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Adjusting the Inventory Account When Companies Use LIFO: Explanation and Application to Distribution and Chemical Industries

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Abstract

It is widely understood that a disadvantage of LIFO is that it assigns the oldest inventory costs to the inventory account, which, when prices are changing, can result in an inventory value that is useless as a measure of current value. FIFO, however, avoids this disadvantage by assigning the most current costs to inventory.

The purpose of this article is to explain a simple adjustment that restates LIFO inventory to the more current cost based FIFO value and analyze effects of this adjustment. We begin by demonstrating the LIFO adjustment and explaining its effect on one company. This is followed by an analysis of the effects of the LIFO adjustment on a sample of companies from the distributing and chemicals industries.

*We found the mean increase in inventory is 22.8%, but the effect is quite variable by company ranging from a decrease of 15.9% to an increase of 81.2%. This substantial change in inventory balance produces substantial changes in measures of financial strength, operating efficiency, and Z-score. All except one of the differences in the measures due to the LIFO adjustment are significantly different using paired *t* tests.*

Introduction

For most companies that are other than financial or service companies, inventories are an important resource. Inventories represent resources that are either held for sale or will be used or consumed in the production of goods that will be held for sale. As such, inventories are closely tied to a company's revenue generating activities and resultant profitability. However, because United States accounting principles allow companies to choose how they value and report their inventory balances, the dollar amount of inventory displayed in a company's financial statement may not approximate the actual value of that inventory. Within this article, we explain two major

inventory valuation methods, and illustrate the adjustments that credit analysts should consider when evaluating the credit worthiness of an individual company.

Inventory Cost Flow Assumptions

If all inventory could be acquired at a constant price, inventory valuation and the flow of costs into and out of the inventory account would be very simple. However, because inventory is acquired at different prices at different times, management must adopt a cost flow assumption when accounting for inventories. To illustrate, assume that a company (with no beginning inventory on hand) makes three separate purchases of inventory, buying one unit each time. At the time of the first purchase the unit cost \$10, at the second purchase the unit cost \$11 and at the third purchase the unit cost \$12. After the purchases, the company has three units in inventory, represented by the three costs in the inventory account, and inventory with a total cost of \$33. When, toward the end of the period, the company sells one unit what cost should be assigned to that unit? Three answers are possible: \$10, \$11, or \$12. The cost flow assumption determines which cost is selected, thereby affecting both the inventory balance and the related expense account.

For purposes of this article, we focus on two cost flow assumptions – LIFO and FIFO. LIFO is short for last-in, first-out. Under a LIFO cost flow, the last cost that was entered into the accounting system (in our example, the \$12 cost), is the first cost out. “Out” means the cost is transferred out of the inventory account, and into the expense account called cost of goods sold. FIFO is short for first-in, first-out. This assumption requires that the first cost into the accounting system (the \$10 purchase cost), is the first cost assigned to cost of goods sold. When a company operates in an environment in which inventory prices are consistently rising (or falling), the use of FIFO or LIFO results in different asset and income balances. For example, if we evaluate the impact of adopting a FIFO or LIFO cost flow using our example inventory, and add assumptions that the company establishes its selling prices using a 100% mark up on current cost, and has operating expenses of \$9 per period, we can see that the two cost flow assumptions result in different gross profits, income, and inventory numbers.

	<u>FIFO</u>	<u>LIFO</u>
Sales revenue	\$ 24	\$ 24
Cost of goods sold	<u>10</u>	<u>12</u>
Gross profit	14	12
Operating expenses	<u>9</u>	<u>9</u>
Income from operations	5	3
Inventory	\$ 23	\$21

The above example illustrates that the use of LIFO during a period of rising prices results in lower income and lower inventory balances than when FIFO is used. This occurs because LIFO expenses the most recent cost of inventory, and retains the cost of the oldest items within the inventory account. FIFO does just the opposite. The rest of this article assumes a period of rising

prices. The results would be reversed if prices were falling; in this situation, LIFO would result in the highest income and the highest inventory.

Cost Flow Assumption Selection and Usage

The cost flow assumption is selected by company management and disclosed in the financial statement notes, usually the first footnote entitled, Significant Accounting Policies. Implications of the cost flow assumption choice are complex, and in the United States are tied to tax considerations, as companies that wish to reduce their income tax liability through a LIFO assumption must also use the assumption for financial reporting purposes.

Analysts should be mindful that management chooses the cost flow method that best suits their financial reporting objectives, and recall that the cost flow assumption used for accounting does not have to match the actual physical flow of goods. For example, a food distributor that makes sure to effectively rotate inventory, thereby achieving a FIFO physical flow, may elect to use a LIFO assumption within its accounting records and financial reports.

FIFO and LIFO are widely used in the United States. The results of a recent survey of 600 primarily large companies reported in *Accounting Trends and Techniques* reveal that over 40% of the companies reported using LIFO for some of their inventories. The use of FIFO and LIFO varies widely by industry. For example, LIFO is the primary inventory assumption in the department store, food retail, and oil and gas refining industries; is widely used in the diversified chemical, drug retail, home furnishings, industrial machinery, and packaged food industries; but is rarely used in the aerospace and defense, retail apparel, and semiconductor industries.

In practice, many companies use more than one cost-flow assumption for their inventories. They may use different methods for different types of inventory, different business segments, or foreign operations since LIFO is not allowed under International Financial Reporting Standards and rarely used outside the United States. Companies may also use other inventory cost flow assumptions, most notably weighted-average. In practice, the weighted-average method provides income and inventory numbers between the LIFO and FIFO results. For the remainder of their article, we concentrate on the LIFO and FIFO differences.

Why LIFO Inventory Should Be Adjusted

Companies choose to use the LIFO cost flow assumption for two primary reasons – it expenses the most recent costs and frequently provides a tax advantage. LIFO cost of goods sold approximates replacement costs because LIFO expenses the most recent inventory costs. Income based on replacement cost is typically a better predictor of future income than FIFO-based or weighted-average-based income. During a period of rising prices, LIFO reports the highest cost of goods sold and, therefore, the lowest incomes. When LIFO is permitted for tax calculations, LIFO minimizes the cash outflow for taxes (by minimizing taxable income).

When prices are rising, LIFO leaves the oldest and therefore lowest costs in the inventory account and assigns the higher, most recent costs to the cost of goods sold account. This is illustrated in our simple example, shown earlier. If LIFO is used over a long period of time, the costs left in the inventory account can become quite old. If a company has maintained or

increased the quantity of inventory it carries over a period of, say, fifteen years, the costs that comprise the inventory balance will be fifteen years old and fifteen years out of date. This is the disadvantage to LIFO – the oldest costs are left in the inventory account, and, as a result the inventory account balance may not approximate the current value of the resource.

The analyst should be aware of the consequences of this LIFO disadvantage. One consequence is that the inventory balance does not reflect an approximation of current inventory cost (or value), and thereby understates any measure of financial strength that incorporates inventory. Such measures include those based upon working capital or total assets. The combination of an artificially low inventory balance and a high cost of goods sold balance also results in an overstated inventory turnover ratio as compared with a similar FIFO company.

LIFO Inventories Adjustment Explained

As we have seen, LIFO inventory balances are based on older costs. In some situations the LIFO inventory balance may be virtually useless as a measure of the current value of the inventory. Because of this deficiency, whenever a company uses LIFO the credit analyst should consider adjusting the LIFO inventory balance included in the company's balance sheet. The adjustment changes the LIFO inventory value to that amount which would have been reported had the company used FIFO, providing the advantage of an inventory value based on up-to-date costs.

This important inventory adjustment is easy to do. United States generally accepted accounting principles require companies that use LIFO to disclose the LIFO reserve, defined as the difference between the LIFO inventory value that is reported and what the inventory value would have been had the company used FIFO. This disclosure is usually within the notes to the financial statements, but may be on the face of the statement.

The information included in the financial statements allows analysts to make the following adjustment to compensate for the use of the LIFO method:

$$\text{Inventory}_{\text{FIFO}} = \text{Inventory}_{\text{LIFO}} + \text{LIFO Reserve.}$$

LIFO Inventory Adjustment Applied to One Company

In this section we illustrate how the LIFO reserve adjustment is applied to one company and discuss the effects of the adjustment on common measures of short-term financial strength, operating efficiency and the likelihood of bankruptcy. National Wine & Spirits is the largest distributor of wine and spirits in the Midwest, and one of the largest in the country. Its distribution network of master warehouses, hyper-terminals, and cross docking facilities allows it to distribute over 120,000 SKUs to 36,000 retail outlets. The Company has historically satisfied its cash requirements, in part, through trade terms.⁸ National reports inventory of \$ 80,568,000 in its March 31, 2005 balance sheet. However, the following disclosure is found in its footnote 3, Inventory:

⁸SEC Form 10-K for fiscal year ended March 31, 2005.

Inventory at March 31 is comprised of the following:

	<u>2005</u>	<u>2004</u>
Inventory at FIFO	\$ 92,228,000	\$ 91,070,000
Less: LIFO reserve	<u>(11,660,000)</u>	<u>(10,874,000)</u>
	\$ 80,568,000	\$ 80,196,000

The Company utilizes the LIFO method of accounting for inventory for substantially all of its inventory.

The LIFO reserve is the amount by which the FIFO inventory value exceeds the LIFO inventory value. Readers of financial statements should expect to find a wide variety of terminology in the inventory footnote. "LIFO reserve" is frequently referred to by other terminology, including "amount to reduce inventories to LIFO value," "LIFO adjustment," or "excess of replacement costs over LIFO carrying value" among others.

National discloses the FIFO inventory value directly. Occasionally, just the LIFO reserve is disclosed, and when that is the case, the credit analyst should simply add the LIFO reserve to the LIFO inventory value to arrive at FIFO-based inventory values:

	<u>2005</u>	<u>2004</u>
Inventory, as reported, valued at LIFO	\$ 80,568,000	\$ 80,196,000
LIFO Reserve	<u>11,660,000</u>	<u>10,874,000</u>
Inventory at FIFO	\$ 92,228,000	\$ 91,070,000

National's LIFO adjustment increased reported inventory by 14.5%. This adjustment indicates that the balance sheet carrying amount understated the current cost of inventories by approximately 14.5%. This increase, and the related impact of the LIFO adjustment on other financial measures is shown below. The adjustment to inventory increases reported current assets by 9.6% and reported working capital by 22.2%. A comparable 14% increase to the inventory value of another LIFO company may result in drastically different working capital effects. When inventory is a large percentage of current assets and the amount of current liabilities is relatively small, the effect of the inventory adjustment on working capital will be substantial.

Effect of Adjustment on Measures of Financial Strength			
	<u>Inventory</u>	<u>Current Assets</u>	<u>Working Capital</u>
As Reported (LIFO)	\$ 80,568	\$ 120,834	\$ 52,638
LIFO Reserve	<u>11,660</u>	<u>11,660</u>	<u>11,660</u>
As Adjusted (FIFO)	<u>92,228</u>	<u>132,494</u>	<u>64,298</u>
Effect of Adjustment	14.5%	9.6%	22.2%

During times of rising prices, LIFO inventory exaggerates many measures of the company's operational efficiency. Adjusted ratios more clearly present a company's current efficiency levels because they incorporated the adjusted inventory value.

To illustrate, we determined the impact of the LIFO adjustment on six measures of operating performance, again using the 2005 financial information of National. As expected, the impact of

the LIFO reserve adjustment decreases National's inventory turnover by 12.1% (or just less than 10 days). The lower turnover indicates less efficiency in inventory utilization. The LIFO adjustment increases the other efficiency ratios by a similar magnitude. The increase to days of inventory held in stock, days in the operating cycle, and days in the cash cycle all provide lower, but more realistic, measures of efficiency.

Effect of Adjustment on Efficiency Ratios						
	Inventory Turnover	Days Inventory Held in Stock	Days to Collect Trade Receivables ⁹	Days in Operating Cycle	Days to Pay Payables	Days in Cash Cycle
As Reported (LIFO)	5.27	69.2	17.79	86.99	34.53	52.46
As Adjusted (FIFO)	4.63	78.9	17.79	96.69	34.53	62.16
Effect Adjustment	of -12.1%	14.0%	not applicable	11.2%	Not applicable	18.5%

The adjustment of LIFO inventories is likely to affect typical credit scoring systems, especially those that emphasize measures of financial strength or operating efficiency. We use Altman's Z-Score as an example of a credit scoring system and discuss how it is affected by the LIFO inventory adjustment. We use the Z-Score commonly used for public manufacturing companies because of its wide applicability, and its reliance on book values, rather than market values of equity securities.

Altman developed the Z-Score to discriminate between companies that are likely to enter bankruptcy in the near future from those that are not. Altman [2000] discusses an improved Z-Score model and denotes the enhanced version by Z''. The model uses four independent variables, shown below:

- X₁ = working capital / total assets,
- X₂ = retained earnings / total assets,
- X₃ = earnings before interest and tax / total assets, and
- X₄ = book value of equity / total liabilities.

The Z''-Score is calculated as: $Z'' = 6.56 X_1 + 3.26X_2 + 6.72X_3 + 1.05X_4$

A Z''-Score of 1.1 or less indicates a high probability of bankruptcy in the near future. A Z''-Score of 2.6 or above indicates that bankruptcy is not likely. The effect of the LIFO inventory adjustment on the Z''-Score and its four terms for National is shown in the table below. The X₁ and X₄ terms are affected more than the other two terms because the inventory adjustment has the largest effects on working capital and book value of equity.

⁹ The average number of days a company takes to collect its trade receivables is not affected by any change in inventory, but it is shown because it is used to compute days in operating and cash cycles. The number of days to pay payables is shown for the same reason.

Effect of Adjustment on Z''-Score					
	<u>X1</u>	<u>X2</u>	<u>X3</u>	<u>X4</u>	<u>Z''-Score</u>
As Reported (LIFO)	0.27	-0.04	0.06	0.10	2.18
As Adjusted (FIFO)	0.31	-0.04	0.06	0.17	2.51
Effect of Adjustment	14.8%	0	0	70%	15.1%

Overall, the effect of adjusting the LIFO inventory value to the more current cost-based FIFO value reveals that National Wine & Spirits has greater short-term financial strength, less operational efficiency, and less likelihood of near-term bankruptcy than it appeared with reported inventories.

LIFO Adjustment Applied to Distribution and Chemical Industries

Our detailed analysis of National Wine & Spirits determined that the use of LIFO resulted in efficiency measures that were lower than those determined using FIFO. We extended our analysis from that one company to two industries, distribution and chemicals. We examined all the companies within the Standard & Poor's Research Insight, North America database (using the October 31, 2005 CD-ROM) that are classified in the sub-industries listed in the table below. Of the 149 companies in these industries, 37 reported using LIFO, but we included only the 34 LIFO companies reporting a nonzero LIFO reserve.

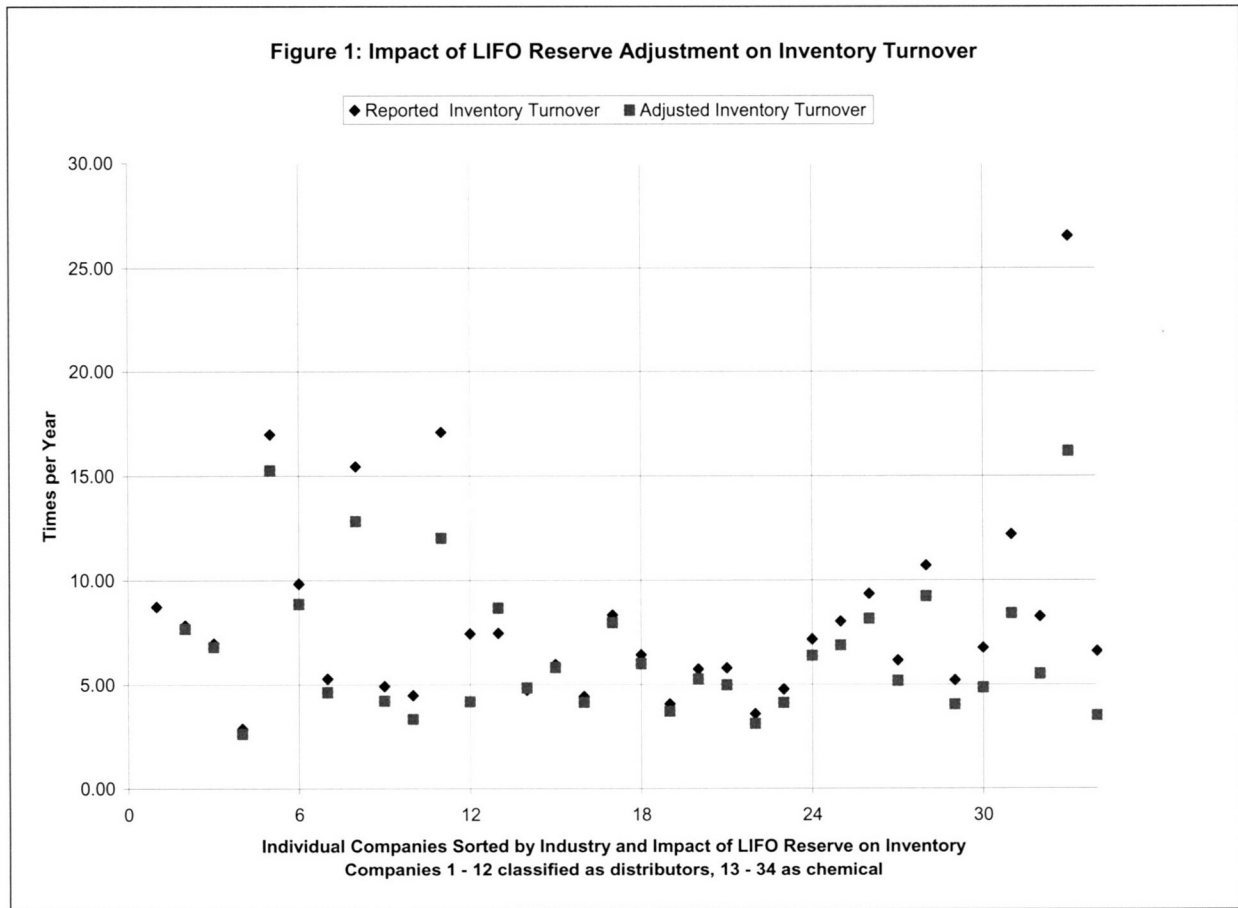
Sample Composition by GICS Sub industry			
<u>GICS Sub industry</u>	<u>Number of Companies in Sub industry</u>	<u>Number of Companies Reporting LIFO Inventory Method</u>	<u>Number of Companies Reporting a nonzero LIFO Reserve</u>
Diversified Chemicals	20	9	9
Specialty Chemicals	70	15	13
Distributors	31	8	7
Food Distributors	13	2	2
Trading Companies & Distributors	15	3	3
Totals	<u>149</u>	<u>37</u>	<u>34</u>

We chose distribution and chemical companies for our further analysis because they have very different cost structures. To assess the impact of the LIFO adjustment on these different cost structures, we used t-tests to determine if the mean change in the inventory to total assets ratios with and without the LIFO adjustment, and the change in the Z''-scores with and without the adjustment differed between the 12 distribution and 22 chemical companies in our sample. Because our sample sizes are quite small, we evaluated the results using the assumption that the variance of the means within the two industries is not equal.¹⁰ The t-test results indicate that the level of inventory to total assets, both with and without the LIFO adjustment, is significantly greater for the distributors than the chemical companies. The ratios for distributors increased from 31.1% to 35.1%, while the ratios for chemical companies were 12.1% and 14.2%. The change in the Z-score was statistically greater for distributors than it was for the chemical

¹⁰ The results of the t-tests were very similar to nonparametric tests, which would be generally considered more appropriate, but also more difficult to interpret in dollar terms.

companies. These results further indicate that the larger the inventory relative to a company's assets, the greater the impact the LIFO adjustment will have on assessments of the company's financial condition.

We next sorted the 34 LIFO companies by industry (distribution and chemical), and then by the extent of the LIFO reserve adjustment, determined as the LIFO adjustment divided by inventory. We then graphed the inventory turnover with and without the inventory adjustment for each of companies. The graph is shown in Figure 1. The graph illustrates a few things. First, companies with small LIFO adjustments will see little change in the turnover ratios, as shown in the overlapping points for the first four distributors, and then seven of the first eight of the chemical companies. The relative LIFO adjustment is largest for the companies that appear within the right side of the industry groups. The graph shows that generally as the LIFO adjustment grows, the impact on the inventory turnover grows as well. This is most clearly indicated in the company at point 33, in which the reported turnover approximates 26 times per year, but after adjustment is reduced to approximately 16 times a year.



To determine the impact of the LIFO reserve adjustment on the inventory, operating measures and Z'-scores of the 34 companies, we analyzed the company data using paired t-tests. Paired t-tests evaluate the impact of the inventory adjustment on a company-by-company basis within the entire sample, and are considered to have more statistical power than other t-tests. We evaluated the results using a level of significance of $p < .05$ and a one-tail approach, as we expect that the

LIFO reserve adjustment will increase inventory and working capital, decrease measures of operating efficiency, and increase the Z''-score.

The results of the t-tests are shown on the table below. The table sections present the mean results as adjusted for the LIFO reserve, the mean results as reported by the company, and the mean change between the two figures, followed by the statistical significance of the change, as noted by the p value. A quick review of the p values indicates that the changes for all measures other than X₂ are highly significant, generally with p values of .001 or lower. As expected, inventory as a percentage of total assets increases almost 3% with the LIFO reserve adjustment. The increased inventory values also increase the mean working capital, decrease the inventory turnover, and add approximately 10 days to the three measures of operating efficiency. The increased inventory balances also result in significant improvement in the Z''-score and three of its four Z-score components.

The impact of adjusting LIFO inventory by the amount of the LIFO reserve								
Paired Samples Statistics (n=34)	Adjusted for LIFO Reserve		As Reported		1-tailed Paired t-test results			
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	t	p
Inventory as percentage of total assets	0.216	0.123	0.188	0.113	0.028	0.027	5.925	0.000
Working capital	867.930	1661.940	771.944	1544.606	95.986	157.466	3.554	0.001
Inventory turnover	6.701	3.345	8.123	4.770	-1.422	2.020	-	0.000
Number of days sales in inventory	66.470	28.240	56.076	24.175	10.394	11.191	5.415	0.000
Number of days in the operating cycle	108.540	40.189	98.146	36.297	10.394	11.191	5.415	0.000
Number of days in the cash cycle	68.414	34.318	57.766	30.900	10.648	11.217	5.535	0.000
Z score	3.351	3.033	3.145	3.015	0.206	0.192	6.270	0.000
X ₁ = Working capital/total assets	0.225	0.166	0.198	0.161	0.027	0.025	6.253	0.000
X ₂ = Retained earnings/total assets	0.174	0.311	0.181	0.327	-0.006	0.023	-	0.056
X ₃ = Earnings before int. & taxes/total assets	0.075	0.045	0.078	0.050	-0.004	0.006	-	0.001
X ₄ = Book value of equity/total liabilities	0.768	1.284	0.695	1.216	0.072	0.103	4.088	0.000

We also computed the impact of the changes within each industry group. The mean change and t-test results are quite similar to those presented for the combined sample. As mentioned earlier, the LIFO adjustment did have a greater impact on the distributor's inventory as a percentage of sales (increasing by 4%) than it did on the chemical companies (a 2% increase), but the change in inventory turns and days in the operating measures were approximately the same. The Z''-scores for both industries improved, by .30 for distributors and .16 for chemical companies.

Credit analysts should evaluate the mean differences that result from the LIFO reserve adjustment on a relative basis, as well. In the table below, we summarize the changes in the inventory, operating and Z''-scores as a percentage of the respective measure as originally reported for the 34 companies in our sample. This table shows that the range of change, when determined as a percentage of what was originally reported, is quite wide. For example, although the average increases in inventory and working capital are 22.81% and 19.46%, respectively, the changes range from a reduction of 15.9 % to an increase of 81.2%, and 19.5% to 136.39%, respectively. The 3rd quartile measure shows that one-fourth of the LIFO companies experienced an increase in inventory of over 30%, suggesting that for many companies the change will be significant. The range of change in the operating efficiency ratios is also very wide; the percentage change in the cash cycle varies from a reduction of 72% to an increase of 87%, a total range of 159 percentage points across the 34 companies. Of the Z''-score components, the X1 and X4 terms are most affected, with one-fourth of the LIFO companies showing a change in these two terms of approximately 20%, even though the average change in the Z''-score itself, was only 4%. It is important to remember that the mean change masks the effect on individual companies. If we determine the absolute value of the percentage change in the individual company Z''-scores, the mean is 21.39%.

Change in Adjusted Measures as a Percent of the Reported Measures						
Panel A: Z''-Score and Its Components						
	<u>X1</u>	<u>X2</u>	<u>X3</u>	<u>X4</u>	<u>Z''</u>	
Mean	14.52%	-3.60%	-3.60%	10.95%	4.00%	
Minimum	-49.39%	-16.49%	-16.49%	-58.47%	-80.83%	
1 st Quartile	3.56%	-5.58%	-5.58%	2.93%	1.97%	
Median	7.94%	-2.45%	-2.45%	7.68%	4.05%	
3 rd Quartile	20.16%	-1.06%	-1.06%	19.49%	9.64%	
Maximum	113.55%	2.35%	2.35%	65.73%	39.75%	
Panel B: Measures of Financial Strength and Operating Efficiency						
	<u>Inventory</u>	<u>Inventory Turnover</u>	<u>Days Sales in Inv</u>	<u>Working Capital</u>	<u>Operating Cycle</u>	<u>Cash Cycle</u>
Mean	22.81%	-14.93%	20.93%	19.46%	12.07%	18.66%
Minimum	-15.90%	-46.97%	-13.95%	-48.43%	-8.08%	-72.46%
1 st Quartile	7.66%	-21.09%	7.67%	6.04%	4.48%	6.03%
Median	15.83%	-12.96%	14.89%	11.83%	7.27%	12.50%
3 rd Quartile	30.16%	-7.12%	26.84%	29.59%	16.16%	31.90%
Maximum	81.20%	16.21%	88.56%	136.49%	50.50%	87.19%

Conclusion

The LIFO cost flow assumption is widely used by companies for inventory accounting because of its income statement effects and tax advantages. Companies that use LIFO, however, may present an inventory value based on outdated costs. The result is that during a period of rising prices for LIFO companies, inventory and financial strength measures are understated, operating efficiency measures are overstated, and credit scores are likely understated relative to FIFO

companies. Credit analysts should consider making a simple adjustment that converts LIFO inventory values to FIFO inventory values because the FIFO approach values inventory at the most current inventory costs.

When the illustrated LIFO adjustment is applied to companies in the distribution and chemicals industries it makes a substantial and statistically significant increase to inventory value. This improvement in inventory values, in turn, produces more accurate measures of financial strength, operating efficiency, and credit scores. We found that it is important for a credit analyst to calculate the adjustment for each company because the adjustment effect is quite variable by company and does not appear to be easily predicted.

Credit managers can use their understanding of the LIFO adjustment to improve their credit granting decision process. If an in-house credit scoring model is used, the information presented in this article will allow the analyst to incorporate a simple inventory adjustment for companies that use LIFO. If a credit scoring model from a vendor is being used, analysts should determine whether it has an option that allows for a LIFO adjustment, and use the option if it is present. If such an option does not exist, the credit manager may wish to inquire about the possibility of adding it to the model.

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