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The Effect of Measurement Error on Comparisons of Alternative Theories of Corporate Investment Behavior

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The quality of the data used in tests of economic hypotheses has long been of concern to economists. When theories regarding firm behavior have been tested a commonly used data source for the measurement of economic variables has been the published financial statements of corporations. These statements, however, are the end product of the application of various accounting techniques, which may introduce errors in measuring the variables of interest to the economist. General concern about the possible impact of accounting measurement procedures on the results of empirical tests conducted by economists has been expressed by Morgenstern, Johnston, Griliches, Kuznets (1971, 1972), Hall and Weiss, and McCracken among others. This paper reports a specific attempt to assess this impact; it deals with the effect of accounting methods on attempts to rank alternative theories of corporate investment behavior by their explanatory power.

Tests of corporate investment behavior were selected for assessing the impact of accounting methods for three reasons. First, attempts to distinguish between alternative theories of corporate investment are considered important, as can be seen in Eisner, page 138, and Okun, page 19. Second, the economics literature already contains well-documented attempts--by Jorgenson and Siebert (JS) and Elliott--to rank these theories. The methodology used in these two studies could therefore be used to provide a structure for the present research. Moreover, the end result of those studies has been a ranking of investment theories and different rankings of theories on different accounting methods, if obtained, would provide a vivid illustration of the possible impact of accounting methods on empirical tests of economic theories. Third, these studies have been concerned with firm behavior and have used accounting data from financial statements of firms. JS and Elliott both compared the explanatory power of four different theories of corporate investment, the Neoclassical, Accelerator, Expected Profits and Liquidity models, with respect to time series data for a sample of firms. The Elliott study was a methodological replication of the JS study using a larger sample (184 firms versus 15 firms) and resulted in contradictory conclusions about the relative performance of investment theories. This contradiction is taken up again later in the conclusions of this paper when a possible cause for it is pointed out.

The possible impact of accounting methods on these tests of investment theories derives from the fact that the variables entering the models were measured from financial accounting data. For example, in the liquidity model, both studies measured the internal funds available for investment in a given firm by accounting net income less dividends paid plus accounting depreciation. The value of this measure will be affected by the various techniques used by accountants, such as alternative depreciation methods or inventory flow assumptions, as well as methods of accounting for subsidiaries or translation into dollars of accounts denominated in foreign currencies. A different accounting technique would produce a different value for this measure of liquidity without any corresponding change in the underlying economic variable, the funds available for investment. Thus the empirical performance of the model would be influenced by the accounting methods used by the firm to produce financial data. Similarly, the value of output in the Accelerator and Neoclassical models was measured by adding the change in inventory to sales revenue. This measure would be affected primarily by the inventory valuation assumptions which the accountant made. Likewise, the measurement of the cost of capital services in the Neoclassical model would be sensitive to the depreciation method followed by the firm. Only the Expected Profits model does not have an accounting variable entering directly into the measurement process, and changes in accounting methods would not be expected to affect the explanatory power of this model at all.

Given the above reasons for expecting accounting methods to have an impact on the performance of models through the measurement of relevant variables; it was decided to select alternative methods of depreciation accounting and inventory valuation for assessment. These two categories were selected because 1) they are the most important areas in which accounting alternatives exist; 2) both affect three of the four investment models discussed above; and 3) it is easier to derive estimates of numbers under alternative assumptions for these two methods. The two inventory valuation methods considered were first-in first-out (FIFO) and last-in first-out (LIFO). Three depreciation accounting methods were considered: straight line (SL), sum of years digits (SYD), and double declining balance (DDB). There were, therefore, six combinations of inventory and depreciation techniques to consider.

Research Procedure

The research procedure, in summary, was as follows. The exact methodology used by JS was used to fit the four models to a set of data produced under one combination of accounting methods for a sample of firms. The rankings of models by standard error was noted, because this was how JS ranked the four investment theories. The accounting method was then changed to produce a different set of data on the independent variables for the same firms. The measurement of the dependent variable, gross investment, which is not influenced by accounting methods, was left unchanged. The same models were then fitted to this set of data on the independent variables and the resulting rankings were noted. This was done for the six combinations of accounting methods with the dependent variable staying unchanged. The rankings of models for each firm were then compared across accounting methods to see whether each of the methods yielded the same rankings of models. Kendall's coefficient of concordance was used to provide a numerical measure of agreement between the rankings. If the rankings were not in complete agreement across the accounting methods, this would indicate that attempts to rank theories of corporate investment could be influenced by the accounting methods followed by the sample firms. A ranking of accounting methods across the four models was also done to test whether one combination of accounting methods would consistently provide the best fit for all models. If this did not happen, it would indicate that comparative tests of investment models could not be performed using data from any combination of accounting methods.

Before the results of the experiment are presented, certain facets of the research procedure will be explained in greater detail.

To compare alternative investment theories JS employed the flexible accelerator in which:

(1) $$K_t - K_{t-1} = (1-\lambda)\ (K_t^* - K_{t-1})$$

when K_t and K_t^* are actual and desired levels of capital in period t. Assuming replacement to be a constant proportion, δ, of actual capital enables the changes in capital to be expressed as:

(2) $$K_t - K_{t-1} = I_t - \delta K_{t-1}$$

where I_t is the level of gross investment in period t. Expressions 1 and 2 are combined to produce a flexible accelerator framework for analysis of gross investment:

(3) $$I_t = (1-\lambda)\ (K_t^* - K_{t-1}) + \delta K_{t-1}.$$

JS show that expression 3 can be generalized to:

(4) $$I_t = \sum_{i=o}^{\infty} u_i\ (K_{t-i}^* - K_{t-i-1}^*) + \delta K_{t-1}$$

where the u_i are weights which are non-negative and sum to unity. JS assume that the distributed lag influence of each K^* on I_t follows a generalized Pascal distribution, and they obtain the operational version of the model used to compare the statistical importance of alternative specifications of desired capital (K^*):

(5) $$I_t = \sum_{i=o}^{2} u_i\ (K_{t-i}^* - K_{t-i-1}^*) - \sum_{i=1}^{2} w_i\ (I_{t-i} - \delta K_{t-i-1}) + \delta K_{t-I}.$$

JS fitted this distributed lag model to time series data for a sample of firms by ordinary least squares, using four different specifications of desired capital stock. As can be seen, up to three desired capital stock changes and up to two lagged net investment terms were admitted into the specification of this distributed by model. Changes in desired capital and lagged net investment were allowed to enter the distributed lag function so long as they lowered the residual variance around the regression.

JS compared four alternative representation of K^* representing major branches of investment theory. Different investment theories have emphasized the primacy of different influences on K^*. The four that were considered were:

1) The Neoclassical formulation, in which K^* is taken as proportional to the value of output in constant dollars ($p_t\ Q_t$) deflated by the price of capital services (c_t). The value of output was measured by sales plus the change in inventory, a measure which is susceptible to both the inventory and depreciation methods used by accountants. The price of capital services, c_t, was measured as:

$$c_t = \frac{q_t}{1 - v_t} \quad (1 - v_t\ w_t) \quad \delta + r_t$$

where q_t is the investment goods price index; δ is the rate of replacement obtained in the calculation of net capital stock; r_t is the cost of capital measured as the ratio of accounting net income (adjusted for current cost depreciation) to the total market value of the firm's securities; v_t is the rate of taxation of corporate income and is measured from financial reports as the ratio of accounting income before taxes less accounting income after taxes to accounting income before taxes. The variable w_t is the ratio of depreciation taken for tax purposes to depreciation at current replacement cost. The values of all the above measures, except q_t, can be influenced by the accounting methods followed by the firm without any change in the underlying economic reality.

2) The Accelerator model, in which desired capital is taken to be proportional to output. The measurement of this variable and the influence of accounting procedures on it has already been discussed in connection with the Neoclassical formulation.

3) The Liquidity model, in which desired capital is taken to be proportional to internal funds available for investment. This was measured by accounting net income after taxes plus accounting depreciation less dividends paid, in constant dollars.

4) The Expected Profits Theory of investment behavior, in which desired capital is proportional to the market value of the firm. This was measured as the market value of stocks outstanding plus the book value of debt, all in constant dollars.

The statistical importance of each of the four different formulations of desired capital was evaluated by JS by its separate insertion into the distributed lag model given in (5). The best specification of the distributed lag model given fitted to time series data for a given firm for each specification of desired capital was found by selecting the lag structure with the minimum residual variance. Once this had been done the alternative theories of investment behavior were compared and ranked on a firm-by-firm basis by their explanatory power as measured by the size of the standard error.

As mentioned earlier, the present research used exactly the same statistical procedure to fit alternative investment models to the data and compare their performance. Care was also taken to utilize the same sources for data--such as price indexes used for deflating variables and financial data of firms--as JS used. These data sources are described in their paper and a statistical appendix to a longer version of the same paper available directly from the authors. All variables are denominated here in millions of dollars rather than in billions of dollars. Procedures with regard to measurement identical to those used by JS were also used here. What was changed were the accounting methods used to produce the numbers to which these measurement procedures were applied. For example, the liquidity variable was still measured as accounting net income after taxes plus depreciation less dividends paid. In this research the accounting methods with regard to inventory valuation and depreciation used by accountants to calculate net income and depreciation were changed. There were six combination of accounting methods being tested and they thus yielded six different measures of liquidity to be inserted into the distributed lag model above to see the effect of different accounting methods on the performance of the Liquidity model. The same was done for the measures of the independent variables in the other investment models, and thus the impact of accounting methods on the relative performance of the four models in explaining the same dependent variable could be evaluated.

In order to produce the six different sets of financial data for any firm it was necessary to use estimation procedures, because a firm using a given set of accounting methods for inventory and depreciation, such as FIFO and SL, will not reveal financial data under some other set of accounting methods, such as LIFO and SYD. It is necessary, therefore, to estimate the financial data which would be produced under inventory and depreciation methods different from those currently used by a firm. The method used to estimate FIFO inventory values for firms which use LIFO and vice versa is an adaptation of the Dollar-Value LIFO technique. The technique itself is described in Hirsch. Its use for estimation of alternative inventory values in another context can be found in Derstine and Huefner. The method used to compute depreciation expense under alternative methods was to layer the existing dollar value of gross plant by capital expenditures each year to find the various years in which the existing balance in gross plant was acquired. This method assumes that retirements of plant come from earlier purchases and the existing balance comes from the most recent purchases. A similar estimation procedure can be found in short. Alternative depreciation procedures using asset age estimates adapted from the Asset Depreciation Range System can then be applied to the acquisition layers to determine alternative depreciation expense for a given year.

These estimation methods contain a fair number of assumptions and the accuracy of the estimates produced was, therefore, assessed using data from a sample of firms. The validation procedures used is described by Nair along with a detailed description of the above estimation techniques (see Working Paper No. 157 of this series). It was found that the average error in percentage terms (ie., 100 X $\frac{\text{Estimated less Actual}}{\text{Actual}}$) for the FIFO to LIFO restatement technique for 20 observations was 1.34 percent. For the LIFO to FIFO restatement the average percentage error over 7 comparisons was -4.5 percent, whereas the average percentage error produced by the depreciation estimation technique across 26 comparisons was 1.46 percent. To ensure that the final conclusions of the study would be robust it was decided not to rely completely on the accuracy of the estimation procedure but to perform the entire model fitting and ranking process three times: once with the estimates and then with the estimates plus 10 percent as well as minus 10 percent. This step, although adding considerably to the computational effort involved, should serve as an adequate test of the sensitivity of the conclusions drawn to any errors in the estimation process.

Finding the best-distributed lag structure for one investment model according to the criterion of minimum residual variance for each firm under just one of the three sets of estimates for one of the six combinations of accounting methods in itself was to involve the examination of nearly thirty regression equations. Because, in addition to the estimation computations described above, seventy-two distributed lag structures had to be determined for each firm in the sample (6 combinations of accounting methods x 4 investment models x 3 sets of estimates), it was decided to limit the sample size in this study to ten firms. JS, in comparison, had a sample of fifteen firms. This limitation does not constitute a departure from the JS methodology, however, since the models are being fitted on a firm-by-firm basis.

The criteria used in the selection of the ten firms were as follows: The sample represented a cross-section of the six combinations of accounting methods. Such a sample design prevents complete reliance on the accuracy of the restatement procedures, since for any given combination of accounting methods at least one firm in the sample actually followed those methods in its financial reporting. It was also decided to select the firms to represent a cross-section of industries with a bias towards the larger firms in an industry for the same two reasons cited in JS: the availability of accurate and consistent data for a time period going back to 1935 to layer gross plant for restatement purposes; and the importance of the investment activity of larger firms. The sample selected for this study is given in Table 1. As shown they are the largest firms in their industries and account for a sizable percentage of investment expenditure in their industries. The firms common with the JS sample are: Anaconda, General Electric, General Motors and R.J. Reynolds. The period of analysis used in this study is 1961 to 1975. The length of this time period, 15 years, is the same as that in the JS study, which considered the time period 1949-63.

The agreement among rankings of these investment models across accounting methods could of course be examined visually. However, in order to provide a numerical measure of the agreement between rankings Kendall's coeffiecient of concordance, W, was used. This coefficient takes on the value of 1 in the case of perfect agreement and 0 in the case of no agreement between rankings. Tests of statistical significance of W can be conducted, although it should be noted that any value of W not equal to 1 would indicate that accounting methods have a distorting impact on attempts to rank investment models. The calcultaion of W has to be amended if tied ranks are present. In ranking investment models across accounting methods no tied rankings were given. In ranking the six accounting methods across the four models, however, ties were unavoidable, especially with the Expected Profits and Accelerator models, and therefore necessary adjustments as suggested in Siegel were made. For a more detailed exploration of the agreement in rankings of methods, the Spearman Rank Correlation Coefficient was used to examine the rankings of the Neoclassical and Liquidity models.

Empirical Results

Tables 2-11 present the results of ranking the four investment models across data on six accounting methods for the ten firms in the sample. The actual standard errors obtained for each model are shown across the top of the tables, while the rankings are given in the middle section of the tables. As can be seen, every firm except General Motors exhibits some disagreement in rankings between the different accounting methods. This would indicate that accounting methods do have an impact on tests of comparative performance of investment models. The value of W, the coefficient of concordance given in the lower section of each table, reflect this disagreement, ranging from 1.0 for General Motors to 0.6333 for Allis-Chalmers. The average coefficient of concordance across the ten firms is 0.8108, where 1.0 would indicate perfect agreement. However from a statistcal point of view we can reject the null hypothesis that the rankings disagree at the .01 level of significance for all ten firms. The tentative conclusion to be drawn from these results, then, is that an economist conducting a comparative test of investment models on two firms identical with respect to every substantive attribute except the accounting methods they follow to record their transactions may obtain different rankings of models. The difference in those rankings will not be statistically significant, but it should be noted that tests for statistical significance of differences in rankings have not been part of studies which have ranked investment models, such as those of JS and Elliott.

As noted earlier the procedure used to estimate financial data under different accounting methods is susceptible to error. The sensitivity of the results obtained was therefore tested using the estimates plus 10 percent as well as minus 10 percent. That is, the above procedure was repeated and the models were again ranked by standard error for these two additional sets of data across the six accounting methods for each firm. For the sake of economy of space, however, these rankings will not be presented. Instead, Table 12 sets forth only the coefficients of concordance calculated to quantify the agreement among rankings of models across the six methods using these two sets of data, and to aid comparison of the results, repeats the coefficients of concordance using the original set of data (and reported in Tables 2 to 11) in its first column.

The results using the estimates plus 10 percent are similar to those using the unadjusted estimates. Nine out of the ten firms continue to show disagreement in rankings, with General Motors again being the only exception. The range of the disagreement as measured by the coefficient of concordance W is slightly greater, being from 0.5778 for Anaconda to 1.0 for General Motors. The average coefficient of concordance for the ten firms is now 0.8099. Again, from a statistical point of view the null hypothesis that the rankings disagree can be rejected at the .01 level of significance for all ten firms.

When the original estimates minus 10 percent are used to develop the rankings, the number of firms showing complete agreement increases to four. Besides General Motors they are Standard Oil of California, Zenith, and Consolidated Foods. The range of the disagreement as measured by the coefficient of concordance is now from 0.6444 for Allis-Chalmers to 1.0 for the above four firms. The average coefficient of concordance for the ten firms is now 0.8964. However, the null hypothesis that the rankings disagree is rejected at the .01 level of significance for all ten firms.

The results of this sensitivity analysis tend to bolster the conclusion reached above that differences in accounting methods may lead to unwarranted inferences about the relative merits of investment models. That conclusion seems fairly robust with respect to any error in the techniques used to estimate the data produced by different accounting methods.

In the light of this conclusion it would be interesting to see if the rankings of accounting methods across the four models are in agreement. A finding that one combination of methods, say FIFODDB, uniformly provided the best fit for all four models would indicate that comparative tests of those models could then be conducted on data developed by using that combination of methods. If, however, the accounting methods which yield the best fit differ from model to model it would imply that comparative tests should be conducted using other, possibly nonaccounting, measures of the variables in the models.

To investigate this issue, the same methodology used earlier to compare rankings of models across methods was used. Tables 13-22 present the rankings of six accounting methods for each of the four models on the basis of standard error. They were derived from the information given in Tables 2-11. Thus, for example, in the case of RCA (Table 13) the best fit for the Liquidity model was obtained by using FIFOSYD data, while for the Neoclassical model FIFODDB data yielded the best fit. As expected, the same inventory method yields the same results for the Accelerator model with the standard error changing only when we change inventory methods. With the Expected Profits model the explanatory power does not change at all and therefore all the methods tie for the same position.

Once again, the coefficient of concordance, W, was calculated in each case with suitable adjustments made for the occurrence of ties. It should be remembered that 1 indicates perfect agreement while 0 indicates no agreement. In this case, it was found that the null hypothesis that the rankings are in disagreement could not be rejected at the .05 or .01 levels in nine out of the ten cases. The exception is

Allis-Chalmers. From this it can be concluded that there is no one set of accounting methods which can be applied uniformly across models for the purpose of comparative tests.

Sensitivity analyses similar to the previous case using the standard error developed from the estimates plus and minus 10 percent were also conducted. The rankings themselves are not being presented here for the sake of economy of space. Instead, the coefficients of concordance between the rankings in the two sensitivity runs are displayed in Table 23 together with coefficients calculated using the unadjusted estimates. Thus Table 23 also summarizes Table 13-22 and serves as an easy reference for comparing the three sets of estimates. As can be seen, the coefficients seem to indicate a persisting disagreement between the rankings of the six methods across models, which would indicate that greater effort should be devoted to developing other more accurate, possibly nonaccounting measures of variables. This point is elaborated upon later in the paper.

To explore the issue in greater detail it was decided to examine the agreement between rankings of the six methods for only the Liquidity and Neoclassical models, the other two models having shown a high proportion of tied ranks. The appropriate statistic for measuring the agreement between two sets of rankings is the Spearman Rank Correlation Coefficient.

This statistic was used to measure the agreement between the rankings of the six accounting methods for the Liquidity and Neoclassical models for the ten firms. The sensitivity analyses were again conducted using the same range of 10 percent around the estimates. The results are presented together in Table 24, along with the critical values of r_s for the .05 and .01 levels of significance.

As can be seen, none of the coefficients has the value of 1 (which would indicate perfect agreement). Nearly half of the coefficients (thirteen out of thirty) are negative, although not significantly so except in the case of Consolidated Foods and R.J. Reynolds in one of the sensitivity runs. The extreme case of Consolidated Foods indicates no agreement at all in the rankings. Significant degrees of agreement can be found in the sensitivity runs for RCA, Standard Oil of California, General Electric, and Zenith.

The relationship between the rankings of models by accounting methods and the rankings of accounting methods by models can be seen by examining, for the sake of exposition, the relative performance of the Liquidity and Neoclassical models for a given firm. This can be done with reference to Monsanto with good effect, because for that firm these two models switch relative positions as we change accounting methods. The relevant Tables are 4 and 15. From Table 4 it can be seen that the Liquidity model does worse than the Neoclassical model when FIFOSL, LIFOSL, and LIFODDB are used. Table 15 reveals that this could have been expected to happen because those three combinations of accounting methods provide the worst fit for the Liquidity model and the best fit for the Neoclassical model. The rankings of the two models are reversed when the two models are on FIFOSYD, FIFODDB, and LIFOSYD data, which provide a better fit for the Liquidity model and a worse fit for the Neoclassical model.

These results seem to indicate that comparative tests of the two models can not be conducted on any given combination of accounting methods, the method being used may provide the best fit for one model and the worst fit for another and thus may seriously bias any attempt at ranking models.

Conclusions

The findings of this study suggest that the accounting methods followed by firms have a distorting impact on inferences to be drawn from financial data of those firms. Depending upon the firm's accounting methods, different conclusions may be drawn as to which investment theory provides the best explanation of corporate investment behavior. It was also found that no one combination of accounting methods provides the best fit uniformly for all models. The implications of the first conclusion are that care should be exercised in comparing results obtained from two different samples of firms. This would be the case, for example, in comparing the results of the Elliott study with the JS study. If the samples were not comparable with respect to accounting methods the results of this study would lead one to expect different rankings of models. The second conclusion above points out another reason why the Elliott and JS studies disagreed on the relative performance of the Liquidity and Neoclassical models. As noted earlier, it was found that the accounting methods providing the best fit for one of those two models were not the accounting methods providing the best fit for the other model. These findings imply comparative tests of models should be conducted using more accurate, possibly nonaccounting, measures of the variables of interest. For example, in computing the value of output, actual production data for firms can be used instead of balance sheet inventory fiqures. Similarly, in determining the funds available for investment in a firm, more accurate measures of this variable can be constructed from the Statement of Changes in Financial Position presented in the financial reports. Comparison of alternative investment models using such data is essential and will improve assessment of the relative merits of various investment theories.

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Table 1

FIRMS IN THE SAMPLE BY INDUSTRY

Firm	Capital Expenditures by Firm in 1975*	Industry Number	Industry Name	Capital Expenditures by Industry in 1975*	Firm Expenditures as Percentage of Industry Expenditure	Firm Accounting Methods
Consolidated Foods	52.961	2000	Food	612.884	8.64%	FIFOSL
Anaconda	163.063	3331	Primary Smelting	532.563	30.6%	LIFOSL
General Electric	448.200	3600	Electric	1,316.616	34%	LIFOSYD
General Motors	1,200.889	3711	Motor Vehicles	2,068.225	58%	FIFODDB
Allis-Chalmers	40.070	3522	Machinery-Agricultural	425.698	9.4%	FIFOSL
Monsanto	544.200	2801	Chemicals	5,082.795	10.7%	FIFOSYD
Standard Oil of California	1,158.796	2913	Oil	11,408.080	10.2%	LIFODDB
R.C.A.	680.899	3600	Electric	1,316.616	51%	FIFOSL
R.J. Reynolds	190.419	2111	Tobacco	548.825	34.7%	LIFOSYD
Zenith	21.281	3651	Radio-TV Manufacturing	only firm listed in industry		FIFODDB

* In millions of 1975 dollars.

Source: Compustat Tapes

Table 2

RCA: STANDARD ERROR, MODEL RANKINGS, AND COEFFICIENT OF CONCORDANCE

	Accounting Method					
	LIFOSYD	FIFOSYD	LIFODDB	FIFODDB	FIFOSL	LIFOSL
Model:						
Liquidity	36.030	35.989	36.046	36.014	38.476	37.676
Accelerator	36.611	36.727	36.611	36.727	36.727	36.611
Expected Profits	36.812	36.812	36.812	36.812	36.812	36.812
Neoclassical	29.813	29.742	29.296	29.171	33.287	33.381
Rankings:						
Liquidity	2	2	2	2	4	4
Accelerator	3	3	3	3	2	2
Expected Profits	4	4	4	4	3	3
Neoclassical	1	1	1	1	1	1

Agreement:

Coefficient of Concordance, W = 0.7333.

Table 3

GENERAL MOTORS: STANDARD ERROR, MODEL RANKINGS, AND COEFFICIENT OF CONCORDANCE

	Accounting Method					
	LIFOSYD	FIFOSYD	LIFODDB	FIFODDB	FIFOSL	LIFOSL
<u>Model</u>:						
Liquidity	289.23	289.37	288.70	288.74	289.03	288.88
Accelerator	283.88	283.88	284.08	283.22	283.89	283.89
Expected Profits	245.52	245.52	245.52	244.01	245.53	245.53
Neoclassical	269.06	258.04	274.20	263.10	268.57	277.56
<u>Rankings:</u>						
Liquidity	4	4	4	4	4	4
Accelerator	3	3	3	3	3	3
Expected Profits	1	1	1	1	1	1
Neoclassical	2	2	2	2	2	2
<u>Agreement:</u>						

Coeffiecient of Concordance, W = 1.000.

Table 4

NONSANTO: STANDARD ERROR, MODEL RANKINGS, AND COEFFICIENT OF CONCORDANCE

	Accounting Method					
	LIFOSYD	FIFOSYD	LIFODDB	FIFODDB	FIFOSL	LIFOSL
Model:						
Liquidity	48.536	48.226	49.448	49.043	49.788	50.117
Accelerator	41.324	41.181	41.324	41.181	41.181	41.324
Expected Profits	54.062	54.062	54.061	54.061	54.062	54.062
Neoclassical	56.463	55.732	48.376	53.745	47.532	50.865
Rankings:						
Liquidity	2	2	3	2	3	3
Accelerator	1	1	1	1	1	1
Expected Profits	3	3	4	4	4	4
Neoclassical	4	4	2	3	2	2

Agreement:

Coefficient of Concordance, W = 0.7444.

Table 5

STANDARD OIL OF CALIFORNIA: STANDARD ERROR, MODEL RANKINGS AND COEFFICIENT OF CONCORDANCE

	Accounting Method					
	LIFOSYD	FIFOSYD	LIFODDB	FIFODDB	FIFOSL	LIFOSL
Model:						
Liquidity	63.456	65.071	64.563	65.933	64.506	63.563
Accelerator	58.974	59.269	58.976	59.270	59.270	58.976
Expected Profits	60.932	60.932	60.932	60.932	60.932	60.932
Neoclassical	59.820	63.149	61.082	62.632	63.102	60.983
Rankings:						
Liquidity	4	4	4	4	4	4
Accelerator	1	1	1	1	1	1
Expected Profits	3	2	2	2	2	2
Neoclassical	2	3	3	3	3	3

Agreement:

Coefficient of Concordance, $W = 0.9444$.

Table 6

ANACONDA: STANDARD ERROR, MODEL RANKINGS, AND COEFFIECIENT OF CONCORDANCE

	Accounting Method					
	LIFOSYD	FIFOSYD	LIFODDB	FIFODDB	FIFOSL	LIFOSL
Model:						
Liquidity	$35.881	36.411	35.835	36.403	36.386	35.468
Accelerator	35.689	36.027	35.673	36.011	36.026	35.688
Expected Profits	32.990	32.990	32.975	32.975	32.990	32.990
Neoclassical	36.125	33.845	36.850	36.469	36.854	34.900
Rankings:						
Liquidity	3	4	3	3	3	3
Accelerator	2	3	2	2	2	4
Expected Profits	1	1	1	1	1	1
Neoclassical	4	2	4	4	4	2

Agreement:

Coefficient of Concordance, W = 0.6778

Table 7

GENERAL ELECTRIC: STANDARD ERROR, MODEL RANKINGS, AND COEFFICIENT OF CONCORDANCE

	Accounting Method					
	LIFOSYD	FIFOSYD	LIFODDB	FIFODDB	FIFOSL	LIFOSL
Model:						
Liquidity	87.748	81.890	93.387	87.408	85.551	91.788
Accelerator	68.161	68.298	68.161	68.298	68.298	68.161
Expected Profits	70.957	70.957	70.957	70.957	70.957	70.957
Neoclassical	62.084	59.879	71.499	67.445	59.379	66.563
Rankings:						
Liquidity	4	4	4	4	4	4
Accelerator	2	2	1	2	2	2
Expected Profits	3	3	2	3	3	3
Neoclassical	1	1	3	1	1	1

Agreement:

Coefficient of Concordance, W = 0.8333.

Table 8

R.J. REYNOLDS: STANDARD ERROR, MODEL RANKINGS, AND COEFFICIENT OF CONCORDANCE

	Accounting Method					
	LIFOSYD	FIFOSYD	LIFODDB	FIFODDB	FIFOSL	LIFOSL
Model:						
Liquidity	46.948	43.858	51.403	44.746	42.810	47.473
Accelerator	53.060	62.295	53.060	62.295	62.295	53.060
Expected Profits	58.960	58.960	58.960	58.960	58.960	58.960
Neoclassical	53.110	55.314	53.601	55.704	56.351	54.758
Rankings:						
Liquidity	1	1	1	1	1	1
Accelerator	2	4	2	4	4	2
Expected Profits	4	3	4	3	3	4
Neoclassical	3	2	3	2	2	3

Agreement:

Coefficient of Concordance, W = 0.7000.

Table 9

ZENITH: STANDARD ERROR, MODEL RANKINGS, AND COEFFICIENT OF CONCORDANCE

	Accounting Method					
	LIFOSYD	[illegible]	LIFODDB	FIFODDB	FIFOSL	LIFOSL
Model:						
Liquidity	4.7249	4.7731	4.6994	4.7569	4.7432	4.6901
Accelerator	4.5698	4.5977	4.5698	4.5977	4.5977	4.5698
Expected Profits	6.6606	6.6606	6.6606	6.6606	6.6606	6.6606
Neoclassical	6.6021	6.7132	6.6297	6.7300	6.7851	6.6524
Rankings:						
Liquidity	2	2	2	2	2	2
Accelerator	1	1	1	1	1	1
Expected Profits	4	3	4	3	3	4
Neoclassical	3	4	3	4	4	3

Agreement:

Coefficient of Concordance, $W = 0.9000$.

Table 10

CONSOLIDATED FOODS: STANDARD ERROR, MODEL RANKINGS, AND COEFFICIENT OF CONCORDANCE

	Accounting Method					
	LIFOSYD	FIFOSYD	LIFODDB	FIFODDB	FIFOSL	LIFOSL
Model:						
Liquidity	5.140	4.312	5.157	4.322	5.115	5.454
Accelerator	6.434	6.423	6.434	6.423	6.423	6.434
Expected Profits	5.954	5.954	5.954	5.954	5.954	5.954
Neoclassical	5.195	5.327	5.191	5.324	5.295	5.135
Rankings:						
Liquidity	1	1	1	1	1	2
Accelerator	4	4	4	4	4	4
Expected Profits	3	3	3	3	3	3
Neoclassical	2	2	2	2	2	1

Agreement:

Coefficient of Concordance, W = 0.9444.

Table 11

ALLIS-CHALMERS: STANDARD ERROR, MODEL RANKINGS, AND COEFFICIENT OF CONCORDANCE

	Accounting Method					
	LIFOSYD	FIFOSYD	LIFODDB	FIFODDB	FIFOSL	LIFOSL
Model:						
Liquidity	5.242	5.331	5.243	5.332	5.323	5.185
Accelerator	5.297	5.304	5.297	5.304	5.527	5.297
Expected Profits	3.638	3.638	3.638	3.638	3.638	3.638
Neoclassical	5.016	5.283	5.182	5.415	5.475	5.312
Rankings:						
Liquidity	3	4	3	3	2	2
Accelerator	4	3	4	2	4	3
Expected Profits	1	1	1	1	1	1
Neoclassical	2	2	2	4	3	4

Agreement:

Coefficient of Concordance, W = 0.6333.

TABLE 12

COEFFICIENT OF CONCORDANCE FOR RANKINGS OF INVESTMENT MODELS BY ACCOUNTING METHOD FOR THREE SETS OF DATA FOR THE TEN FIRMS

Firm	Estimated Data	Estimated Data Minus 10 Percent	Estimated Data Plus 10 Percent
RCA	0.7333	0.7333	0.8111
General Motors	1.0000	1.000	1.0000
Monsanto	0.7444	0.7444	0.7000
Standard Oil of California	0.9444	1.0000	0.9444
Anaconda	0.6778	0.6778	0.5778
General Electric	0.8333	0.8333	0.8333
R. J. Reynolds	0.7000	0.7000	0.7444
Zenith	0.9000	1.000	0.9111
Consolidated Foods	0.9444	1.000	0.9000
Allis-Chalmers	0.6333	0.6444	0.6778

TABLE 13

RCA: METHOD RANKINGS AND COEFFICIENT OF CONCORDANCE USING ESTIMATED DATA

Method	Model: Liquidity	Neoclassical	Accelerator	Expected Profits
FIFOSL	6	5	5	3.5
FIFOSYD	1	3	5	3.5
FIFODDB	2	1	5	3.5
LIFOSL	5	6	2	3.5
LIFOSYD	3	4	2	3.5
LIFODDB	4	2	2	3.5

Agreement

Coefficient of Concordance, W = 0.2758

TABLE 14

GENERAL MOTORS: METHOD RANKINGS AND COEFFICIENT OF CONCORDANCE USING ESTIMATED DATA

	Model			
Method	Liquidity	Neoclassical	Accelerator	Expected Profits
FIFOSL	4	3	4	4
FIFOSYD	6	1	2	4
FIFODDB	2	2	1	1
LIFOSL	3	6	4	4
LIFOSYD	5	4	4	4
LIFODDB	1	5	6	4

Agreement

Coefficient of Concordance, W = 0.3793

TABLE 15

MONSANTO: METHOD RANKINGS AND COEFFICIENT OF CONCORDANCE USING ESTIMATED DATA

Method	Model: Liquidity	Neoclassical	Accelerator	Expected Profits
FIFOSL	5	1	2	3.5
FIFOSYD	1	5	2	3.5
FIFODDB	3	4	2	3.5
LIFOSL	6	3	5	3.5
LIFOSYD	2	6	5	3.5
LIFODDB	4	2	5	3.5

Agreement

Coefficient of Concordance, W = 0.1727

TABLE 16

STANDARD OIL OF CALIFORNIA: METHOD RANKINGS AND COEFFICIENT OF CONCORDANCE USING ESTIMATED DATA

Method	Model: Liquidity	Neoclassical	Accelerator	Expected Profits
FIFOSL	3	5	5	3.5
FIFOSYD	5	6	5	3.5
FIFODDB	6	4	5	3.5
LIFOSL	2	2	2	3.5
LIFOSYD	1	1	2	3.5
LIFODDB	4	3	2	3.5

Agreement

Coefficient of Concordance, W = 0.6263

TABLE 17

ANACONDA: METHOD RANKINGS AND COEFFICIENT OF CONCORDANCE USING ESTIMATED DATA

Method	Model: Liquidity	Neoclassical	Accelerator	Expected Profits
FIFOSL	4	6	5	3.5
FIFOSYD	6	1	6	5.5
FIFODDB	5	4	4	1.5
LIFOSL	1	2	2	3.5
LIFOSYD	3	3	3	5.5
LIFODDB	2	5	1	1.5

Agreement

Coefficient of Concordance, W = 0.3339

TABLE 18

GENERAL ELECTRIC: METHOD RANKINGS AND COEFFICIENT OF CONCORDANCE USING ESTIMATED DATA

	Model			
Method	Liquidity	Neoclassical	Accelerator	Expected Profits
FIFOSL	2	1	5	3.5
FIFOSYD	1	2	5	3.5
FIFODDB	3	5	5	3.5
LIFOSL	5	4	2	3.5
LIFOSYD	4	3	2	3.5
LIFODDB	6	6	2	3.5

Agreement

Coefficient of Concordance, W = 0.1727

TABLE 19

R.J. REYNOLDS: METHOD RANKINGS AND COEFFICIENT OF CONCORDANCE USING ESTIMATED DATA

Method	Model: Liquidity	Neoclassical	Accelerator	Expected Profits
FIFOSL	1	6	5	3.5
FIFOSYD	2	4	5	3.5
FIFODDB	3	5	5	3.5
LIFOSL	5	3	2	3.5
LIFOSYD	4	1	2	3.5
LIFODDB	6	2	2	3.5

Agreement

Coefficient of Concordance, W = 0.1108

TABLE 20

ZENITH: METHOD RANKINGS AND COEFFICIENT OF CONCORDANCE USING ESTIMATED DATA

	Model			
Method	Liquidity	Neoclassical	Accelerator	Expected Profits
FIFOSL	4	6	5	3.5
FIFOSYD	6	4	5	3.5
FIFODDB	5	5	5	3.5
LIFOSL	1	3	2	3.5
LIFOSYD	3	1	2	3.5
LIFODDB	2	2	2	3.5

Agreement

Coefficient of Concordance, W = 0.6263

TABLE 21

CONSOLIDATED FOODS: METHOD RANKINGS AND COEFFICIENT OF CONCORDANCE USING ESTIMATED DATA

Method	Model: Liquidity	Neoclassical	Accelerator	Expected Profits
FIFOSL	3	3	2	3.5
FIFOSYD	1	6	2	3.5
FIFODDB	2	5	2	3.5
LIFOSL	6	1	5	3.5
LIFOSYD	4	3	5	3.5
LIFODDB	5	2	5	3.5

Agreement

Coefficient of Concordance, W = 0.0696

TABLE 22

ALLIS-CHALMERS: METHOD RANKINGS AND COEFFICIENT OF CONCORDANCE USING ESTIMATED DATA

	Model			
Method	Liquidity	Neoclassical	Accelerator	Expected Profits
FIFOSL	4	6	6	6
FIFOSYD	5	3	4.5	3
FIFODDB	6	5	4.5	3
LIFOSL	1	4	2	3
LIFOSYD	2	1	2	3
LIFODDB	3	2	2	3

Agreement

Coefficient of Concordance, W = 0.6717

TABLE 23

COEFFICIENT OF CONCORDANCE FOR RANKINGS OF ACCOUNTING METHODS FOR THE FOUR MODELS FOR THREE SETS OF DATA FOR THE TEN FIRMS

Firm	Estimated Data	Estimated Data Minus 10 Percent	Estimated Data Plus 10 Percent
RCA	0.2758	0.5644	0.5644
General Motors	0.3793	0.3421	0.6659
Monsanto	0.1727	0.2552	0.1194
Standard Oil of California	0.6263	0.6000	0.6540
Anaconda	0.3339	0.4389	0.3396
General Electric	0.1727	0.2345	0.1727
R.J. Reynolds	0.1108	0.1108	0.0799
Zenith	0.6263	0.0714	0.1339
Consolidated Foods	0.0696	0.1933	0.0696
Allis-Chalmers	0.6717	0.4629	0.6059

TABLE 24

SPEARMAN RANK CORRELATION COEFFICIENT OF RANKINGS OF ACCOUNTING METHODS FOR THE LIQUIDITY AND NEOCLASSICAL MODELS FOR THREE SETS OF DATA FOR THE TEN FIRMS

Firm	Estimated Data	Estimated Data Minus 10 Percent	Estimated Data Plus 10 Percent
RCA	0.6571	0.8857	0.8857
General Motors	-0.4857	-0.5508	0.2354
Monsanto	-.07714	-0.5798	-0.7537
Standard Oil of California	0.7143	0.4857	0.9276
Anaconda	-0.1429	0.0857	-0.2571
General Electric	0.7714	0.7714	0.9429
R.J. Reynolds	-0.7714	-0.6000	-0.9429
Zenith	0.5429	0.8286	0.5429
Consolidated Foods	-1.0000	-0.6571	-1.000
Allis-Chalmers	0.4286	0.0286	0.2571

Critical values: at .05 level = 0.829

at .01 level = 0.943