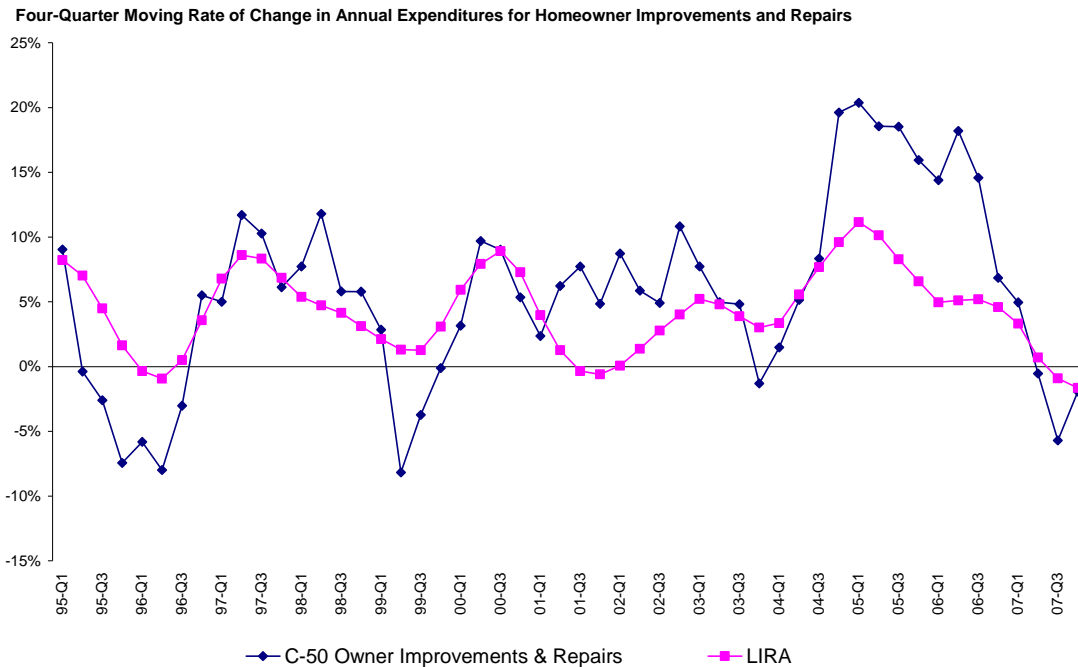
### **LIRA Methodology and Performance Against the C-50**

The LIRA is computed as a moving four-quarter rate of change of its weighted components. A four-quarter, or annual, rate of change is the ratio that results when the total activity in any given four-quarter period is divided by the total activity that occurred in the prior four quarters. This calculation results in a rate of change that measures annual (year-over-year) changes in activity levels on a quarterly basis. The final inputs of the LIRA were determined by the magnitude and strength of their correlations with the C-50's measure of homeowner improvements and maintenance and repair expenditures. Input series with strong and highly significant correlation coefficients received greater weight, while inputs with high variability (as measured by the standard deviation) received lesser weight. To be exact, inputs with strong correlation to the C-50, but low variation received the greatest weight, while those with weaker correlation and higher variation received the least weight in calculating the LIRA rate of change.

When benchmarked to the C-50, the LIRA produced an annual rate of change in homeowner improvement and repair spending. Again, the LIRA was designed to produce more stable projections of market size trends that better reflect actual changes in remodeling activity than those produced by the C-50. While the remodeling industry is cyclical with alternating periods of growth and decline, the highly erratic fluctuations found in the quarterly C-50

estimates pointed toward data quality problems rather than real changes in activity. Figure 1 shows how the LIRA estimates compared to the C-50 historically, and confirms that the LIRA produces much smoother estimates of industry trends, while still following the same general pattern of upturn and downturn.

**Figure 1: LIRA Closely Tracked General Trends in C-50, Yet Much More Stable**



Source: Joint Center for Housing Studies and U.S. Census Bureau's Residential Improvements and Repairs Statistics (C-50).

### **Replacing of the C-50 as the LIRA Benchmark**

Due to the many challenges of reliable data collection, few sources exist that provide frequent and direct measures of national remodeling expenditures. While the Department of Housing and Urban Development's American Housing Survey (AHS) covers homeowner improvement spending in great detail, the AHS is only conducted once every two years. Other government surveys are conducted much more frequently, but they are not designed to specifically collect data on remodeling expenditures. For example, the Bureau of Labor Statistics' Consumer Expenditure Survey (CE) is conducted quarterly and is designed to collect detailed information on the buying habits of American consumers, including expenditures for home improvements and repairs. However, the CE has a relatively small sample of approximately 7,000 households per quarter, which is not optimal for capturing data on large and

infrequent expenditures, such as home improvements. Nevertheless, beginning in the mid 1980s the Census Bureau began incorporating data from the CE on homeowner improvement and repair spending into the C-50 estimates as a means of eliminating data collection redundancies. The same improvements (but not maintenance and repairs) data from the CE has also been incorporated into the Census Bureau's Value of Private Construction Put in Place (C-30), making this component of the C-30 a comparable replacement for the C-50.<sup>4</sup>

The homeowner improvement estimates from the CE data are embedded in the monthly estimates of total private residential construction spending in the C-30. That is, the improvement numbers are not a published line item in the report, but rather are included in the total. By subtracting the values of new single family and new multi-family construction, the remainder is the value of improvements to owner-occupied units (both single and multi-family). Since both the C-50 and C-30 used owner improvements data from the same survey, one would expect the two series to match perfectly. Yet, as seen in Table 1, the C-50 and C-30 estimates only equal on an annual basis, but vary somewhat by quarter. The relatively small differences from quarter to quarter are due to various smoothing and benchmarking routines run by the Census Bureau as are required to create a monthly series from the quarterly CE survey data. Also, while the C-30 reports data with only a one month lag, the embedded estimates of improvements are based on incomplete survey data for a period of five months after first release and are subject to substantial revisions until data collection and reporting is complete.<sup>5</sup>

A comparison of the four-quarter moving rates of change in the C-50 estimates of homeowner improvement and repair spending and the C-30 estimates of owner improvement expenditures shows that the C-30 estimates are much smoother than the C-50, but also considerably more cyclical (see Figure 2). This increased cyclicity is expected since discretionary improvement spending tends to be more volatile compared to the more routine and less costly expense of maintenance and repairs.

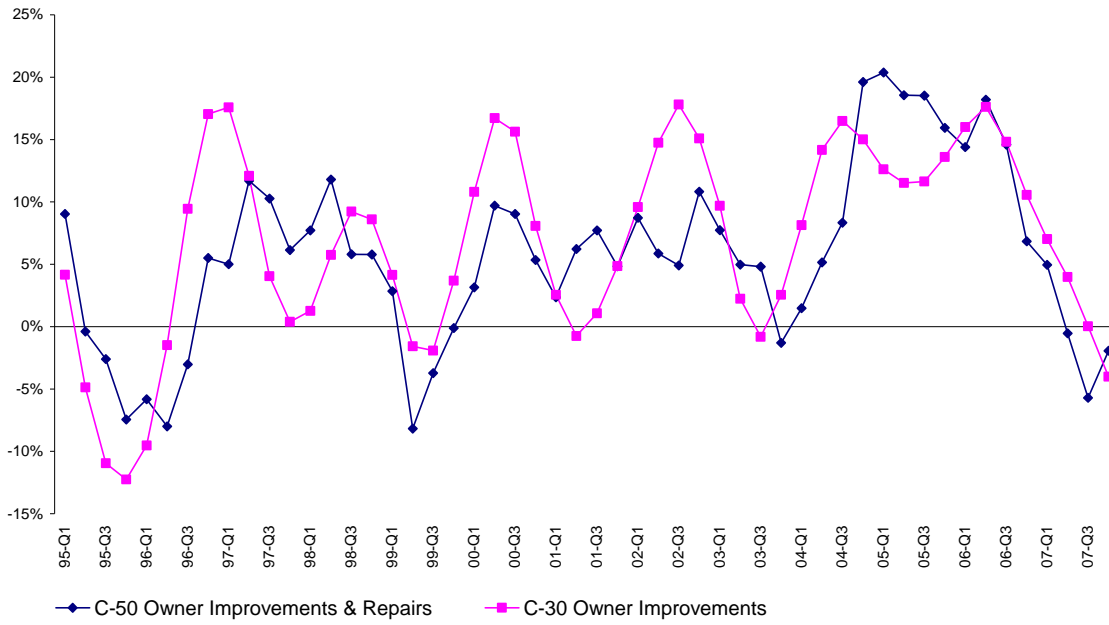
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<sup>4</sup> See <http://www.census.gov/const/www/c30index.html> for the U.S. Census Bureau's Construction Spending reports.

<sup>5</sup> In this way, improvement estimates based on complete survey data are first used in the May publication for revisions to the previous year. See <http://www.census.gov/const/C30/methodology.pdf> for a full description of the methodology for collecting and reporting improvements to owner-occupied units in the C-30.

**Figure 2: Annual Movement in C-30 is Less Erratic, But More Cyclical Than C-50**

Four-Quarter Moving Rate of Change in Annual Homeowner Remodeling Expenditures



Source: JCHS tabulations of U.S. Census Bureau's Residential Improvements and Repairs Statistics (C-50) and Value of Private Residential Construction Put in Place (C-30).

**Table 1: Comparison of Homeowner Improvement Expenditure Estimates in U.S. Census Bureau's C-30 and C-50 Series**

	Homeowner Improvements (\$Bil, NSA)		Difference from C-50
	C-30	C-50	
<b>1993 Total</b>	<b>57.3</b>	<b>57.3</b>	<b>0.0</b>
Q1	9.8	10.2	-0.4
Q2	15.3	14.9	0.4
Q3	17.3	16.7	0.5
Q4	14.9	15.4	-0.5
<b>1994 Total</b>	<b>64.6</b>	<b>64.6</b>	<b>0.0</b>
Q1	13.1	11.9	1.2
Q2	18.5	20.6	-2.1
Q3	18.7	17.0	1.7
Q4	14.3	15.1	-0.8
<b>1995 Total</b>	<b>56.7</b>	<b>56.7</b>	<b>0.0</b>
Q1	11.6	10.7	0.9
Q2	16.0	17.8	-1.8
Q3	16.2	16.7	-0.5
Q4	12.9	11.6	1.4
<b>1996 Total</b>	<b>66.4</b>	<b>66.4</b>	<b>0.0</b>
Q1	11.9	13.0	-1.0
Q2	18.7	16.6	2.1
Q3	20.0	20.2	-0.2
Q4	15.8	16.6	-0.8
<b>1997 Total</b>	<b>66.6</b>	<b>66.6</b>	<b>0.0</b>
Q1	12.7	12.7	0.0
Q2	18.5	17.6	0.9
Q3	19.1	19.8	-0.6
Q4	16.3	16.5	-0.2
<b>1998 Total</b>	<b>72.4</b>	<b>72.4</b>	<b>0.0</b>
Q1	14.0	13.7	0.3
Q2	21.4	23.6	-2.2
Q3	20.6	18.3	2.3
Q4	16.4	16.8	-0.3
<b>1999 Total</b>	<b>75.0</b>	<b>75.0</b>	<b>0.0</b>
Q1	12.4	12.9	-0.5
Q2	20.3	19.5	0.8
Q3	21.7	21.5	0.2
Q4	20.6	21.2	-0.5
<b>2000 Total</b>	<b>81.1</b>	<b>81.1</b>	<b>0.0</b>
Q1	15.8	14.5	1.3
Q2	23.2	21.6	1.6
Q3	22.2	22.4	-0.2
Q4	19.8	22.6	-2.7



**Table 1 Cont.: Comparison of Homeowner Improvement Expenditure Estimates in U.S. Census Bureau's C-30 and C-50 Series**

	Homeowner Improvements (\$Bil, NSA)		Difference from C-50
	C-30	C-50	
<b>2001 Total</b>	<b>85.0</b>	<b>85.0</b>	<b>0.0</b>
Q1	15.1	14.7	0.4
Q2	23.5	25.4	-1.9
Q3	24.3	25.1	-0.8
Q4	22.1	19.8	2.3
<b>2002 Total</b>	<b>97.9</b>	<b>97.9</b>	<b>0.0</b>
Q1	18.2	18.7	-0.5
Q2	28.1	27.8	0.2
Q3	29.1	28.1	1.0
Q4	22.4	23.2	-0.8
<b>2003 Total</b>	<b>100.3</b>	<b>100.3</b>	<b>0.0</b>
Q1	17.0	18.0	-1.0
Q2	26.1	28.7	-2.6
Q3	31.1	30.9	0.2
Q4	26.1	22.7	3.4
<b>2004 Total</b>	<b>115.4</b>	<b>115.4</b>	<b>0.0</b>
Q1	21.2	21.2	0.0
Q2	29.7	29.2	0.5
Q3	35.7	34.5	1.2
Q4	28.8	30.6	-1.7
<b>2005 Total</b>	<b>131.1</b>	<b>131.1</b>	<b>0.0</b>
Q1	23.5	24.3	-0.8
Q2	32.6	30.8	1.8
Q3	40.8	40.0	0.8
Q4	34.2	36.0	-1.8
<b>2006 Total</b>	<b>144.9</b>	<b>144.9</b>	<b>0.0</b>
Q1	28.9	28.7	0.2
Q2	37.9	38.8	-1.0
Q3	43.4	43.1	0.3
Q4	34.7	34.3	0.5
<b>2007 Total</b>	<b>139.1</b>	<b>139.1</b>	<b>0.0</b>
Q1	30.0	28.9	1.2
Q2	39.2	37.2	2.1
Q3	40.4	37.3	3.1
Q4	29.4	35.7	-6.3

Source: Census Bureau, Value of Construction Put in Place      Census Bureau, Expenditures for Residential Improvements and Repairs

Native Frequency: Monthly      Quarterly

### **Re-benchmarking the LIRA to the C-30**

The same procedures were followed in re-benchmarking the LIRA to the C-30 estimates of homeowner improvement spending as were used when the C-50 was the reference series. A variety of economic indicators that are thought to influence remodeling spending were identified and tested for correlation with the C-30 at various leads (in quarters) over C-30 spending.<sup>6</sup> As expected, many of the indicators previously included in the LIRA also exhibited strong correlation with the C-30. However, several inputs that previously correlated well with the C-50 had a much weaker association to the C-30. These indicators were thus dropped from the LIRA, including Hours Worked by Remodelers and ECRI's Weekly Leading Index.<sup>7</sup> New additions to the LIRA include the Number of Employees of at Residential Remodeling Establishments, Single Family Housing Starts, and 30-Year Treasury Bond Yields. A complete description of the final input variables used to compute the re-benchmarked LIRA is found in Table 2.

The correlation results and associated lead times for the final inputs, including significance levels, are found in Table 3. A simple correlation between the four-quarter rates of change in each indicator and the rates of change in homeowner improvements was calculated at varying lead times over a relatively short time period from the second quarter of 2001 to the fourth quarter of 2007. The reason for the short time frame is because poorly documented revisions were made to the owner improvement estimates in early 1999, which indicates that data from the more recent time period may not be completely comparable to the data from before 1999. Since the calculation of the four-quarter rates of change includes eight quarters worth of data, the first annual rate of change to not include data from the first half of 1999 is that of the second quarter of 2001. For each input, the lead time that produced the highest correlation with the C-30 is outlined in the table, with two exceptions. In the case of Housing Starts and the Remodeling Market Index, some discretion was used to trade a slightly better correlation with the C-30 for a greater lead time.

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<sup>6</sup> See Appendix Table A1 for the four-quarter moving rates of change from 1995 to 2007 for each input variable included in the re-benchmarked LIRA.

<sup>7</sup> The Improvements input previously included in the LIRA was essentially the same as the C-30 estimates now used as a benchmark. Also, the Cash-Out Refinancing input was previously removed from the LIRA when Freddie Mac discontinued the publishing of quarterly forecasts in late 2007.

**Table 2: Description of Final Input Variables for LIRA**

<b>Data Series</b>	<b>Mnemonic</b>	<b>Source</b>	<b>Lead Time*</b>	<b>Definition</b>
Purchasing Managers' Index (PMI)	ISM	Institute of Supply Management	0	Composite index based on the diffusion index of five indicators: New Orders, Production, Employment, Supplier Deliveries and Inventories; 50+ = Expansion in manufacturing activity.
Number of Employees at Residential Remodeling Establishments	Labor	Bureau of Labor Statistics	0	Total payroll employment in residential remodeling industry, including remodeling general contractors, operative remodelers, remodeling design-build firms, and remodeling project construction management firms.
Shipments of Building Materials	Shipmts	U.S. Census Bureau, Manufacturers' Shipments, Inventories and Orders (M3)	0	Manufacturers' shipments of Construction Materials and Supplies, Wood Products, and Household Appliances.
Retail Sales of Building Materials	Retail	Department of Commerce	1	Retail Sales at Building Materials and Supplies Dealers.
Single Family Housing Starts	Starts	U.S. Census Bureau	3	New privately-owned 1-unit housing starts.
Remodeling Market Index, Future Expectations	RMI	National Association of Home Builders	4	Average of four indices: Call For Bids, Amount of Work Committed for the Next 3 Months, Backlog of Remodeling Jobs, and Appointments for Proposal; 50+ = Remodelers view remodeling conditions as higher than the previous quarter.
Pending Home Sales Index	PHSI	National Association of Realtors	4	Index based on signed real estate contracts for existing single-family homes, condos and co-ops; A signed contract is not counted as a sale until the transaction closes.
30-Year Treasury Bonds Yield	Bond	Federal Reserve Board	4	30-Year Treasury Bond Yield at Constant Maturity (% p.a.)

\* Refers to lead over C-30 spending in quarters

**Table 3: Correlation Coefficients with C-30 Owner Improvements, 2001Q2 to 2007Q4**

	ISM	Labor	Shipmts	Retail	Starts	RMI	PHSI	Bond*
<b>t(0)</b>	<b>0.543</b>	<b>0.441</b>	<b>0.664</b>	<b>0.735</b>	<b>0.465</b>	<b>-0.004</b>	<b>0.457</b>	<b>-0.173</b>
	0.004	0.022	0.000	0.000	0.014	0.988	0.037	0.389
<b>t(1)</b>	<b>0.375</b>	<b>0.184</b>	<b>0.591</b>	<b>0.786</b>	<b>0.609</b>	<b>0.286</b>	<b>0.585</b>	<b>0.058</b>
	0.054	0.357	0.001	0.000	0.001	0.221	0.007	0.773
<b>t(2)</b>	<b>0.061</b>	<b>-0.052</b>	<b>0.399</b>	<b>0.673</b>	<b>0.692</b>	<b>0.493</b>	<b>0.688</b>	<b>0.416</b>
	0.762	0.798	0.039	0.000	0.000	0.032	0.001	0.031
<b>t(3)</b>	<b>-0.217</b>	<b>-0.177</b>	<b>0.171</b>	<b>0.411</b>	<b>0.686</b>	<b>0.562</b>	<b>0.772</b>	<b>0.672</b>
	0.277	0.377	0.395	0.033	0.000	0.015	0.000	0.000
<b>t(4)</b>	<b>-0.294</b>	<b>-0.200</b>	<b>-0.004</b>	<b>0.090</b>	<b>0.571</b>	<b>0.537</b>	<b>0.835</b>	<b>0.672</b>
	0.137	0.317	0.983	0.655	0.002	0.026	0.000	0.000
<b>Obs</b>	27	27	27	27	27	21	21	27
<b>Std. Dev</b>	0.103	0.043	0.050	0.050	0.129	0.078	0.089	0.054
<b>Mean</b>	1.029	1.063	1.018	1.064	1.028	1.012	1.035	0.972
<b>Min</b>	0.842	0.973	0.940	0.964	0.734	0.907	0.885	0.888
<b>Max</b>	1.224	1.113	1.088	1.141	1.169	1.187	1.156	1.082

\*The correlations for Treasury Bond yields were calculated using inverse yield rates since a decline in yield rates is correlated with an increase in improvement spending.

Note: The significance level of each correlation coefficient is reported in the line below the coefficient as a p-value indicating the level of confidence that the correlation is not equal to zero.

The next step in re-benchmarking the LIRA involves the calculation of the input weights. Again, inputs with higher correlations to the C-30 and lower standard deviations will have greater weight in calculating the final LIRA estimates. The final weight calculations are described in Table 4. With both very low variation and high correlation, Retail Sales of Building Materials has the highest weight of the final eight indicators at 15.7% followed by Shipments of Building Materials, Bond Yields, and Number of Remodeling Employees.

**Table 4: Calculation of LIRA Weights Using Input Correlations with C-30 Improvements from 2001Q2-2007Q4**

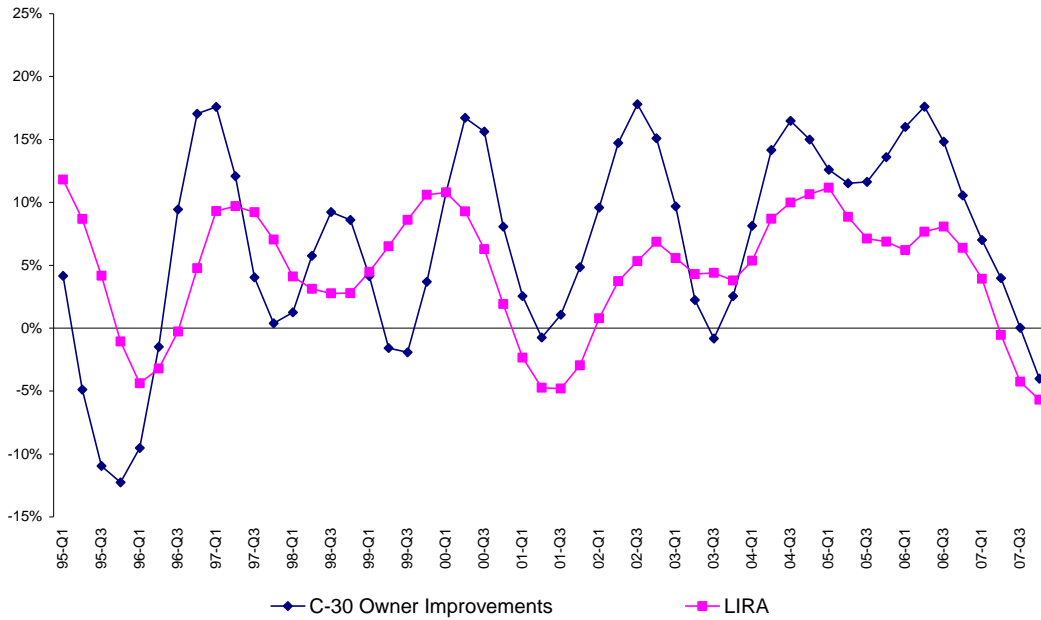
	ISM	Labor	Shipmts	Retail	Starts	RMI	PHSI	Bond
Lead over C-30 (number of quarters)	0	0	0	1	3	4	4	4
Standard Deviation	0.103	0.043	0.050	0.050	0.129	0.078	0.089	0.054
1/STD	9.75	23.31	20.10	19.94	7.78	12.76	11.28	18.39
Share of sum of 1/STD	8%	19%	16%	16%	6%	10%	9%	15%
Correlation w/ C-30	0.543	0.441	0.664	0.786	0.686	0.537	0.835	0.672
Share of sum of Correlation	11%	9%	13%	15%	13%	10%	16%	13%
<b>Final LIRA Weights</b>	<b>9.2%</b>	<b>13.7%</b>	<b>14.6%</b>	<b>15.7%</b>	<b>9.8%</b>	<b>10.4%</b>	<b>12.7%</b>	<b>14.0%</b>

As seen in Figure 3, the re-benchmarked LIRA closely follows the same trends in remodeling activity as the C-30 and anticipates turning points well. While the C-30 is considerably less erratic from quarter to quarter compared to the C-50, the LIRA is still much less volatile than the C-30. Where the standard deviation of the annual growth in the C-30 between 1995 and 2007 is 0.078, the standard deviation of the LIRA is only 0.048. The correlation between the C-30 and the re-benchmarked LIRA is 0.792 over the more current reference period between 2001 and 2007 (the same time period from which the input correlations and weights are drawn). An adjusted  $R^2$  value of 0.6120 suggests that the eight LIRA inputs explain over 60% of the variation in the C-30's estimates of homeowner improvement spending.

Finally, a comparison of the LIRA estimates produced from benchmarking to the C-50 and the LIRA estimates resulting from benchmarking to the C-30 shows that both procedures produce very similar trends in annual growth in their respective markets, but the re-benchmarked LIRA estimates stronger year-over-year declines in the improvements market than were previously estimated for the improvements and repairs market (see Figure 4). Again, this finding is not surprising since the improvements market is typically more cyclical than the overall market for both improvements and repairs.

**Figure 3: Re-Benchmarked LIRA Smoothes Volatility of C-30**

Four-Quarter Moving Rate of Change in Annual Expenditures for Homeowner Improvements



Source: Joint Center for Housing Studies and JCHS tabulations of U.S. Census Bureau's Value of Private Residential Construction Put in Place (C-30).

**Figure 4: Re-benchmarked LIRA Estimates Similar Growth, More Dramatic Declines**

Four-Quarter Moving Rate of Change in Annual Homeowner Remodeling Expenditures



Source: Joint Center for Housing Studies.

## **Conclusion**

The Leading Indicator of Remodeling Activity (LIRA) was first developed by the Joint Center for Housing Studies to project near-term trends in homeowner improvement and repair activity using the Census Bureau's C-50 estimates as a reference series. With the recent discontinuation of the C-50, the LIRA has been re-benchmarked to the embedded estimates of homeowner improvements found in the Bureau's Value of Private Residential Construction Put in Place (C-30). The embedded improvement figures in the C-30 are estimated using the same survey data as was formerly used in estimating the C-50, making the improvement estimates of the C-50 and C-30 fairly comparable on a quarterly basis. The major change in re-benchmarking the LIRA from the C-50 to the C-30 is that the LIRA no longer tracks changes in both improvements *and* maintenance and repair activity, but rather only homeowner improvement activity since the C-30 only includes estimates of improvements to owner-occupied units.

The re-benchmarked LIRA closely follows the trends in homeowner improvement activity in the C-30, but as designed, the LIRA estimates show significantly reduced volatility compared to the C-30 and seems to anticipate turning points in the industry well. Whereas the C-30 estimates include a great deal of random variation (due to small sample size and the associated measurement errors) that obscures the underlying trend in activity, the LIRA produces estimates that are more closely aligned with actual changes in home improvement activity levels.

**Appendix A1: Four-Quarter Moving Rates of Change in Final Input Variables, 1995-2007**

	ISM t(0)	Labor t(0)	Shipmts t(0)	Retail t(1)	Starts t(3)	RMI t(4)	PHSI t(4)	Bond t(4)
1995-Q1	11.4	9.0	9.4	12.4	2.1	NA	NA	18.1
1995-Q2	2.8	7.2	5.7	10.0	-5.2	NA	NA	14.3
1995-Q3	-5.2	4.8	3.4	6.7	-8.0	NA	NA	5.9
1995-Q4	-12.1	3.5	1.3	4.4	-7.6	NA	NA	-6.6
1996-Q1	-15.4	3.5	-0.6	2.7	-2.3	NA	NA	-14.3
1996-Q2	-10.3	4.7	1.4	3.7	7.2	NA	NA	-13.2
1996-Q3	-4.9	6.7	2.1	5.6	10.5	NA	NA	-9.7
1996-Q4	4.4	8.5	3.5	6.7	11.0	NA	NA	-2.7
1997-Q1	13.3	9.6	5.9	7.8	8.2	NA	NA	4.3
1997-Q2	13.8	9.4	5.5	8.2	1.8	NA	NA	4.5
1997-Q3	15.1	8.4	5.7	7.8	-0.6	NA	NA	1.8
1997-Q4	12.3	7.2	6.2	7.7	-0.1	NA	NA	-1.4
1998-Q1	7.7	5.7	6.1	7.3	1.6	NA	NA	-6.7
1998-Q2	3.3	5.3	6.3	6.4	6.4	NA	NA	-10.7
1998-Q3	-2.5	5.7	5.7	5.9	10.1	NA	NA	-13.2
1998-Q4	-7.3	6.6	4.3	6.3	13.9	NA	NA	-15.6
1999-Q1	-7.8	8.4	3.1	7.1	14.5	NA	NA	-14.5
1999-Q2	-4.2	10.1	2.8	8.1	11.7	NA	NA	-10.9
1999-Q3	2.1	11.2	2.9	8.9	8.8	NA	NA	-4.4
1999-Q4	11.3	12.0	3.3	9.1	4.7	NA	NA	5.2
2000-Q1	14.7	12.2	4.6	9.4	2.0	NA	NA	11.9
2000-Q2	12.5	11.0	4.2	8.8	1.1	NA	NA	13.0
2000-Q3	7.3	9.2	3.1	7.2	-0.7	NA	NA	9.0
2000-Q4	-2.3	6.6	1.1	5.2	-2.3	NA	NA	1.3
2001-Q1	-10.3	2.7	-3.3	2.8	-2.0	NA	NA	-6.1
2001-Q2	-14.9	-0.4	-5.4	2.6	0.2	NA	NA	-7.9
2001-Q3	-15.8	-2.2	-6.0	3.2	3.8	NA	NA	-8.1
2001-Q4	-13.5	-2.7	-5.4	4.7	6.4	NA	NA	-7.6
2002-Q1	-4.0	-1.1	-3.4	5.7	7.9	NA	NA	-3.5
2002-Q2	7.1	1.2	-2.1	5.3	6.8	NA	NA	-2.2
2002-Q3	12.8	3.4	-0.9	5.4	6.3	NA	NA	-2.1
2002-Q4	18.9	5.6	0.6	4.9	8.4	-1.7	3.9	-1.0
2003-Q1	13.5	6.8	1.2	4.5	8.0	-1.8	3.8	-3.9
2003-Q2	4.8	7.9	1.0	4.0	8.8	2.7	5.7	-8.1
2003-Q3	3.3	7.8	1.9	4.9	11.3	3.1	5.9	-7.1
2003-Q4	4.2	7.2	2.7	6.7	12.9	9.9	7.5	-6.0
2004-Q1	10.5	7.3	4.4	9.6	14.8	18.7	11.0	-3.9
2004-Q2	20.2	6.9	7.7	13.7	16.9	17.8	12.6	3.2
2004-Q3	22.4	8.5	8.8	14.1	14.9	12.5	14.0	2.5
2004-Q4	17.2	10.0	8.4	13.6	10.3	6.6	15.6	0.5



**A1 Cont.: Four-Quarter Moving Rates of Change in Final Input Variables, 1995-2007**

	<b>ISM t(0)</b>	<b>Labor t(0)</b>	<b>Shipmts t(0)</b>	<b>Retail t(1)</b>	<b>Starts t(3)</b>	<b>RMI t(4)</b>	<b>PHSI t(4)</b>	<b>Bond t(4)</b>
2005-Q1	8.9	10.5	8.5	12.2	9.2	-1.1	13.9	-1.0
2005-Q2	-1.0	11.3	6.9	10.2	7.8	-1.4	12.0	-8.3
2005-Q3	-5.2	10.3	5.9	9.9	8.2	-0.2	9.8	-11.2
2005-Q4	-4.8	9.5	6.7	10.2	10.1	-1.4	6.3	-11.1
2006-Q1	-2.7	9.7	6.7	11.7	9.5	-1.6	3.9	-10.0
2006-Q2	2.2	9.5	6.7	10.9	4.6	-6.4	-0.7	-2.2
2006-Q3	3.5	10.7	5.5	8.9	-3.4	-9.3	-5.6	4.7
2006-Q4	0.8	10.9	1.9	5.7	-11.9	-8.3	-7.1	6.8
2007-Q1	-1.3	8.9	-1.7	0.3	-20.1	-7.2	-8.6	8.2
2007-Q2	-3.0	7.4	-3.8	-2.3	-24.0	-2.5	-9.0	3.6
2007-Q3	-3.3	4.1	-4.5	-3.3	-26.4	-0.5	-10.0	0.3
2007-Q4	-1.1	1.6	-4.2	-3.6	-26.6	-2.9	-11.5	-0.8

Source: Joint Center for Housing Studies