

# **Joint Center for Housing Studies**

## **Harvard University**

### **Development of an Indicator for the Homeowner Improvement and Repairs Market**

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**W98-6**

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## **Abstract**

Although conservatively estimated at \$90 billion a year, data on spending by U.S. homeowners on improvements and repairs to their homes are not reported on a timely basis, and quarterly estimates provided by the U.S. Department of Commerce typically are very volatile. An indicator of remodeling activity by homeowners that remedies these problems is presented in this paper. It uses readily available government data that have a high correlation with homeowner remodeling activity, that are released on a timely basis, and that provide a stable estimate of spending in this industry. The Remodeling Activity Indicator (RAI) is shown to estimate annual spending levels within 5% of accuracy over 75% of the time, and to accurately measure turning points within the industry. The principal applications of this indicator are to help companies in this industry to monitor market trends on timely basis, and to track changes in market share of their products.

# Development of an Indicator for the Homeowner Improvement and Repairs Market

by

Kermit Baker, J. Michael Collins and Andrea Hopf

## I. Introduction and Overview

The U.S. Commerce Department estimates that homeowners spend about \$90 billion annually to improve and repair their homes. Despite the importance of this industry, however, the Commerce Department's quarterly survey *Expenditures for Residential Improvements and Repairs*, commonly referred to as the C-50 report, generally are released several quarters after the reference period and are unusually volatile. The sample size on which these estimates are based—about 5,000 households—often is insufficient to achieve stable quarterly estimates since substantial portions of industry expenditures are comprised of large and relatively infrequent expenditures by homeowners.

Problems with the timeliness of the survey results, and the amount of random variation in the quarterly estimates, therefore, often obscures the underlying trend in improvements and repairs activity limiting the usefulness of the C-50 estimates for business planning. Therefore, there is a need for a stable and timely estimate of activity levels in this market.

This working paper presents an economic indicator that estimates activity levels for home improvements and repairs made by homeowners that meets the need for a timely and stable estimate of remodeling activity. The indicator closely tracks the four-quarter moving average of the Commerce Department's estimates, and correctly measured the turning points in remodeling activity over the past 12 years, while reducing excess cyclical volatility in the underlying Commerce Department C-50 series.

## II. Developing an Indicator

Ideally, an economic indicator should have the following characteristics:

- ◆ Timely - The data can be made available easily and quickly.
- ◆ Stable - Fluctuation in the indicator is produced by real changes in activity levels rather than random measurement variation.
- ◆ Accurate - The indicator consistently links one activity to another.
- ◆ Leading - Movements in the indicator and its components precede the reference activity with a predictable relationship.

### *Identification of candidates for inclusion*

Within the residential improvements and repairs industry, there are data sources for three major influences on trends within the home improvements and repairs market:

- ◆ Manufacturers of lumber, building materials, and home improvement products. Potential information includes production levels, inventories, new orders, and backlogs of unfilled orders.
- ◆ Distributors of building materials and home improvement products, both contractor-oriented and consumer-oriented outlets. Potential information includes sales, turns, and inventory levels.
- ◆ Household demand for home improvements and repairs. Potential information includes remodeling plans, level of perceived economic security, and other economic factors that might influence a homeowner's willingness to undertake a home improvement.

Ideally, a residential improvements and repairs indicator will reflect the information from all of these sources. The following data series were evaluated for potential inclusion in the indicator (data sources in parentheses):

#### (1) Production of construction products

- shipments of clay floor and wall tile products (U.S. Dept. Of Commerce, SIC 5253)
- shipments of plumbing fixtures (U.S. Dept. Of Commerce, SIC 3261)
- shipments of flat glass (U.S. Dept. Of Commerce, SIC 321)
- shipments of other lumber products (U.S. Dept. Of Commerce, SIC 249)

(2) Distribution of construction products

- wholesale sales of lumber products (U.S. Dept. Of Commerce, SIC 5031)
- wholesale sales of hardware, plumbing, and heating equipment supplies (U.S. Dept. of Commerce, SIC 507)
- wholesale sales of electrical goods (U.S. Dept. Of Commerce, SIC 521,3)
- retail sales at hardware stores (U.S. Dept. Of Commerce, SIC 525)

(3) Household behavior, attitudes and related economic indicators

- consumer sentiment (University of Michigan index)
- existing one-family home sales (National Assoc. Of Realtors)
- construction of private one-unit homes (U.S. Dept. Of Commerce)
- interest rate for conventional 30-year mortgages (Federal Reserve Board)
- secondary market rate for 90 day treasury bills (Federal Reserve Board)

*Selection of data sources*

The candidate data series were individually correlated with quarterly data of home owner spending for home improvements (the C-50 data). The correlations were estimated over the period of 1984 through 1997 to measure the relationship through several business cycles. The government's data collection procedures for homeowner improvements and repairs were substantially revised in 1984, creating a break in the data series and making analysis of pre-1984 data problematic. The correlations were calculated across a range of lead and lag relationships to determine which of the timing relationships provided the best fit with the C-50 home improvement data.

Components were selected for inclusion based on the magnitude of their correlation with the C-50 data, and the amount of variation in the C-50 data explained once combined with other components. Four components were selected for inclusion using these criteria. Other components with high correlations with the C-50 data were eliminated because they

added little to the overall explanatory power of the indicator.\*

Exhibit 1 provides a summary of the four components that were selected for inclusion in the indicator. A correlation coefficient equals 1.0 when two series move together perfectly. A correlation of 0.0 indicates that there is no linear relationship between the two series.

The row heading represents the number of quarters that each component “leads” homeowner improvements and repairs. The entry in each column presents the simple correlation between that component and homeowner improvements and repairs with the corresponding lead. The quarterly lead relationship that produces the highest correlation for that series is shaded. Correlations were computed to the point where the relationship was clearly diminishing.

### **Exhibit 1**

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\* A related estimation procedure was used as an alternative method to identify components for inclusion in the indicator and to determine appropriate weights. The components with high correlations with the C-50 data were used to estimate an ordinary least squares (OLS) multivariate model, using the Cochrane-Orcut auto-correlation procedure due to the high degree of serial correlation in the data series. While this procedure generated evidence as to which components should be included in the RAI model, and produced overall explanatory results very similar to those described in this paper, it generated substantially different weights, including some negative weights due to multi-collinearity. Since the OLS estimated coefficients (weights) were

*Correlation Matrix: Homeowner Improvements and Industry Indicators*

**Components Selected for Remodeling Activity Indicator**

Number of Quarters Lead Over C-50	Inverse Real Prime	Tile Shipments	Retail Sales	Existing Homes
7	0.5827	-0.0931	-0.0515	0.1058
6	0.6855	-0.0496	0.0983	0.3879
5	0.6442	0.0777	0.2318	0.5993
4	0.5320	0.2294	0.3704	0.6902
3	0.3597	0.3948	0.5145	0.6595
2	0.1824	0.5283	0.6023	0.5335
1	0.0784	0.5638	0.6647	0.4477
0 (no lead / lag)	0.0146	0.5109	0.6609	0.3902
+ 1	-0.0113	0.3812	0.5581	0.2979
+ 2	-0.0127	0.2517	0.4478	0.2448

*Joint Center for Housing Studies; 1st Quarter 1984 to 3rd Quarter 1998*

A summary of the components used to create the indicator, the frequency of release of the components, and other relevant information are provided in Exhibit 2.

**Exhibit 2**

Components of Remodeling Activity Indicator (RAI)									
	Name of Data Series	Data Sources	Release Frequency	Release Dates	SIC Codes	NAICS Codes	Leads Remodeling Data (in quarters)	Notes	Web Address
	Expenditures for Residential Improvements and Repairs (C50)	Dept. of Commerce/ CES	Quarterly	6 months after reporting period	N.A.	N.A.			<a href="http://www.census.gov/pub/const/c50">http://www.census.gov/pub/const/c50</a>
1	The Inverse of the Bank Prime Loan Rate	Federal Reserve Board	Daily	Immediately after reporting period	N.A.	N.A.	6		<a href="http://www.bog.frb.fed.us/Releases/H15/update/">http://www.bog.frb.fed.us/Releases/H15/update/</a>
2	Retail Sales at Building Material and Supply Stores	Dept. of Commerce	Monthly	6 weeks after reporting period	5211	44411 (home centers) 44419 (other building material suppliers)	1	Sum of quarterly unadjusted	<a href="http://www.census.gov/svsd/retlmon/download/">http://www.census.gov/svsd/retlmon/download/</a>
3	Manufacturers Shipments of Floor and Wall Tile Products	Dept. of Commerce	Quarterly	6 weeks after reporting period	3253	327122 (ceramic wall and floor tile)	1	Current Industrial Report; quarterly report on clay construction products; MQ23D	<a href="http://www.census.gov/ftp/pub/industry/mq32dYQ.txt">http://www.census.gov/ftp/pub/industry/mq32dYQ.txt</a> (YY=Year, Q=Qtr)
4	Existing One-Family Home Sales	National Assoc. of Realtors	Monthly	3 weeks after reporting period	N.A.	N.A.	4	Average SAAR for Quarter	<a href="http://nar.realtor.com/databank/ehssqv.htm">http://nar.realtor.com/databank/ehssqv.htm</a>

highly dependent on the other variables used in the model, and not as easily updated as other procedures, this approach was not used in the final development of the indicator.

### *Constructing the Indicator*

An indicator of economic activity often is measured in units that are not directly comparable with another indicator. Those that are used to compare activity across different products or markets are typically presented as change in activity levels over time. The indicator presented here, the Remodeling Activity Indicator (RAI), is computed as a weighted composite of ratios computed from each of the four components. Each ratio is equal to the current four-quarter moving total of activity levels for that component, divided by the same four-quarter moving total of a year ago. This calculation creates an annual moving rate-of-change for the indicator.

The four data components that comprise the RAI were weighted relative to the variation of each element. The weights are the inverse of the standard deviation of each component so that large swings in the rate-of-change in one data series would not swamp more modest swings in another. The final construction of the RAI follows the formula:

$$\frac{\sum w_i x_i}{\sum_{i=1}^n w_i}$$

where  $w_i$  refers to the inverse of the standard deviation of each data element, and  $x_i$  refers to the data element. The procedure used to weight the components is similar to the procedure developed by the U.S. Commerce Department in computing the indexes of leading, coincident, and lagging indicators.

Exhibit 3 summarizes the information used to calculate the weights used in the RAI.

### Exhibit 3

#### *Summary Characteristics of Included Components*

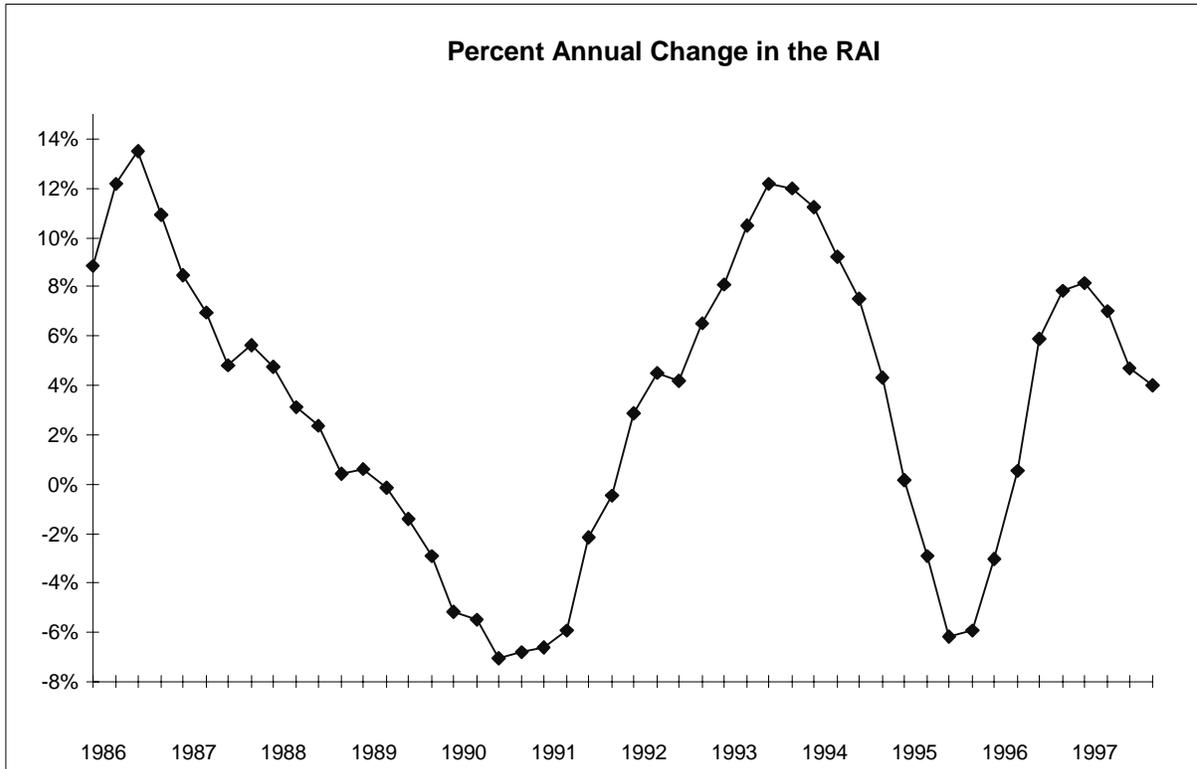
	Inverse Real Prime	Tile Shipments	Retail Sales	Existing Homes	C50
Standard Deviation	0.19	0.08	0.05	0.11	0.09
<b>Weight (1/STD)</b>	<b>5.29</b>	<b>12.33</b>	<b>19.58</b>	<b>9.12</b>	<b>11.13</b>
No. Observations	68	62	62	62	62
Average Value	1.04	1.03	1.05	1.04	1.03
Median Value	1.04	1.01	1.05	1.05	1.03
Minimum Value	0.73	0.89	0.92	0.72	0.90
Maximum Value	1.43	1.18	1.14	1.35	1.32
Correlation w/ C50 ( r )	0.65	0.49	0.65	0.66	1.00
Correlation w/ Indicator ( r )	0.70	0.82	0.85	0.88	0.75
<i>RAI 1st Quarter 1984 to 3rd Quarter 1998 Joint Center for Housing Studies</i>					

Since weights are computed as the inverse of the standard deviation for that component of the index, larger weights are associated with components that generally exhibit less variation, and smaller weights with those that exhibit more variation. This helps ensure that the indicator is not dominated by a single component with large fluctuations in values.

Exhibit 4 presents a plot of the RAI when computed on an annual rate-of-change basis. Since the indicator is plotted on a rate-of-change basis, it conveys the business cycle for homeowner remodeling activity.

## Exhibit 4

### *Cyclical Pattern of the Remodeling Activity Indicator*



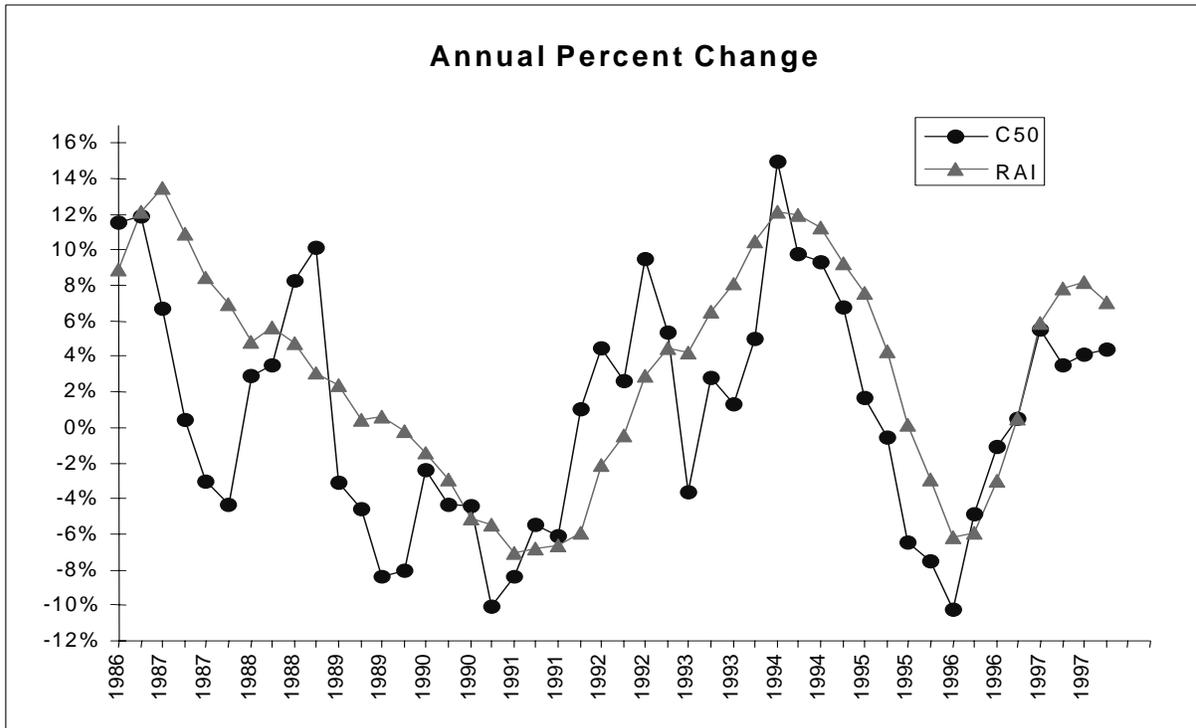
*Source: U.S. Department of Commerce and Remodeling Futures Program*

### *Performance of the Remodeling Activity Indicator*

Exhibit 5 overlays the RAI on a comparable plot of spending for homeowner improvements as measured by the C-50 series. As hoped, the cyclical pattern of the RAI and the cyclical pattern of spending for homeowner improvements match up well. As was shown in Exhibit 3, each of the elements that comprises the RAI has a simple correlation with the C-50 data of 0.49 or greater. The RAI explains 57% of the variation exhibited in the C-50 data over this period ( $r^2 = 0.57$ ). Also as hoped, the RAI exhibits a much more stable cyclical pattern than does homeowner spending for improvements as measured by the C-50 data.

## Exhibit 5

### *RAI Smoothes Remodeling Cycles*



*Source: U.S. Department of Commerce and Remodeling Futures Program*

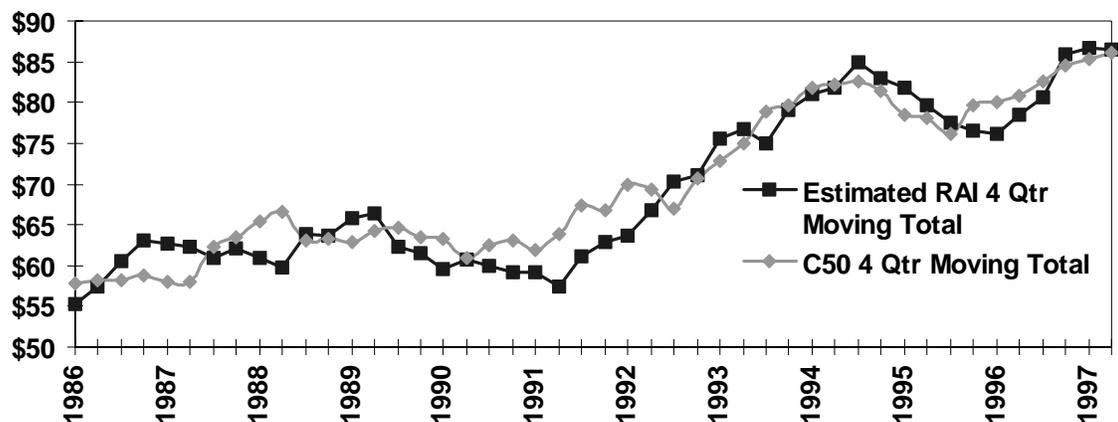
### **Estimating Activity Levels with the RAI**

The RAI in its general form estimates the annual rate-of-change within the homeowner improvements and repairs market. However, levels of spending can be estimated by benchmarking the RAI to the U.S. Commerce Department measurements of spending by homeowners on residential improvements and repairs as reported in the C-50 reports. Exhibit 6 compares the annual moving totals in homeowner spending with the RAI estimates. The RAI tracks very closely with the C-50 data, particularly for periods since 1993.

## Exhibit 6

### *Remodeling Activity Indicator Tracks C-50 Data*

Billions of dollars



*Source: U.S. Department of Commerce and Remodeling Futures Program*

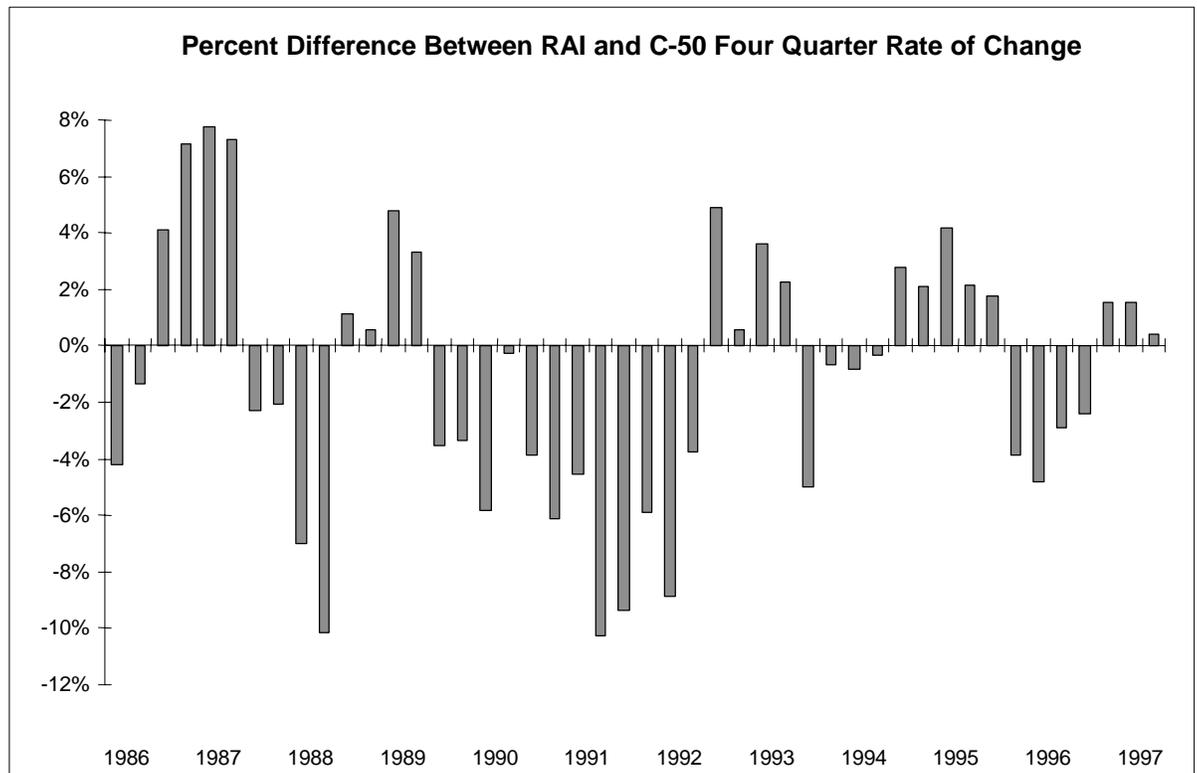
Exhibit 7 compares the RAI estimates and the C-50 survey results historically to evaluate whether there is any systemic error in the RAI estimates across the business cycle. The RAI consistently estimated spending levels below the C-50 survey between mid-1989 and mid-1992, a period when the industry was in recession. During the recent industry downturn in 1995 and 1996, however, the RAI estimated spending levels more consistent with the C-50 survey.

Overall, however, the assessment of market activity levels as estimated quarterly by the RAI was within 5% of the reported C-50 annual spending levels over 75% of the time between 1984 and 1997, and within 10% over 95% of the time. Therefore, the RAI is generally an accurate estimate of the C-50 data when it eventually is released, and shows no obvious distortion through the business cycle. Additionally, given measurement errors

associated with the C-50 data, this series may actually overestimate or underestimate remodeling activity during any period.

### Exhibit 7

#### *Difference Between RAI and C-50*



Source: U.S. Department of Commerce and Remodeling Futures Program

An additional issue relative to the performance of the RAI is how well it anticipates turning points in the remodeling cycle. The most critical points are high and low turning points; points where the momentum of activity shifts from acceleration to deceleration. As seen in Exhibit 8, there were three turning points between 1986 and 1997. In each case, the estimated turning point in the RAI was close to the turning point as eventually measured by the C-50. The C-50 turning points have been consistently more volatile (as measured by the

percentage growth at cyclical high points, and by percentage declines at cyclical low points) than those of the RAI, but the relative volatility between the two series generally has been constant.

### Exhibit 8

Remodeling Indicator Cycles Match Remodeling Spending Cycles				
1986-1997	Quarter		Estimated Change in Remodeling for Period	
	C-50	RAI	C-50	RAI
Low	1991:Q1	1991:Q2	-10%	-8%
High	1994:Q2	1994:Q2	15%	12%
Low	1996:Q2	1996:Q3	-10%	-7%

### III. Applying the RAI

The principal application of the RAI is to provide a timely reading of the level of remodeling activity and market momentum. One benefit of this indicator is that it can be used as a yardstick to compare company sales performance of remodeling products or services with industry performance. The first step for a company is to prepare its internal information so that it is directly comparable to the RAI.

Exhibit 9 is a sample worksheet for compiling company information and computing it in a rate-of-change format. After collecting the quarterly (or monthly) data, a four quarter moving total is calculated. These annual totals are then computed as ratios of the same four quarter period from a year ago. These moving rate-of-change figures are then plotted against the RAI.

## Exhibit 9

### *Preparation of Company Data*

	Quarterly Values	Annual Values	Rate-of-Change	Change from Year-Ago
1994:1	150			
2	155			
3	160			
4	165	630		
1995:1	170	650		
2	155	650		
3	170	660		
4	170	665	1.056	5.6%
1996:1	165	660	1.015	1.5%
2	175	680	1.046	4.6%
3	180	690	1.045	4.5%
4	175	695	1.045	4.5%
1997:1	180	710	1.076	7.6%
2	185	720	1.059	5.9%
3	190	730	1.058	5.8%
4	195	750	1.079	7.9%

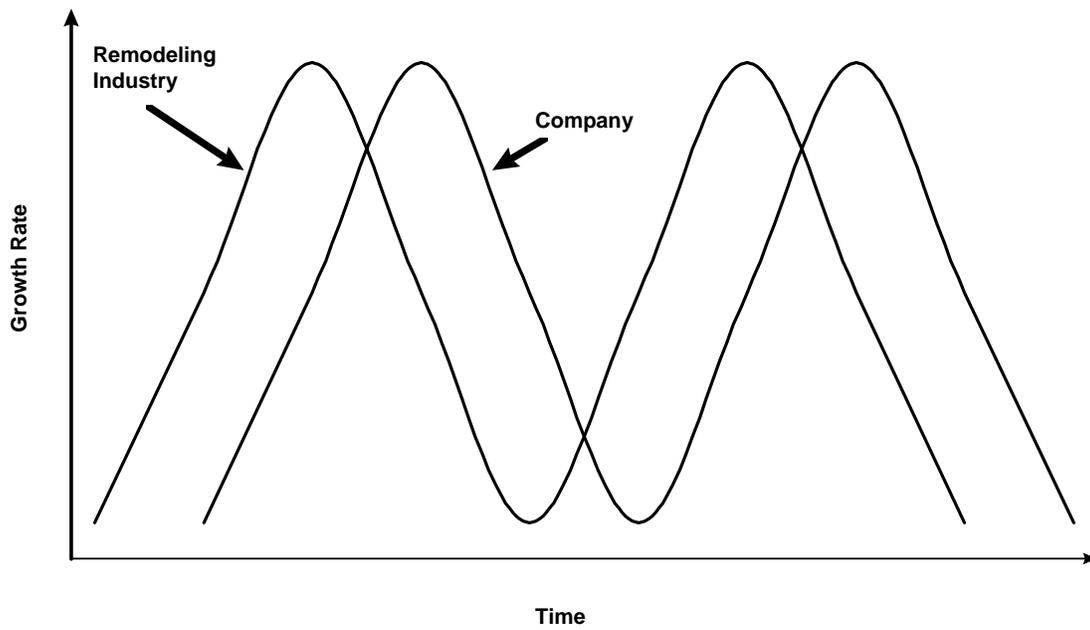
The comparison of company information with industry information allows for a more meaningful evaluation of company performance. Company sales growth of 5 percent, for example, has a very different interpretation if the industry was growing by 1 percent over that same period than if it was growing by 10 percent.

The comparison of company data with industry data also allows for a market share analysis. Periods where the company sales are increasing faster than industry sales implies an increase in market share for that company. Periods where the opposite is occurring implies a loss in market share. It may be the case that a company routinely gains or loses market share a certain stages of the business cycle, which could be important strategic information. Such a situation is illustrated in Exhibit 10.

With more timely and more stable estimates of homeowner remodeling activity, companies doing business in the remodeling industry can better identify evolving trends and thereby benefit from emerging opportunities in the market.

**Exhibit 10**

*Market Share Analysis*



**Appendix: Values for Remodeling Activity Indicator for Homeowner Remodeling**

<b>Date</b>	<b><u>Rate-Of-Change</u></b>		<b><u>Annual Level of Activity (Millions \$)</u></b>	
	<b>C50 Annual Rate of Change</b>	<b>RAI Annual Rate of Change</b>	<b>Actual C50 Annual Moving Total</b>	<b>RAI Annual Moving Total</b>
1986:Q4	11.54%	8.86%	\$57,724	\$55,314
1987:Q1	11.85%	12.17%	\$58,224	\$57,454
1987:Q2	6.66%	13.50%	\$58,140	\$60,525
1987:Q3	0.43%	10.90%	\$58,795	\$63,001
1987:Q4	-3.04%	8.49%	\$58,093	\$62,625
1988:Q1	-4.29%	6.94%	\$58,029	\$62,264
1988:Q2	2.92%	4.84%	\$62,381	\$60,953
1988:Q3	3.51%	5.61%	\$63,390	\$62,093
1988:Q4	8.24%	4.78%	\$65,447	\$60,871
1989:Q1	10.17%	3.10%	\$66,584	\$59,827
1989:Q2	-3.07%	2.38%	\$63,150	\$63,868
1989:Q3	-4.60%	0.45%	\$63,291	\$63,675
1989:Q4	-8.38%	0.61%	\$62,838	\$65,846
1990:Q1	-8.02%	-0.17%	\$64,320	\$66,470
1990:Q2	-2.44%	-1.39%	\$64,546	\$62,269
1990:Q3	-4.32%	-2.92%	\$63,555	\$61,443
1990:Q4	-4.39%	-5.15%	\$63,286	\$59,600
1991:Q1	-10.04%	-5.46%	\$60,961	\$60,808
1991:Q2	-8.41%	-7.06%	\$62,397	\$59,988
1991:Q3	-5.52%	-6.78%	\$63,094	\$59,245
1991:Q4	-6.14%	-6.61%	\$61,912	\$59,102
1992:Q1	1.03%	-5.91%	\$63,900	\$57,360
1992:Q2	4.51%	-2.17%	\$67,360	\$61,046
1992:Q3	2.67%	-0.49%	\$66,719	\$62,787
1992:Q4	9.52%	2.86%	\$69,860	\$63,684
1993:Q1	5.37%	4.52%	\$69,379	\$66,790
1993:Q2	-3.64%	4.20%	\$66,893	\$70,192
1993:Q3	2.80%	6.54%	\$70,666	\$71,082
1993:Q4	1.27%	8.08%	\$72,883	\$75,502
1994:Q1	4.97%	10.50%	\$74,948	\$76,662
1994:Q2	15.00%	12.15%	\$78,961	\$75,023
1994:Q3	9.81%	11.96%	\$79,630	\$79,116
1994:Q4	9.31%	11.25%	\$81,737	\$81,082
1995:Q1	6.75%	9.21%	\$82,132	\$81,851
1995:Q2	1.70%	7.53%	\$82,588	\$84,903
1995:Q3	-0.57%	4.33%	\$81,376	\$83,078
1995:Q4	-6.45%	0.15%	\$78,583	\$81,863

<b>Date</b>	<b><u>Rate-Of-Change</u></b>		<b><u>Annual Level of Activity (Millions \$)</u></b>	
	<b>C50 Annual Rate of Change</b>	<b>RAI Annual Rate of Change</b>	<b>Actual C50 Annual Moving Total</b>	<b>RAI Annual Moving Total</b>
1996:Q1	-7.50%	-2.88%	\$78,086	\$79,764
1996:Q2	-10.25%	-6.19%	\$76,153	\$77,476
1996:Q3	-4.87%	-5.90%	\$79,649	\$76,574
1996:Q4	-1.05%	-3.02%	\$80,070	\$76,213
1997:Q1	0.53%	0.53%	\$80,843	\$78,497
1997:Q2	5.50%	5.89%	\$82,598	\$80,641
1997:Q3	3.51%	7.82%	\$84,586	\$85,878
1997:Q4	4.16%	8.18%	\$85,306	\$86,620
1998:Q1	4.43%	7.01%	\$86,133	\$86,512
1998:Q2	n/a	4.71%	n/a	\$86,492
1998:Q3	n/a	4.03%	n/a	\$87,995