Joint Center for Housing Studies

Harvard University

An Improved Method for Estimating Homeowner Improvement and Repair Activity Through Revisions to the Remodeling Activity Indicator

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Introduction

Since 1998 the Joint Center for Housing Studies at Harvard University, through its Remodeling Activity Indicator (RAI), has been releasing quarterly estimates of the U.S. home improvement and maintenance activity undertaken by homeowners. The purpose of this indicator is to anticipate trends in the U.S. Commerce Department's future releases of it quarterly "Expenditures for Residential Improvements and Repairs" (C-50) reports. Due to unusually long delays in the release of this indicator and the typical volatility of the data, the Joint Center developed this indicator to support industry and academic analysis of trends in this important market.

Released approximately two weeks after the end of the reference period, the RAI integrates growth rates of four related industry indicators: retail sales at building material and supply stores; shipments of tile products; existing home sales; and bank prime loan rates. Integrating these four elements through the RAI was found to provide an accurate estimation of the annual rate of change of remodeling activity among homeowners.[1]

Since its release, the Joint Center has been continually monitoring the performance of the RAI and tracking new data sources that might enhance its performance. Preliminary evaluation of the indicator showed a growing variance in the RAI estimates relative to the C-50 figures. This may in part be due to recent rebenchmarking of the C-50 series undertaken by the U.S. Commerce Department. The variance may also be due to revisions in original RAI components owing to the modification of industry definitions related to the introduction the North American Industry Classification System (NAICS). Finally, the variance may be the result of recent changes in remodeling market behavior during this past recession when unusually low financing costs prompted large levels of equity cash-out mortgage refinancing activity. A significant share of the cash pulled out of homes was devoted to home improvement activity.

Regardless of the source of the apparent bias in the estimates generated by the RAI, the entire estimation process was reviewed, both in terms of the indicators used, as well as the methodology for weighting the indicators to compute the RAI. Using a similar methodology, new components were identified that more accurately estimate remodeling spending by homeowners.

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[1] K. Baker, M. Collins & A. Hopf. "Developing and Indicator for the Homeowner Improvements and Repairs Market" JCHS Working Paper 98-6. October 1998

The first part of this paper describes the original components of the RAI, discusses some of the reasons for the underestimation of the volume of remodeling among homeowners, and analyzes the impact of alternative new components. The second section deals with the construction of the new indicator, the weighting method, and the improvements that the new components produce in the RAI. This working paper is intended to update the methodology presented in Joint Center Working Paper W98-6 "Development of an Indicator for the Homeowner Improvement and Repairs Market". However, that paper contains information on the motivation for developing the indicator, as well as potential applications, which are not contained in this document.

Overview of the Remodeling Activity Indicator

The Remodeling Activity Indicator (RAI) was created to provide the home improvement industry with a timely and accurate estimation of changes in spending activity by homeowners. On a quarterly basis, the RAI tracks the annual volume of homeowner expenditures in home improvements and repairs from the U.S. Department of Commerce (C-50 series) using the four quarter moving average of four indicators that are associated with homeowner maintenance and improvement activity: retail sales at building material and supply stores; the inverse of interest rates charged by banks for short-term loans to their most credit-worthy customers (the so-called prime rate); sales of existing homes; and manufacturer shipments of clay floor and wall tile.

The annual rates-of-change for the four RAI components were lagged differentially, meaning that they have a different timing relationship with home improvement spending. This relationship was determined by evaluating which lag produced the best correlation with annual rate-of-change of homeowner remodeling expenditures.

Typical of the calculation of economic relationships, the four components of the RAI are weighted relative to the variation of each element. To avoid the excessive impact of the components with higher volatility, each element is weighted by the inverse of the standard deviation of the series. The model can be expressed in terms of:

$$[1.0] \quad (RAI_{t0}) = \frac{I_{t6}W_{t6I} + R_{t1}W_{t1R} + T_{t1}W_{t1T} + H_{t4}W_{t4H}}{\Sigma W_{IRTH}}$$

where the change in homeowner remodeling (RAI_{t0}), measured in terms of four quarters rates-of-change, is equal to the sum of the four components at their highest lags: (prime rates (I), retail sales (R), shipments of tiles (T), and existing home sales (H), weighted by the inverse of the standard deviation of each element (W).

Performance of the RAI

       The resulting RAI calculations have provided a fairly accurate estimation of the trends in the homeowner remodeling market. Over the period of 1995-2002, the RAI has followed similar trends to the C-50 series [Fig 1]. The actual deviation of the RAI to the moving four quarter totals for homeowner expenditures as measured by the C-50 series represents about 1% of the actual values on average as reported by the Department of Commerce.

**Figure 1: Comparison of Estimates of Homeowner Spending
on Improvements Between the RAI and the C-50**
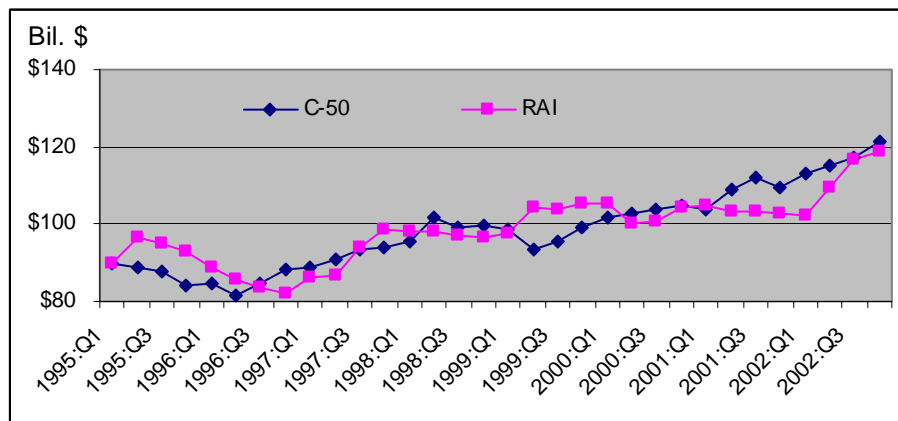
Source: U.S. Commerce Department and Joint Center for Housing Studies

       While the RAI served as a reasonably accurate – and much more timely – estimate of remodeling activity as measured by the U. S. Commerce Department's quarterly survey of expenditures for improvements and repairs for owner-occupied properties, three factors prompted the Joint Center to reevaluate how it is computed. First, changes in the macroeconomy in recent years have changed the relationships between historic drivers of home improvement activity and actual spending on these projects. Secondly, there have been benchmark revisions in the components used to compute the RAI, as well as in the estimates of homeowner spending for

improvements and repairs that affect the performance of the RAI as originally designed. Finally, there are newly developed data sources to estimate home improvement activity.

Changes in Economy

While the two-decade relationship has been strong, the correlation between the RAI and the C-50 spending data has diminished in recent years, particularly during the 2001 and 2002 economic recession and period of slow recovery. As can be observed in Figure 1, the gap between the estimated value and the actual value once released increased over this period. The strength of the relationship has diminished for all of the componentsand the timing of the lead and lag relationships between the components and the C-50 data has changed for most of the components, in some cases significantly.

Abnormally low mortgage rates on fixed rate mortgages in recent years encouraged many homeowners to refinance their mortgages. Many of these homeowners took advantage of these low rates to pull equity out of their homes and finance this debt with the low fixed-rate mortgages. Studies by the Federal Reserve Board found that a significant share of the cash-out refinancing was used for home improvements.[2] The net effect was that homeowners were often reacting to different factors in considering their home improvement strategies. Figure 2 shows the recently diverging relationship of the inverse of the prime rate and homeowner spending on home improvements and repairs as measured by the C-50 figures. While the two series generally moved together during the latter part of the 1990s, beginning around 2001 they began to diverge. Since historic relationships between such things as the prime bank rate with home improvement spending by homeowners were changing over this period, components that exhibited more stable long-term relationships were desired.

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[2] Canner, Glen, Karen Dynan, and Wayne Passmore. Mortgage Refinancing in 2001 and Early 2002. Federal Reserve Bulletin, December 2002.

Figure 2: Bank Prime Rate and Home Improvement and Repair Spending by Homeowners
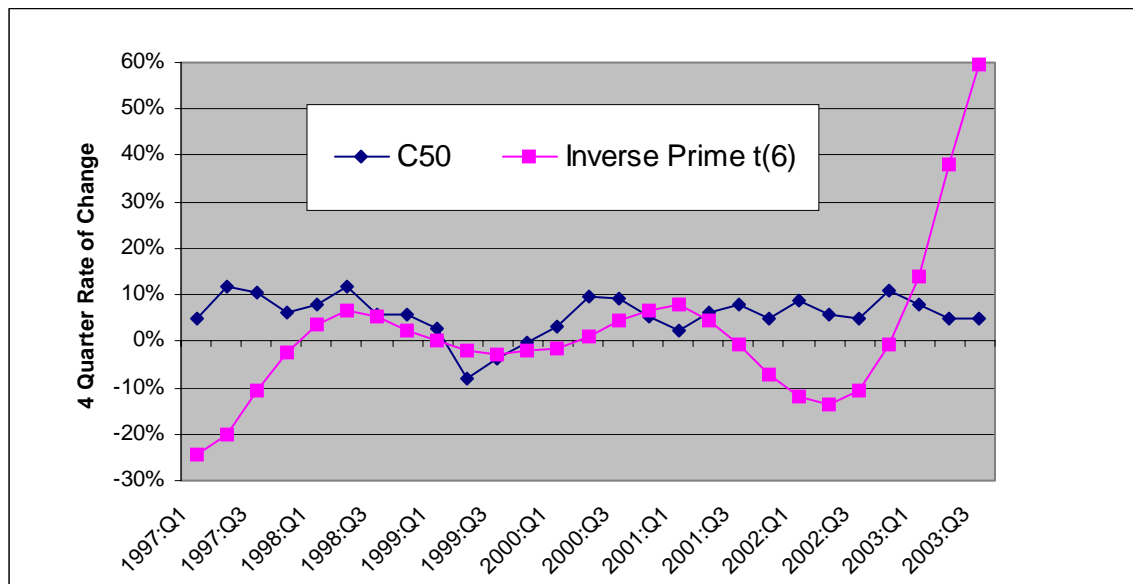
Source: Federal Reserve Board and Joint Center for Housing Studies

Benchmark Revisions

Furthermore, the C-50 data has been rebenchmarked two times by the U.S. Commerce Department since the RAI was originally released, thereby changing the relationship with key components of the RAI. Additionally, some of components have been significantly transformed. The move from the old Standard Industrial Coding (SIC) to the new North American Industrial Coding System (NAICS) has significantly affected the reported level of retail sales at building materials and supply dealers. The new NAICS system partially bridges to the discontinued SIC series, but the new NAICS series only includes retail sales data back to January 1992.

New Components of the RAI

In addition to some components of the RAI exhibiting a different relationship to remodeling spending in recent years as compared to previous periods, several data sources have been introduced since the RAI was initially developed that merit consideration for inclusion in the index. The 2002 revisions to the North American Industrial Classification System redefines some industries. One change implemented by this industrial classification system was the separation of remodeling general contractors from those primarily engaged in new construction activities. With the identification of this classification of construction comes related information on weekly hours worked and weekly compensation for employees of these firms. Analysis of this

new data source indicated that homeowner's expenditures on home improvements and repairs correlate positively with average hours worked weekly by employees of remodeling general contractors.

Estimations of spending for residential improvements are included in the Commerce Department's series for residential value put-in-place. Due to reporting delays, the Department of Commerce estimates the value put-in-place for residential improvements and repairs by combining incomplete actual survey data with estimations for future periods. For the estimates, the Commerce Department uses a complex autoregressive model[3]. This data series, not surprisingly, is also a good indicator for the estimation of the homeowner remodeling activity. The improvements series, lagged from the previous quarter, also show a strong correlation with the reference data.

Manufacturers activity related to building products was measured for the original RAI using shipments of clay floor and wall tile products. This series, however, limits the scope for remodeling spending to a focused set of products. Eventual changes in demand for tile products may have a dramatic effect on the RAI estimations but may not reflect overall trends in the remodeling market. Shipments of a more inclusive set of remodeling related products was assembled from the Department of Commerce's survey of Manufacturer's Shipment, Inventory and Orders (M3). Shipments of building materials, electrical appliances, and wood products show lower correlations with the C-50 than some of the other components used to compute the RAI. However, this product aggregation provides a robust proxy for production of remodeling materials, reducing fluctuations in the indicator.

Numerous other data series were tested for inclusion in the RAI in an effort to find those series that provided a higher correlation to the RAI both historically as well as during recent quarters. Since the launch of the Remodeling Activity Indicator in 1998, several new data sources related to the home improvements and repairs market activity have become available. Capturing remodeling contractors' perceptions on the remodeling market, quarterly indexes such as the Remodeling Market Index (RMI) by the National Association of Home Builders track industry trends. Other quarterly series, like the Homeowner Remodeling Behavior Index by the Home Improvement Research Institute (HIRI), estimate current consumer attitudes and future

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[3] The data for this series comes from the same survey CES than the C-50 and is generated through a sophisticated prediction model ARIMA X-12

expectations towards remodeling. Also, the U.S. Commerce Department resumed the monthly collection of permits for residential improvements beginning in January 2002. This data collection effort had been suspended in 1995 due to budgetary constraints. Despite the ultimate potential of these data sources in tracking remodeling spending, these indicators have insufficient historical data[4] to fully assess their correlation with the C-50 data on homeowner spending on improvements and repairs.

Using the same computation methodology of the original RAI, these alternative data series have been compared with the home improvements and repairs spending data. Out of almost a dozen data series that were tested, two show a strong relationship with the reference data: average weekly hours for residential remodelers, and residential improvements [Table 1]. Several proxies for shipments of construction materials were tested. The combination of product shipments selected captured the best linear relation with the C-50 series.

Table 1: Correlation Coefficients for Data Series Used in the Revised Data

Number of Quarters Lead Over C-50	Sales at Building Supply stores	Shipments Building Materials	Estimated Residential Improvements	Hours Worked by Remodeling Contractors	Sales of Existing Homes
t (3)	-0.2580	-0.3134	0.2462	0.2682	0.1842
t (2)	-0.0631	-0.1088	0.4692	0.5254	0.1945
t (1)	0.1104	0.0424	0.6246	0.5945	0.0685
t (0) (No Lead/Lag)	0.1732	0.1187	0.5464	0.3917	-0.0522
t (-1)	0.0901	0.0868	0.2000	0.1921	-0.1340
No. Obs	32	32	30	32	32

From 1995:Q1 to 2002:Q4 (Residential Improvements from 1995:Q3 to 2002:Q4)

Constructing the Remodeling Activity Indicator

The resulting indicator includes one revised component (manufacturers shipments of building materials), two new components (trended spending on residential improvements, and weekly hours worked by employees at remodeling general contracting firms), and retains two

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[4] The Remodeling Market Index was launched in 2001, while HIRI's behavior index was first released in 2002.

series from the original indicator (existing home sales, and retail sales at building materials and supply stores).

Additionally, the method for weighting the indicator components has been revised to include their correlation with remodeling expenditures, while continuing to control for the volatility in the components. The components with a stronger correlation with remodeling expenditures therefore have a higher weight in the RAI estimations. With the original RAI, the four components showed approximately equal correlation to the C-50 data. The five components of the revised indicator show a broader range of correlation with the C-50 series [Table 2].

Table 2: Selected Statistics for the New RAI Components

	Retail sales at building materials and supply stores	Shipments of building materials	Estimated residential improvements	Hours worked by remodeling contractors	Existing homes sales	C-50
Lag	t (0)	t (0)	t (1)	t (1)	t (2)	
Number of Observations	32	32	32	32	32	32
Average Value – annual rate of change	6.42%	2.25%	5.33%	0.04%	4.37%	3.78%
Standard Deviation	0.0239	0.0387	0.0957	0.0067	0.0518	0.0589
1/STD	41.92	25.83	10.45	148.42	19.31	
Share of sum of 1/STD	17.0%	10.5%	4.3%	60.4%	7.9%	
Correlation w/ C-50	0.1732	0.1187	0.6246	0.5945	0.1945	1.0000
Share of sum of correlation coefficients	10.2%	7.0%	36.6%	34.9%	11.4%	
Avg: share of sum of correl & 1/STD	13.6%	8.7%	20.4%	47.6%	9.6%	
Correlation w/ RAI	0.654	0.579	0.921	0.579	0.4393	0.6143

Statistics for period 1995:Q1 to 2002:Q4

The weight for each indicator is calculated using both the correlation and the inverse of its variation for each component. Each component is weighted by the inverse of its standard deviation, and by its correlation with the reference series. The weight can be expressed in terms of:

$$[2.0] \quad \frac{\sum w_i \, n_i}{\sum_{i=1}^{n} w_i}$$

where w_i refers to the average of the inverse of the standard deviation (1/STD) and the share of the correlation coefficients for each element (n_i). The function for the indicator can be summarized in the formula:

$$[2.1] \quad (RAI_{t0}) = \frac{R_{t0}W_{t0R} + S_{t0}W_{t0S} + I_{t1}W_{t1I} + H_{t1}W_{t1H} + E_{t2}W_{t2E}}{\sum W_{RSIHE}}$$

where R = retail sales at building material and supply stores; S = shipments of building materials; I = estimated residential improvements; H = weekly hours worked by remodeling contractors; E = existing home sales; and W = weight

Performance of The Revised Remodeling Activity Indicator

The revised RAI shows a much stronger relationship with historical homeowner improvement spending. The rate-of-change of the revised RAI lies closer than the original RAI to the reference series (Fig. 2). The correlation of the revised RAI with the C-50 (0.614) suggests that these five elements can explain almost 38% of the variation in the reference series (r^2=0.377).

More importantly, the revised RAI follows the cyclical pattern of the C-50 series better than the original indicator, capturing major turning points in the market. For example the sharp increases in the rate of change in 1997 and 2000 are reflected better by the revised RAI than by the original version.

Figure 2: Annual Rates of Change for Revised RAI, Original RAI, and C-50
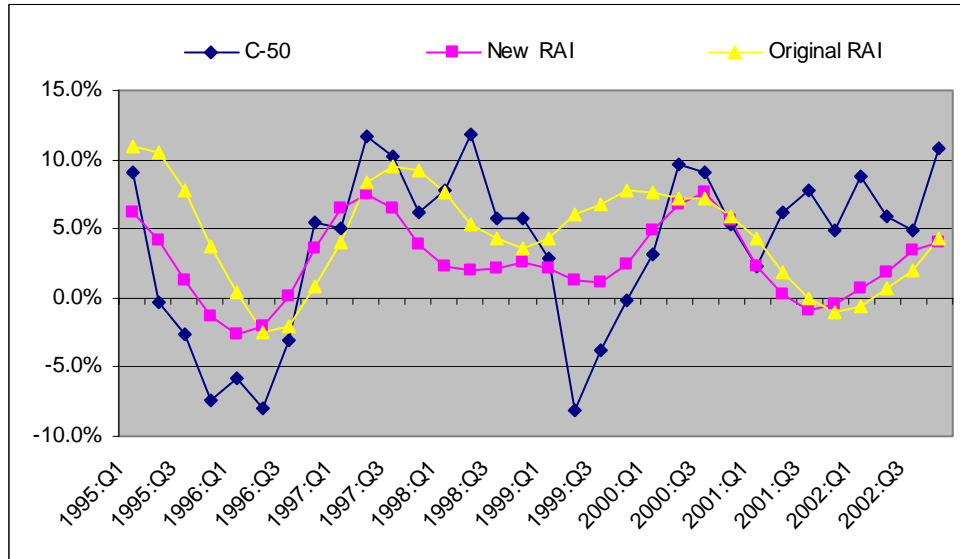
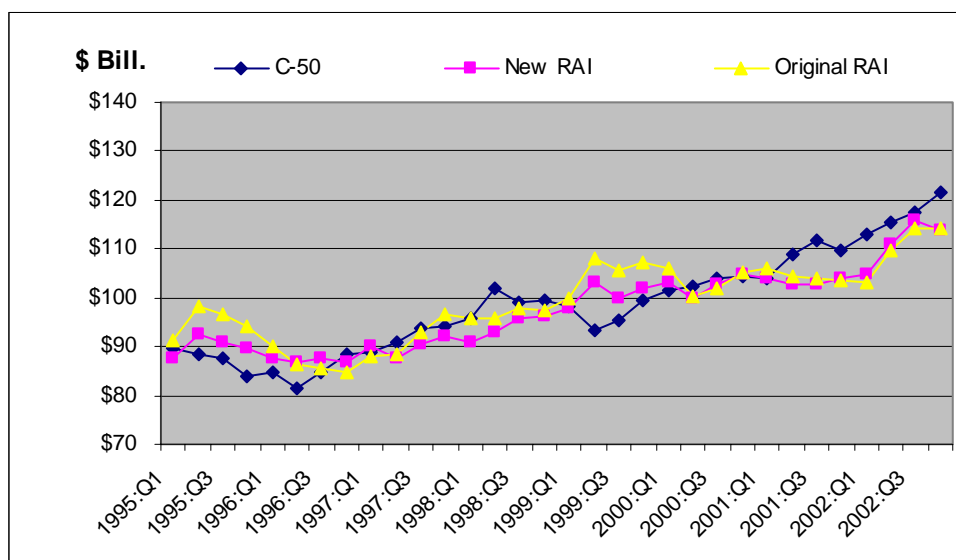Source: Dept. of Commerce and Joint Center for Housing Studies.

The average estimation of expenditures for the revised RAI deviates only –0.9% from the C-50 data [Table 3]. The new components explain more of the variation in homeowner remodeling activity, thereby producing an indicator that more closely approximates the actual observations (Fig 3).

Table 3: Revised and Original RAI Comparison
with the C-50 Remodeling Spending Data

	Revised RAI	Original RAI
Average	-0.90%	1.04%
Correlation	0.61	0.24
Min. growth rate	-8.71%	-8.63%
Max. growth rate	10.35%	15.52%
No. Observations	32	32

Source: JCHS and Dept of Commerce for period 1995:Q1-2002:Q4

Figure 3: Volume of Homeowner Expenditures C-50 vs. New & Original RAI

Source: U.S. Commerce Department and Joint Center for Housing Studies

Conclusions

Since the Joint Center for Housing Studies first released the Remodeling Activity Indicator in 1998, several changes have occurred that have encouraged a revision in the computation methodology. First, changes in the macroeconomy, most noticeably the lowest long-term interest rates in several decades, have altered financing decisions of homeowner improvement projects for many homeowners. This reduces the importance of the prime rate as an influence on remodeling spending.

Secondly, the purpose of the RAI is to estimate the C-50 data before they are released. However, the C-50 data has gone through two major rebenchmarking revisions since the RAI was first introduced. Components that accurately predicted the C-50 prior to the rebenchmarking may not work as well afterwards.

Finally, key data sources, such as employment-related information on remodeling contractors, were not available when the original RAI was developed. Also, several other data sources are currently available that may ultimately be helpful in estimating homeowner remodeling expenditures once a sufficiently long data series has been established.

The RAI revisions included dropping one of the original components (prime rate), broadening another (clay floor and wall tile shipments were expanded to include a fuller set of building products used in the home improvement process), adding two components (weekly

hours worked by employees at remodeling general contracting firms, and a trended estimate of home improvement and repairs expenditures computed internally by the U.S. Commerce Department). Two of the components—sales of existing homes, and retail sales at building material and supply stores—remain from the original indicator.

The result of the revisions to the RAI produce an indicator that correlates better with historical C-50 data: the correlation coefficient increases from 0.24 to 0.61 over the 1995 to 2002 period. More importantly, with the improved correlation comes an indicator that more closely anticipates the pattern of the business cycle of the C-50 data, so upcoming turning points in improvement spending by homeowners are better predicted by the revised indicator.