ABSTRACT

AN APPLICATION OF A CURRENT MARKET VALUE ACCOUNTING MODEL

By

James Charles McKeown

In recent years accounting theorists have developed several models which include asset valuation rules using bases other than historical cost. As these models were developed and discussed theoretically, disagreements arose concerning the applicability of these models to realistic situations. The settlement of these controversies can only be effected empirically. Unfortunately, this research is unlikely to originate with the practicing accountant, either internal or external. Therefore, these models must be implemented first by academic accountants who have a minimum of vested interest in maintaining the status quo and a maximum interest in improving the quality and utility of financial information.

Prior research has already been performed concerning applicability of several of the models employing current cost of replacement as the basis for valuation of assets. Consequently, this study attempted to implement the model described by Raymond J. Chambers in Accounting, Evaluation, and Economic Behavior. This model basically values assets at their net realizable value and liabilities at discounted present value with residual equity being equal to total assets minus total liabilities. Income is then the change

in residual equity (adjusted for changes in investment and general price level).

A medium-sized road construction company was chosen as the subject company. The satisfactory application does not prove the general applicability of the model, but an unsatisfactory application would have provided very strong evidence of general impracticality because application of the model should be feasible for a company of this type if it is to be feasible for any type of firm.

Two balance sheets and the intervening income statement were prepared in a form consistent with Chambers' model. Although all assets and liabilities were restated, the major test of the model came with the attempt to determine the net realizable value of the plant assets. The primary measurement method for plant assets was multiple linear regression based upon auction prices. The standard error of estimate of the regression was compared to a dispersion of the book values obtainable under application of alternative accounting methods for a particular asset. A further test was comparison of the dispersions of measurements possible under generally accepted accounting principles to the dispersions of measurements determined at the direction of five independent measurers interpreting Chambers' model. These comparisons were aided by an index of accuracy developed in the appendix.

The most difficult problem of the application related to the existence of a tax loss carryforward for the subject

company. This type of problem was certainly not predicted by any of those who maintained that the model was impractical. Most of these adverse predictors indicated the belief that the major problem would be the valuation of fixed assets. The results showed very clearly that measurements under the revised methods were more verifiable than the measurements under alternative methods acceptable under generally accepted accounting principles. All of the revised measurements showed acceptable dispersions. The accuracy and verifiability of the measurements in the revised statements compared favorably with the measurements in the conventional statements and because of the marked difference in the amounts presented an informed reader of the revised statements would probably form a significantly different opinion than he would if he had read the conventional statements.

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CHAPTER I

INTRODUCTION

One of the major criticisms of accountants in recent years has been their failure to present financial statements which have current relevance. This is somewhat puzzling since this deficiency was recognized more than fifty years ago by such writers as Montgomery, who believed that users "have the right to believe that the values stated are real values as of the date of the balance sheet,"[1] and Dickinson who stated that "a balance sheet is required to show the true financial position...".[2] In 1939 MacNeal devoted an entire book to the subject, calling then current statements misleading and arguing for statements based on current values.[3]

As a result of these and other similar comments, several individuals and groups have published theoretical descriptions

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[1]Robert H. Montgomery, Auditing Theory and Practice (New York: The Ronald Press Company, 1913), p. 104, cited by Kenneth MacNeal, Truth in Accounting (New York): The Ronald Press Company, 1939), p. 26.

[2]Arthur L. Dickinson, Accounting Practice and Procedure (New York: The Ronald Press Company, 1914), p. 94, cited by MacNeal, op. cit., pp. 27-28.

[3]MacNeal, Truth in Accounting.

of accounting systems based either partly or wholly on some form of current value.[4] This, however, has not completely solved the problem since little or no work has been done to investigate the feasibility and/or practical implications of these models.

The need for attempts at application of these systems is shown by the following comments expressing doubt or disagreement with those who doubt:

> It is my opinion that realistic market prices are not nearly so widespread as would be necessary if your theory were to be adopted.[5]
>
> It appears to me, therefore, that either there are no markets for most of these goods [accounts receivable, raw materials, work in process, finished goods, and plant and equipment] or the firm is active on the

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[4]Four of the best-known, recent efforts: Edgar O. Edwards and Philip W. Bell, The Theory and Measurement of Business Income (Berkeley: University of California Press, 1961); Robert T. Sprouse and Maurice Moonitz, "A Tentative Set of Broad Accounting Principles for Business Enterprises," Accounting Research Study Number 3 (New York: American Institute of Certified Public Accountants, 1962), pp. 1-59; Committee to Prepare a Statement of Basic Accounting Theory, A Statement of Basic Accounting Theory (Evanston: American Accounting Association, 1966); and Raymond J. Chambers, Accounting, Evaluation and Economic Behavior (Prentice-Hall, Inc., 1966).

[5]Comments of William W. Werntz, on Robert T. Sprouse and Maurice Moonitz, "A Tentative Set of Broad Accounting Principles for Business Enterprises," Accounting Research Study Number 3 (New York: American Institute of Certified Public Accountants, 1962), p. 81.

buying side of the market and really has no contact with the selling side.[6]

This must be a very limited per cent of the total assets we are talking about [that have readily determinable market values]. It must be a fraction of one per cent.[7]

I like market value. I disagree with that one per cent. If industry would look around, they would discover a surprising number of things for which an accurate market value could be determined.[8]

The problems areas [in determining current values for assets] cover a very minor part of the field.[9]

If Ross could really be convincing on this point [that the areas are minor], it would go a long way toward persuading those of us who can see the merit of current value statements, but doubt whether they can be achieved as easily as he [Ross] suggests.[10]

My preference for current cost of replacement over sales prices is based in large measure on the belief the former is more readily determinable and more objective.[11]

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[6]Discussion by Carl L. Nelson, on R. J. Chambers, "The Foundations of Financial Accounting," Berkeley Symposium on the Foundations of Financial Accounting (Berkeley, School of Business Administration, University of California, Berkeley, 1967), pp. 51-52.

[7]The Measurement of Property, Plant, and Equipment in Financial Statements (Boston: Harvard University, Graduate School of Business Administration, 1964), p. 51.

[8]Ibid.

[9]Howard I. Ross, "The Pursuit of Usefulness," Berkeley Symposium on the Foundations of Financial Accounting, p. 86.

[10]Discussion by Paul Kircher, on Howard I. Ross, op. cit., p. 97.

[11]Discussion by Charles T. Zlatkovich, on R. J. Chambers, op. cit., p. 49.

The validity of these statements can only be determined by massive empirical research. This call is sounded clearly by Zlatkovich as he says that the theoretical defeat, on paper, of historical cost "has amounted to little more than academic exercise".[12] Ross also sees this need as demonstrated by one of his many calls for research: "Plenty of ideas have been batted around. It is time to find out which of them would prove serviceable in practice."[13] Another important benefit from more innovation would be discovery of "the real problems of statement presentation instead of simply listening to accountants pontificating on what they suppose the problems might be."[14]

There are several reasons for the lack of innovation aimed at improvement of the relevance of published financial statements. The public, investors, analysts and small creditors, do not have the direct power that management and large lenders have to demand more relevant statements. Without pressure, managements of corporations are unlikely to publish relevant statements since there are several reasons for managers to shun statements based on current values:

1. The possibility, or even probability, of a qualified audit opinion or objection by a regulatory agency to whom the

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[12] Ibid., p. 48.

[13] Howard I. Ross, The Elusive Art of Accounting (New York: The Ronald Press Company, 1966), p. 132.

[14] Ibid., p. 133.

statements would be submitted.

2. Statements based on current values might increase the tax expense of the firm.

3. The expectation of additional expense required to prepare current-value statements.

4. Fear of revealing information which will aid a competitor.

5. Better statements would mean that outsiders would be better able to judge the performance of managers.[15]

6. Many corporate managers may have motives which are in direct conflict with the objectives of current-value financial statements in the hands of owners and the general public. [Among these are:]...A vested interest in understated assets, thus reducing depreciation, overstating income or gain in the period of sale, as well as understating book value of investment for return on investment computations [and manipulation of income through sales of particular assets (resulting in gain or loss)]... may be a far more important influence on financial reports than possible manipulation resulting from deliberate errors in measuring current values of assets.[16]

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[15]Howard I. Ross, The Elusive Art of Accounting (New York; The Ronald Press Company, 1966), p. 198.

[16]Discussion by Paul E. Fertig, on Howard I. Ross, "The Pursuit of Usefulness," Berkeley Symposium on the Foundations of Financial Accounting, pp. 92-93.

The author does not intend to debate these points. They are presented merely to point out the formidable barriers against initiation of the experimentation by corporate managers. Corporate accountants have in large measure tended to concentrate on refining existing techniques rather than developing basic new methods of presenting information. For these reasons the lead in determining the feasibility of the current-value-based models has fallen mainly to the academic accountant, who has a minimum of vested interest in maintaining the status quo and a maximum interest in improving statement presentation.

This study does not presume to deal conclusively and exhaustively with all of the opinions about practicality mentioned above. Instead the purpose is to attempt an application of the model proposed in R. J. Chambers' Accounting, Evaluation, and Economic Behavior to a medium-sized road construction company. If satisfactory, this application will not prove the general applicability of the model, but, if unsatisfactory, the attempt will provide a very strong evidence of general impracticality because the model should be feasible for a company of this type if it is to be feasible for any type of firm. In either case, the study will provide much needed evidence concerning the information available for the determination of market prices for various assets.

The Model

The Chambers model was chosen because it is based on market price. This approach has had the least amount of practical work[17] and is favored by the author in preference to one using current cost of replacement as a basis for asset valuation.

Chambers' definition of income is similar to that of J.R. Hicks: A man's income ex ante is the maximum amount which he can consume during a period and still expect to be as well off at the end of the period as he was at the beginning.[18] Chambers' definition of income corresponds to the ex post version of this definition.[19] "Well offness" is determined by the amount of capital held.[20] Residual equity (capital)

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[17]For examples of applications of replacement cost models, see Peter J. Dickerson, Business Income--A Critical Analysis (Berkeley: Institute of Business and Economic Research, University of California, Berkeley, 1965); and "Disclosing Effects of Price-Level Changes," Appendix D in Accounting Research Study Number 6 (New York: American Institute of Certified Public Accountants, 1963), pp. 167-218.

[18]J.R. Hicks, Value and Capital (Oxford: Clarendon Press, 1946), p. 172.

[19]Raymond J. Chambers, Accounting, Evaluation and Economic Behavior, p. 116.

[20]Chambers accepts von Mises' definition of capital as "the sum of the money equivalent of all assets minus the sum of the money equivalent of all liabilities". Chambers, op. cit., p. 114, citing Ludwig von Mises, Human Action (London: William Hodge and Company, Ltd., 1949), p. 262.

is the sum of the monetary values of all assets minus the sum of the monetary values of all liabilities. Income is then the ending residual equity minus the beginning residual equity (adjusted for changes in capital investments and general purchasing power).[21]

Assets are valued at current cash equivalent which is the realizable price from resale.[22] This applies to all assets except short-term inventories which are valued at the current cost of direct inputs.[23] Liabilities are valued by discounting the sum payable in the future using the rate of interest payable for the immediate use of the money necessary for immediate settlement.[24]

Methods

The study began with restatement of two balance sheets into form consistent with Chambers' model. The income statement for the intervening year was then prepared based on the beginning and ending balance sheets. The date of preparation of revised statements was assumed to be two months after the ending balance sheet date. A comparison will be presented between the revised statements and the original

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[21] Chambers, op. cit., p. 122.

[22] Ibid., p. 104, p. 92.

[23] Ibid., p. 265.

[24] Ibid., p. 107.

statements, prepared according to generally accepted accounting principles.

The study will concentrate on determining the applicability of the model to this firm without specifically researching the usefulness of the data produced since the need for a determination of feasibility is critical.

Specifically, Chapter II will describe the adjustments needed to arrive at the revised balance sheet items other than plant assets.

Chapter III will describe the techniques used to value the plant assets. The conventional and revised balance sheets will then be compared.

The revised income statement will be developed and compared to the conventional statement in Chapter IV.

Chapter V will compare the results obtained by the author with those obtained by following the instructions of four other persons familiar with the Chambers model.

In Chapters III, IV, and V the major criterion for judgment of feasibility of restatement will be a comparison of the possible dispersion which could result from using different reasonable generally accepted accounting principles with the dispersion shown by the revised statements.

The conclusions will be presented in Chapter VI. These will include estimates of the cost of conversion and the additional cost of maintaining the revised statements.

CHAPTER II

THE BALANCE SHEET

Two revised balance sheets for X Company (the subject company) were prepared. The dates of these balance sheets are December 31, 1966 and December 31, 1967. The conversion process was performed with information which was available before March 1, 1968 since this would be the normal time of preparation of statements covering the calendar year 1967.

As indicated in Chapter I, the Chambers balance sheet reported most assets at realizable price.[1] Liabilities are then reported "by discounting the sum payable in the future to a present sum using the rate of interest payable for the immediate use of the money necessary to enable immediate settlement to be made."[2] The difference between the current cash equivalents of the assets and liabilities is then the current cash equivalent of the residual equity.[3] This chapter will report the valuation of the liabilities and the short-term assets.[4]

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[1] Chambers, Accounting, Evaluation and Economic Behavior, p. 104, p. 92.

[2] Ibid., p. 107.

[3] Ibid.

[4] Short-term assets are the "cash already in hand, the short-term claims against debtors, the marketable securities in possession, and the completed inventories of vendible products." Ibid., p. 191.

Short-term Assets

The problem of determining the current cash equivalents of the short-term assets is merely a matter of application of the principles developed by Chambers with a few appropriate assumptions. The conversions, assumptions and reasons therefore for the individual short-term assets will be explained below.

Cash. No conversion necessary here. The current cash equivalent of cash held is the number of dollars held.

Receivables. Short-term assets includes only the short-term claims against debtors,[5] but the current discussion will apply to all receivables.

The first problem of interpretation is that Chambers never defines "short-term." He implies a very short period when he says, "we may regard nominal amounts as adequate representation of the magnitude of short-term claims."[6] This statement would indicate a period of a few months since at normal interest rates for a business of this size, the amount of distortion at three months is approaching two per cent. This interpretation would limit short-term receivables very severely; probably more severely than

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[5] Ibid.

[6] Ibid., p. 196.

Chambers intended. Therefore, "short-term" will be taken in the normal accounting sense (one year or the normal operating cycle, whichever is longer). Under this assumption X Company has no long-term receivables since all receivables are tied to construction contracts and thus fall within the operating cycle.

The next problem is the determination of the discount rate. It is somewhat impractical to attempt to determine the rates of interest which apply to the borrowing of the money necessary for immediate settlement by the debtors. Thus, for practical reasons, the discount rate would be the effective interest rate on money borrowed by X Company. This appears to be the rate indicated theoretically also. The theoretical argument would be that discounting at the rate which X Company would have to pay would give the amount X Company could borrow at the balance sheet date and have the loan repaid entirely by the collections from the receivables (assuming that the amounts are received as predicted when the discounting calculation is performed).[7] Early in 1967 X Company was granted a loan at

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[7] For each collection of a_i expected m_i periods from now the discounted present value at rate r per period is given by:

$$d_i = \frac{a_i}{(1+r)^{m_i}} \qquad (1)$$

Then the repayment amount L_i of a loan of amount d_i taken now to be repaid after m_i periods with interest rate of r will be given by:

$$L_i = d_i(1+r)^{m_i} . \qquad (2)$$

a rate of 4.5% add-on. This is an effective rate of .62% per month or 7.7% per year. Early in 1968 a loan was being negotiated at the same rate. So the rate that was used for discounting of receivables was .6228 per cent compounded monthly.

Having the amount and the discount rate, it was then only necessary to determine the due or expected date of receipt. This was not as simple as was implied by Chambers.[8] The method of payment of road construction contracts causes this difficulty. It is the practice to bid on a particular contract giving unit prices for all items in the contract. An estimate is made very two weeks on every job, to determine the amount of work (number of units of each item in

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Substituting for d_i from (1) we get:

$$L_i = \left(\frac{a_i}{(1+r)^{m_i}}\right)(1+r)^{m_i}$$

$$L_i = a_i \quad .$$

Thus, for each payment expected, the receipt of the payment when expected will pay the principal and interest of a loan in the amount of the discounted present value (at balance sheet date) of the payment (as long as the interest rate on the loan and the rate used in discounting are equal).

If this is true for each of N payments, we have the conclusion stated in the text.

[8] "The amounts of obligation and their due dates being determinable,...." Ibid., p. 107.

the contract) completed to that point. Payment is then authorized for that amount less previous payment and a reserve to insure completion of the job by the contractor. Thus, at any point in time a certain amount is listed as receivable on a particular job, but this amount consists of the payment computed from the last biweekly estimate and the reserve held back from all estimates. The percentage held back is reduced at various stages of the contract, but the absolute amount of the reserve is not generally reduced by a substantial amount until the contract is near completion. Even at completion a flat amount ($5,000 or $10,000) is held back until all details of the work are completed and the job is accepted by the buyer. This process can take from two weeks to four or five years. This problem was resolved by a first-in, first-out approach within jobs. This means that if $X was the total amount receivable from one job (including both the current estimate and the reserve amount), the first $X received or expected on that job in the next year were assumed to apply to the beginning balance. This applies to those jobs on which work was not completed and a terminal (flat amount) reserve had not been established.

The terminal reserves were considered as expected at a time computed in the following way: All jobs completed in the years 1961 through 1966 were filed according to time elapsed between completion of job and receipt of payment. Any job on which a terminal reserve had been

outstanding for n months was given an expected date of receipt computed from the jobs in the file which had reserves outstanding more than n months.[9]

Using these dates for the construction receivables and the expected dates of receipt for the other receivables, the amounts were discounted using a rate of interest of .6228 per cent per month compounded monthly. All amounts due or expected within one month were not discounted.[10]

This computation resulted in a discount of $92,539 on the December 31, 1966 receivables. The net (or revised) receivable balance is $2,289,876 or 96.1% of the gross receivables, $2,382,415.

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[9]Mathematically

$$E_n = \frac{\sum_{\text{all } m_i > n} a_i (m_i - n)}{\sum_{\text{all } m_i > n} a_i} \quad \text{if} \quad \sum_{\text{all } m_i > n} a_i \neq 0$$

where E_n is the expected date of receipt of terminal reserve outstanding for n months,
a_i is the amount of terminal reserve i,
m_i is the time (in months) elapsed from completion to payment of terminal reserve i.

$$E_n = \infty \quad \text{if} \quad \sum_{\text{all } m_j > n} a_i = 0 \; .$$

This means that a terminal reserve remaining longer than any terminal reserve on the jobs in the sample is assumed to be uncollectible. (There was one account, $5,000, in this category).

[10]See footnote 4.

X Company
Accounts Receivable
December 31, 1966

	Gross	Discount	Revised
As shown by engineers' estimates	$2,057,203	$71,840	$1,985,363
Other construction receivables	301,218	20,699	280,519
Other receivables	23,994	0	23,994
Total accounts receivable	$2,382,415	$92,539	$2,289,876

The comparable results for the December 31, 1967 balance sheet showed total discount to be $151,558 on $2,394,982 gross receivables. The net amount of receivables was $2,243,424 or 93.7% of the gross. The reason for the relative increase in the discount (from 3.9% on December 31, 1966 to 6.3% on December 31, 1967) is that X Company completed more contracts late in 1967. Thus, a larger portion than usual of the estimates receivable represented reserves.[11]

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[11]Composition of estimates receivable were:

	December 31, 1966	December 31, 1967
Current	$ 973,874	$ 886,292
Reserves	1,083,329	1,262,182
Percentage of reserves to total	52.7	58.7

X Company
Accounts Receivable
December 31, 1967

	Gross	Discount	Revised
As shown by engineers' estimates	$2,148,474	$139,517	$2,008,957
Other construction receivables	159,824	11,427	148,397
Other receivables	86,684	614	86,070
Total accounts receivable	$2,394,982	$151,558	$2,243,424

Marketable Securities. The securities were valued at the current cash equivalent as of the balance sheet date. Specifically this was done by determining the market values of the securities on the first trading day of the succeeding year. The market value for securities listed on the major exchanges was taken as the average of the high and low quotations. For those securities traded over-the-counter, the market price was assumed to be the bid price reported.

The current cash equivalent would seem to be the net realizable value to the company, not the market resale price. "What men wish to know, for the purpose of adaptation, is the numerosity of the money tokens which could be substituted for particular objects...."[12] The net

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[12] Ibid., p. 92. The example given on pp. 92-93 would also appear to support this conclusion.

realizable value of securities is the market price minus the commission on sale and the income tax effect of the sale (discounted from date payment is due to the date of sale).[13] Since a gain on a sale of securities realized in early January would have to appear on a declaration of estimated tax filed by April 15, the tax would be due as follows:

April 15	25%
June 15	25%
September 15	25%
December 15	25%

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[13]Chambers does not specifically state that the current cash equivalent is a net-of-tax measurement, but defining current cash equivalent otherwise would mean that an asset sold for an anticipated gain would result in a loss. For example, assume that at time 0 B Company holds as its only asset marketable securities which cost $6,000 but could be sold for $10,000, net of commission. If current cash equivalent is measured without considering the tax which must be paid if the asset is sold, the balance sheet would be as follows:

Marketable Securities $10,000 Residual equity $10,000

If the securities are sold at the anticipated price resulting in a liability for tax of $1,000 (25% of the gain), the following balance sheet will result:

Cash	$10,000	Tax liability	$1,000
		Residual equity	9,000
Total Assets	$10,000	Total Liability and Residual Equity	$10,000

The residual equity has decreased by $1,000 (from $10,000 to $9,000). Assuming no change in general price level, B Company would report a loss of $1,000 under this interpretation of current cash equivalent. If current cash equivalent is measured net-of-tax, the beginning residual equity is $9,000 and the income upon sale of the securities is $0.

Thus the average discounting period would be 219.5 days for the December 31, 1966 balance sheet and 220.5 days for the December 31, 1967 balance sheet.[14]

The current cash equivalent of the securities will be computed by subtracting commissions and discounted taxes from the market value.[15] This computation results in marketable securities valued at $1,675,013 at December 31, 1966 and $1,859,538 at December 31, 1967.[16] This is 353%

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[14]

			1967		1968	
Date	Amount Due		Date		Date	
April 15	25%	x	105	26.25	106	26.50
June 15	25%	x	166	41.50	167	41.75
September 15	25%	x	258	64.50	259	64.75
December 15	25%	x	349	87.25	350	87.50
				219.50		220.50

[15]X Company had a loss carryforward at each of the balance sheet dates. This complicates the analysis somewhat, but because the current cash equivalent of an asset should be equal for different companies, current cash equivalent is computed net of taxes. Since the plant assets are also affected, this problem will be examined and discussed in more detail in Chapter III.

[16]

	December 31, 1966	December 31, 1967
Market value	$2,071,362	$2,309,062
Commissions*	19,451	21,017
Possible cash receipts	$2,051,911	$2,288,045
Less: Cost	474,979	495,183
Possible gain (all long term)	$1,576,932	$1,792,862
Tax on gain (25%)	$ 394,233	$ 448,216
Discounted present value of tax payments at .6228 per cent per month		
Average term 219.5 days	$ 376,898	
Average term 220.5 days		$ 428,507
Possible cash receipts	$2,051,911	$2,288,045
Discounted taxes payable	376,898	428,507
Net realizable value	$1,675,013	$1,859,538

*Commissions were computed based on the rates charged by New York Stock Exchange members assuming that sales were

of cost for 1966 and 382% of cost for 1967. The possible error is very small since at March 1, 1968 the market prices on January 2, 1967 and January 2, 1968 are known.[17]

Inventories. "...The current cash equivalent [of finished goods inventories] is the initial prices of the goods or services sacrificed in production, transformed to contemporary prices, and aggregated."[18] This applies unless the prevailing price of the finished goods is less than the result obtained, in which case the price of the finished goods is the current cash equivalent.[19] This method also is to be applied to the raw materials and work-in-process inventories. "The pricing of raw materials inventories according to the same principle is relatively simple," and "the pricing of work-in-process may be carried out on the same principle...."[20]

In the case of X Company whose products are "sold" bi-weekly, the oldest inventories held were produced at most

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in round lots where possible. E.g., 220 shares of a security were assumed to be sold in two round lots plus an odd lot of twenty shares.

[17]The only possible difference between these figures and the amount which would have been realized by an immediate sale on the first trading day arises from the question of the time of sale.

[18]Ibid., p. 232.

[19]Ibid.

[20]Ibid., p. 233.

two weeks prior to the balance sheet date.[21] No transformation of prices is needed for this short a period. Therefore the only adjustments necessary are the deletion of the non-direct costs and comparisons of the remainder to the contract price.

The only inventory held by X Company at December 31, 1966 was $40,000 of raw materials purchased and received in late December for use in early 1967. Using the above interpretation of Chambers' position, the raw materials are valued at the initial price of the goods transformed to contemporary prices. For goods purchased in the last few weeks, this would be the amount paid, $40,000. This is lower than the selling price less costs to complete so the $40,000 was used for the balance sheet.

On December 31, 1967, X Company again held raw materials delivered in December at a cost of $40,000. By the same process the $40,000 is used for the December 31, 1967 balance. However at this date X Company also held work-in-process in the amount of $174,317. This amount includes materials, supplies, performance, bond expense, taxes, wages, etc. directly related to the job. Also included is an allotted share of general corporation overhead and a rental charge for both owned equipment and equipment rented from outside sources.

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[21]See pages 13-14.

Of the items included in the cost of the completed inventory, only the general factory overhead and the rental charge for equipment owned by X Company appear to be other than "goods and services sacrificed in production." All other items are so aggregated as to be directly related to the projects to which they are assigned.

The general overhead, mainly expense of operating the general office, is not directly related to production. The rental of owned equipment, however, contains depreciation, repair costs, rental of yard space, salaries of personnel directly charged with management of the equipment, etc. These costs would usually not be considered directly related to specific jobs. Chambers does not directly indicate whether such costs would be part of short-term inventories. He does, however, imply that depreciation is to be accounted for separately.[22] The remainder of the costs included in the rental of owned equipment would appear to be classifiable as joint costs.[23]

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[22]The income account lists separately as costs: "(i) current cash equivalent, at time of sale, of short-term inventories and durables" and "(iii) depreciation and obsolescence." Ibid., p. 256.

[23]"A less clearcut group of sacrifices are those which vary in some way with the scale of production or trade but are not clearly identifiable with any particular product or group of products. These are joint costs." Ibid., p. 250.

Joint costs are to be treated as period costs.[24] Thus none of the rental of owned equipment should be included in the current cash equivalent of short-term inventories.

The current cash equivalent of X Company inventories was computed by removing an estimate of the general overhead and rental of owned equipment charges which were included. The estimate is made necessary because it is impractical to obtain an exact figure due to the way the records are currently kept. This problem of application would disappear if records were kept on a basis consistent with Chambers' model, i.e., the general overhead and rental charges would never be apportioned to jobs, and it would, therefore, not be necessary to extract them.

The method of estimation used was simply the computation of the percentage of these costs to total costs of jobs (per X Company records).[25] This percentage was then applied to the total reported work-in-process inventory figure:

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[24] Ibid.

[25] $$\frac{\text{General overhead}}{\text{Total cost of jobs}} = \frac{\$908,446.}{\$16,501,527.} = .055$$

$$\frac{\text{Rental of owned equipment}}{\text{Total cost of jobs}} = \frac{\$794,005.}{\$16,501,527.} = .048$$

Reported work-in-process	$174,317.
Less:	
General overhead $9,596	
Rental charges for owned equipment $8,388	
	17,984
Revised work-in-process	$156,333

The December 31, 1967 balance sheet will therefore show:

Short-term inventories:	
Raw materials	$ 40,000
Work-in-process	156,333
	$196,333

Prepaid Expenses. "... amounts prepaid may be carried forward as monetary assets...."[26] Thus the prepaid expenses which are actually prepaid do not need adjustment. This does not apply to the item described as prepaid interest since it is properly an offset to the related Notes Payable account and will be treated as such.[27] Therefore the only prepaid item is the $4,815 of Prepaid Expense on the December 31, 1967 balance sheet.

Liabilities

Current Liabilities. The current liabilities, except the current portion of long-term Notes Payable, are discussed in this section. The relevant measure for current liabilities is similar to the measure for receivables. The

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[26] Ibid., p. 250.

[27] See page 27.

current cash equivalent of current liabilities is computed by discounting the amount payable in the future using the rate of interest payable for the immediate use of the money necessary to enable immediate settlement to be made.[28]

The accounts payable to subcontractors based on engineers' estimates can be handled in exactly the same way as the receivables based on engineers' estimates because the industry practice is that the prime contractor pays his subcontractor when he receives payments related to work which the subcontractor has completed. The other accounts payable were handled by discounting from the expected date of payment at the same rate (.0062281 per month). All other current liabilities were expected to be paid in January and were not discounted. The revised sections of the balance sheets are shown in Table 1.

Notes Payable. The Notes Payable account at December 31, 1967 contained three notes, two of which were also reported on the December 31, 1966 balance sheet.

Two of these notes were forty-eight month notes being paid in monthly installments with an effective interest rate of .0062281 per month. These are the most recent notes and this rate is the rate payable for any new loans.[29] One note (Note One) is a $500,000 note with payments of

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[28] Ibid., p. 107.

[29] See pages 12-13.

Table 1. Current Liability Summary

X Company
Current Liabilities (except Notes Payable)
December 31, 1966

	Gross	Discount	Revised
Accounts payable to subcontractors based on engineers' estimates	$851,137	$17,940	$833,197
Materials, supplies and other	720,329	14,527	705,802
Total accounts payable	$1,571,466	$32,467	$1,538,999
Accrued payrolls	12,497	0	12,497
Accrued interest payable	40,141	0	40,141
Accrued taxes payable	61,918	0	61,918
Total	$1,686,022	$32,467	$1,653,555

X Company
Current Liabilities (except Notes Payable)
December 31, 1967

	Gross	Discount	Revised
Accounts payable to subcontractors based on engineers' estimates	$ 976,548	$ 71,354.	$ 905,194
Materials, supplies and other	639,764	41,691	598,073
Total accounts payable	$1,616,312	$113,045	$1,503,267
Accrued payroll	5,499	0	5,499
Accrued interest payable	40,816	0	40,816
Accrued taxes payable	34,442	0	34,442
Total	$1,697,069	$113,045	$1,584,024

$12,083 per month; the other (Note Two) $300,000, payments of $7,250. X Company had recorded each note at the total amount of the payments with prepaid interest being debited for the total interest charge for the note. The prepaid interest was being amortized on a straight line basis so that at each balance sheet date, the notes were shown as a liability for the total of the remaining payments and an asset of the unamortized portion of the interest. The revision was accomplished by discounting each payment from its due date back to the balance sheet date at the rate payable for new loans (.0062281 per month).[30] The payments due within one month of the balance sheet date were not discounted.[31]

The third note (Note Three) involved in the Notes Payable account was a $2.3 million note with principal payable two years from each balance sheet date and interest payable quarterly at a rate of .0192 per quarter.[32] Since this is a higher rate of interest than the .0062281 per month (which is .0188 per quarter), the discounted value

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[30]The second note negotiated in July, 1967 evidences this rate on new loans after December 31, 1966. Another loan at the same rate was negotiated early in 1968.

[31]See page 15.

[32]At December 31, 1966, the principal was to be repaid December 31, 1968. The loan was extended for one year during 1967 so that at December 31, 1967, the term was still two years.

of the note and quarterly interest payments is $2,307,503 ($7,503 greater than the principal). If the cost of new debt capital increases from .0188 per quarter to .0192 per quarter, the present value of Note Three will decrease to $2,300,000. The other liabilities and some of the assets (mainly accounts receivable) would also decrease. Since X Company is a net debtor, the liabilities would decrease by a greater amount than the decrease in assets.[33] Therefore, X Company would show income, I, equal to the difference between the amount of the changes (ceteris paribus).[34] X Company (or any net debtor) can cause net income to be reported merely by increasing its cost of debt capital. Conversely, a net debtor would report a loss due to a decrease in the cost of debt capital. This paradox results from Chambers' disqualification of goodwill

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[33] This is generally true for net debtors although in certain cases the expected pattern of receipts and payments on receivables and liabilities could cause the change in receivables to be greater than the change in liabilities. Conversely, certain patterns could also make the change in liabilities greater than the change in receivables for a net creditor. The following discussion will use the term "net debtor" to refer to companies for which a change in cost of debt capital causes a greater change in present value of liabilities than in present value of assets.

[34] $I = \Delta A - \Delta L$ (assuming no capital investment or disinvestment)

where I = income
ΔA = change in present value of assets (mainly receivables)
ΔL = change in present value of liabilities

as an asset.[35] The following example should help to illustrate this point.

Assume A Company has these assets, liability and residual equity at time 0:

Cash	$ 500,000	Bonds payable	$1,000,000
Inventory	$1,000,000	Residual equity	$2,000,000
Plant assets	$1,500,000	Total Liability and Residual	
Total Assets	$3,000,000	Equity	$3,000,000

where the assets are reported at their current cash equivalents and the bonds payable are seven percent twenty-year bonds currently trading at their face value, i.e., to yield seven percent.[36] The bonds are reported at the present value of future payments due discounted at the market rate of interest which is assumed to be equal to the cost of new debt. Goodwill is the difference between the investors' estimate of the value of the stockholders' equity and the reported residual equity:

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[35]"Goodwill is not an asset of the firm, being neither severable nor measurable. It subsists in expectations of constituents, and is, therefore, capable of evaluation; such evaluations, being comparative, will vary from time to time." Ibid., p. 218.

[36]The same result (decrease in goodwill offsetting income) would be obtained if the assets were reported at historical cost or current replacement cost.

$G = V - RE$

where G = goodwill

RE = reported residual equity

V = value of stockholders' equity of A Company probably computed by use of a relationship such as:

$$V = \sum_{i=1}^{\infty} \frac{I_i}{(1+r)^i}$$

where I_i = income of A Company in period i

r = discount rate used by investors

Therefore $G_o = V_o - \$2,000,000$ (1)

If the cost of new borrowing changes to 8% at time 1, the following balance sheet will result (assuming no other changes):

Cash	$ 500,000	Bonds payable	$ 901,036
Inventory	1,000,000	Residual equity	
Plant assets	1,500,000	at time 0	2,000,000
		during period 0-1	98,964
		Total Liability and Residual	
Total Assets	$3,000,000	Equity	$3,000,000

Thus, income (or at least an increment to residual equity) of at least $98,964 results from the increase in cost of debt.[37] But, V, the value of the stockholders' equity will certainly not increase. In fact, V will probably

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[37] It is possible (even probable) that the current cash equivalent of plant assets will be increased because the discounted potential tax payments (deducted from market price to compute current cash equivalent) would be decreased because of the increase in the discount rate (assuming that the change in cost of debt capital does not affect the market prices of the assets).

decrease as a result of one or both of the following effects:

1. If the projected incomes, I_i, had been computed assuming new borrowing at seven percent, the change in cost of debt will decrease the projected incomes.[38]

2. The reason for the change in the cost of debt capital should be either the increase in the pure rate of interest or the increase in the risk premium required of A Company by lenders (i.e., a change in A Company's risk class). Either of these increases should be accompanied by an increase in r, the rate used by investors to discount expected income.

Therefore, $V_1 \leq V_o$ (2)

$G_1 = V_1 - \$2,098,964$ (3)

(3)-(1) gives $G_1-G_o = V_1 - \$2,098,964 - (V_o-\$2,000,000)$

$G_1-G_o = V_1 - V_o - \$98,964$ (4)

From (2) $V_1-V_o \leq 0$, therefore

$G_1-G_o \leq - \$98,964$, or

$G_1 \leq G_o - \$98,964$, or

the decrease in goodwill at least offsets the income ($98,964).[39]

Reversing the whole process will cause a loss and offsetting increase in goodwill.

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[38]Assuming that investors believe the change will be in effect until some borrowing occurs or is foregone, due to the increased cost.

[39]It must be noted that A Company is in a better position financially than it would have been had management not secured the debt capital before the increase in cost.

Possibly foreseeing this difficulty, Chambers has made an exception to his normal measurement rule for obligations. For long-term liabilities the measurement will be "future payment discounted to present at contractual interest rate (generally equal to face value)."[40] This deviation from the usual market price standard is supported by the reasoning that until the company retires its liabilities, "the market price may be regarded only as indicating a possibility of gain."[41] Given this clearcut statement, Note Three was recomputed as the present value of the principal and interest payments discounted at the contractual rate (.0192 per quarter). The result of this computation was, of course, the face value of the note, $2,300,000. Notes One and Two were not recomputed since the contractual rate for these notes equals the market cost of debt capital which was the rate used in the original computation. The results of these computations are shown in Table 2.

Summary

Cash was not adjusted. The accounts receivable and current liabilities were discounted at the current cost of new debt capital. The long-term liabilities were

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[40] Ibid., p. 259.

[41] Ibid., p. 290.

Table 2. Notes Payable Summary

X Company
Notes Payable
December 31, 1966

	Gross	Discount	Revised
As Current Liabilities			
Note One	$145,000	$ 4,836	$140,164
As Long-term Liabilities			
Note One	$ 362,500	$54,551	$ 307,949
Note Three	2,300,000	0	2,300,000
Total Long-term Liabilities	$2,662,500	$54,551	$2,607,949
Total Notes Payable	$2,807,500	$59,387	$2,748,113

X Company
Notes Payable
December 31, 1967

	Gross	Discount	Revised
As Current Liabilities			
Note One	$ 145,000	$ 4,836	$ 140,164
Note Two	87,000	2,901	84,099
Total Current Notes Payable	$ 232,000	$ 7,737	$ 224,263
As Long-Term Liabilities			
Note One	$ 217,500	$25,895	$ 191,605
Note Two	224,750	34,395	190,355
Note Three	2,300,000	0	2,300,000
Total Long-term Liabilities	$2,742,250	$60,290	$2,681,960
Total Notes Payable	$2,974,250	$68,027	$2,906,223

discounted at the contractual rate. In all cases amounts expected to be paid within one month were not discounted. Marketable securities were computed at market value less commissions and taxes payable on gains (discounted from date due to balance sheet date). Short-term inventories were revised to the cost of goods and services sacrificed in production (or for raw materials, the cost), adjusted for price changes (none were necessary because of the short interval between incurrence of cost and the balance sheet date). Prepaid expenses were not adjusted. The partial balance sheets showing adjusted figures for the above items appear in Table 3.

Table 3. Partial Revised Balance Sheets

X Company
Partial Balance Sheets

	December 31, 1966	1967
Current Assets		
Cash	$1,272,637	$ 624,137
Marketable securities	1,675,013	1,859,538
Accounts receivable	2,289,876	2,243,424
Inventories	40,000	196,333
Prepaid expenses		4,815
Total Current Assets	$5,277,526	$4,928,247
Liabilities		
Current Liabilities		
Accounts payable	$1,538,999	$1,503,267
Notes payable - current	140,164	224,263
Accrued payroll	12,497	5,499
Accrued interest payable	40,141	40,816
Accrued taxes payable	61,918	34,442
Total Current Liabilities	$1,793,719	$1,808,287
Long Term Liabilities		
Notes payable	$2,607,949	$2,681,960
Total Liabilities	$4,401,668	$4,490,247

CHAPTER III

PLANT ASSETS

The general measurement rules for assets as applied to marketable securities also apply to plant assets. This requires determination of the realizable price. The realizable price is again the market resale price less commissions and discounted tax payments necessitated by the sale. The major question is thus the determination of the market resale price. Two methods of accomplishing this objective were used. The first was the use of linear regression based on sales of similar assets. The second method was reference to publications generally available which give resale prices of various assets at specific points in time. Where both methods could be used the regression was used for reasons which will be explained later. If neither of these methods yielded a market resale price, the current cash equivalent was approximated by use of indexed calculations. Chambers indicates that this is an acceptable alternative, but that the ideal measure should be based on market resale prices.[1]

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[1] R. J. Chambers, Accounting, Evaluation and Economic Behavior, p. 248.

Valuation by Regression

The regression technique was used wherever possible because it was the only method of calculating current cash equivalent which yielded a dispersion measure which could be compared to the dispersion of measures obtainable under alternative generally accepted accounting principles. This latter dispersion was computed by first presenting many different depreciation methods to the Certified Public Accountant who audited X Company. He was asked, for each type of plant asset, to eliminate any methods which he would hesitate to accept if applied by X Company. For each asset the book value was computed as of each balance sheet date under each method accepted without hesitation by the C.P.A. The dispersion of the measures obtained under these different generally accepted accounting principles was computed for each balance sheet date by computing the standard deviation of the book values at that date calculated under all acceptable depreciation methods.[2,3] For each asset this figure

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[2] If the purchase price of an item was unknown, it was treated as if it were zero. Therefore, the dispersion under different depreciation methods for this item was zero. (The zero purchase price is implied by the omission of this item from the conventional balance sheet.)

[3] As an example of the computation of this dispersion, assume that the CPA indicated that straight line, sum-of-the-years' digits and double declining balance depreciation methods with lives of three and four years and salvage value of zero were acceptable methods for reporting an asset which cost $10,000. If this asset had been

was compared to the standard error of estimate from the regression.

The regression technique was used for most of the large items of equipment (cranes, crawler and wheel tractors, compacting equipment, graders, etc.). The observations used in the regression were taken from reports of actual sales at auctions throughout the year 1967 and throughout the country as reported by the largest firm handling auctions of this type of equipment.[4] The dependent variable was, of course, the price for which

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purchased at the beginning of 1966, the possible book values at December 31, 1966 would be:

Method	Life 3	Life 4
Straight line (SL)	$6,666.67	$7,500.00
Sum of the years' digits (SYD)	5,000.00	6,000.00
Double declining balance (DDB)	3,333.33	5,000.00
Average book value ($\bar{x}$)	$5,583.33	
Standard deviation (σ)	1,339.40	

The standard deviation is more than thirteen percent of the cost and twenty-four percent of the average book value. At December 31, 1967 the average book value would be $2,953.70 and the standard deviation of book values would be $1,059.16 (35.9 percent of the average).

[4] Blue Book of Heavy Equipment Prices (Lincoln, Nebraska: Forke Brothers Incorporated 1967).

the item of equipment was actually sold. The independent variables in most of the regressions were age, condition, list price new, list price of attachments, and month of sale. The combination of these variables which gave the best prediction for each class of equipment was used in the regression for that class. The input for a particular regression was all items in that class for which both the dependent and independent variables were available. The major source of the list price figures was the Green Guide.[5] This book gives prices for a wide variety of heavy equipment.

Tables 4 and 5 report the application of the regression technique at the two balance sheet dates. Although fewer than one-third of the items were valued by the regression, the value of these items constituted more than sixty percent of the value of the plant assets as of December 31, 1966 and more than fifty percent of the value of the plant assets as of December 31, 1967.

Relative to the dispersion criterion, the tables show that 86 of 115 items on the December 31, 1966 balance sheet and 87 of 117 items on the December 31, 1967 balance sheet had a lower standard error of estimate from the regression than the possible dispersion in measures obtainable under generally accepted accounting principles

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[5]Green Guide (Palo Alto, California: Equipment Guide-Book Company, 1966, 1967, 1968).

Table 4. Summary of Valuation by Regression Beginning

DECEMBER 31, 1966

	Reported	Revised
(a) Number of items valued by regression		115
(b) Total number to be valued		385
Percent valued by regression (number) (a/b)		29.9
(c) Valuation of items valued by regression	$632,438	$631,244
(d) Total valuation of all items	$930,155	$1,035,985
Average valuation of items in (a) (c/a)	$5,499	$5,489
Percent valued by regression ($) (c/d)	68.0	60.9
(e) Dispersion of items in (a)	$49,922	$4,427
Average dispersion ($e/\sqrt{a}$)	$4,655	$413
Accuracy *	$<2.00 \times 10^{-5}$	2.26×10^{-4}
(f) Number of items for which dispersion of GAAP is lower		29
(g) Number of items for which dispersion of regression is lower		86
Percent of (f) to total (a)		25.2
(h) Valuation of items in (f)	$0	$6,465
Average value per item (h/f)	$0	$223
(i) Valuation of items in (g)	$632,438	$624,779
Average value per item (i/g)	$7,354	$7,265
Percent of valuation accounted for by successful items (i/c)	100.0	99.0

*As defined in Appendix.

Table 5. Summary of Valuation by Regression Ending

DECEMBER 31, 1967

	Reported	Revised
(a) Number of items valued by regression		117
(b) Total number to be valued		436
Percent valued by regression (number) (a/b)		26.8
(c) Valuation of items valued by regression	$500,778	$587,677
(d) Total valuation of all items	$926,808	$1,122,918
Average valuation of items in (c) (c/a)	$4,280	$5,023
Percent valued by regression ($) (c/d)	54.0	52.3
(e) Dispersion of items in (a)	$63,264	$4,396
Average dispersion ($e/\sqrt{a}$)	$5,849	$406
Accuracy *	$<1.58 \times 10^{-5}$	2.27×10^{-4}
(f) Number of items for which dispersion of GAAP is lower		30
(g) Number of items for which dispersion of regression is lower		87
Percent of (f) to total (a)		25.6
(h) Valuation of items in (f)	$0	$7,072
Average value per item (h/f)	$0	$236
(i) Valuation of items in (g)	$500,778	$580,605
Average value per item (i/g)	$5,756	$6,674
Percent of valuation accounted for by successful items (i/c)	100.0	98.8

*As defined in Appendix.

(GAAP). These items can be classified as "successful" according to the dispersion criterion. None of the other items (those for which the GAAP dispersion was less than the standard error of estimate from regression) had any book value. Not coincidentally the current cash equivalent of these items was very small, averaging less than three percent of the average "successful" item. There are four basic explanations for these "unsuccessful" items.

1. Unknown purchase price. This automatically means that the item will be classed as unsuccessful. (The assumed cost of $0 causes book value to be $0 regardless of depreciation method. See note 2.)

2. Lack of arm's-length transaction at time of purchase resulting in unrealistically low cost. This lowers dispersion of GAAP measures since the dispersion is almost directly proportional to cost.[6,7]

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[6]The "almost" can be removed if the salvage value varies directly with the cost.

[7]Only straight-line, sum-of-the-years' digits, and double declining balance methods of depreciation were used.

C = cost of asset 1
K = any constant
L = depreciable life of assets 1 and 2
S = salvage value of asset 1
C' = cost of asset 2 = KC
S' = salvage value of asset 2 = KS (see note 6.)
A = age of assets 1 and 2
SL = book value at straight-line depreciation of asset 1

3. Extreme age. Some assets still in use were so old that none of the depreciation methods used resulted in a book value greater than zero.

SL' = book value at straight-line depreciation of asset 2
similarly for SYD, SYD', DDB, and DDB' representing sum-of-the years' digits and double declining balances

$$SL = \frac{C - S}{L}(L - A)$$

$$SL' = \frac{C' - S'}{L}(L - A)$$

$$= \frac{KC - KS}{L}(L - A)$$

$$= K\left(\frac{C - S}{L}\right)(L - A)$$

$$= KSL \qquad (1)$$

$$SYD = (C - S)\left(\sum_{i=1}^{L-A} i\right)/\left(\sum_{i=1}^{L} i\right)$$

$$SYD' = (C' - S')\left(\sum_{i=1}^{L-A} i\right)/\left(\sum_{i=1}^{L} i\right)$$

$$= K(C - S)\left(\sum_{i=1}^{L-A} i\right)/\left(\sum_{i=1}^{L} i\right)$$

$$= K\,SYD \qquad (2)$$

$$DDB = C\left(1 - \frac{2}{L}\right)^{A}$$

$$DDB' = C'\left(1 - \frac{2}{L}\right)^{A}$$

$$= KC\left(1 - \frac{2}{L}\right)^{A}$$

$$= K\,DDB \qquad (3)$$

4. No adjustments of standard error of estimate for predictions close to or less than zero. If a prediction equaled zero, it could only be incorrect in one direction

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Thus, for each x_i in the distribution of book values for asset 1 there exists $x_i' = Kx_i$ (4) in the distribution of book values for asset 2.

$$\bar{x} = \left(\sum_{i=1}^{n} x_i\right)/n = \text{mean of book values of asset 1.}$$

$$\bar{x}' = \left(\sum_{i=1}^{n} x_i'\right)/n = \text{mean of book values of asset 2.}$$

$$= \left(\sum_{i=1}^{n} Kx_i\right)/n \quad \text{from (4)}$$

$$= K\left(\sum_{i=1}^{n} x_i\right)/n$$

$$= K\,\bar{x} \qquad (5)$$

$$\sigma^2 = \sum_{i=1}^{n}(x_i - \bar{x})^2/n = \text{variance of book values of asset 1}$$

$$\sigma'^2 = \sum_{i=1}^{n}(x_i' - \bar{x}')^2/n = \text{variance of book values of asset 2}$$

$$= \sum_{i=1}^{n}(Kx_i - K\bar{x})^2/n \quad \text{from (4) and (5)}$$

$$= K^2 \sum_{i=1}^{n}(x_i - \bar{x})^2/n$$

$$= K^2\,\sigma^2 \qquad (6)$$

$$\sigma = \sqrt{\sigma^2} = \text{standard deviation of book values of asset 1}$$

$$\sigma' = \sqrt{\sigma'^2} = \text{standard deviation of book values of asset 2}$$

$$= \sqrt{K^2\,\sigma^2} \quad \text{from (6)}$$

$$= K\sqrt{\sigma^2}$$

$$= K\,\sigma$$

(low) to be a relevant error. Thus the effective error of estimate for that item was approximately 71 percent of the standard error of the regression which generated the prediction.[8] The possible adjustment is even greater for a prediction less than zero.

Note that all four of these conditions are more likely to occur in connection with a fully depreciated asset. Thus, the fact that the total book value of all "unsuccessful" items is zero is not a coincidence. The regression technique is at a great comparative disadvantage for items of little value (either book or market).

Thus the dispersion varies directly with the cost of assets of equal depreciable lives and ages (if salvage value also varies directly with cost).

[8]The standard error of estimate is computed for the regression assuming all values of the dependent variable are relevant. This means that if the prediction is zero, the standard error of estimate is computed under the assumption that an observation of -a is possible and would add a^2 to the sum of squared residuals. In this situation a negative net realizable value is adjusted to zero. Therefore the error is zero and the addition to the sum of the squared residuals should be zero rather than a^2. The effective standard error of estimate would be computed from the sum of squared residuals less the amounts included in that sum which relate to assumed possible negative observations. If the distribution of possible observations was symmetrical, the resulting effective sum of squared residuals would be one-half the original. Thus, the effective standard error would be $1/\sqrt{2}$ times the original standard error (.7071 S).

A more complete analysis of the unsuccessful items is presented in Table 6. The total of the numbers of occurrence of the conditions will not check because several items had more than one of the four conditions present. This table indicates clearly that when the regression technique "fails," it does so on fairly trivial items.

The measure of accuracy, A_r (as developed in the Appendix), of the regression for a particular item is equal to the inverse of the dispersion measure (standard error of estimate, S) for that item. Thus, for the regression method $A_r = \frac{1}{S}$.

The measure of accuracy, A_g, for the measures derived under alternative generally accepted accounting principles can not be determined (because the true measure of the attribute being measured can not be determined), but the upper limit of A_g can be determined and is equal to the measure of verifiability, V_g (as defined in the Appendix).[9] The inverse of verifiability for an item is equal to the standard deviation of the book values for that item, σ, or $V_g = \frac{1}{\sigma}$. $A_g \leq V_g = \frac{1}{\sigma}$.[10]

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[9] V exists independently of the true measure of the attribute being measured. The Appendix demonstrates that the verifiability of a set of measurements is greater than or equal to the accuracy of that set of measurements.

[10] $A_g = \frac{1}{\sqrt{\sigma^2 + B_g^2}}$ where $B_g = \bar{x}_g - T_g$

$\bar{x}_g$ = the mean of all book values

T_g = the true book value

Table 6. Analysis of Unsuccessful Items

	1966	1967
1. Unknown purchase price	8	7
2. Lack of realistic purchase price	1	1
3. Extreme age	4	5
4. Negative prediction	11	12
5. None of the above	9	10
Largest difference in dispersion of items in 5.	$98	$101
Average difference in dispersion of items in 5.	$29	$39
Largest difference in dispersion of successful items (dispersion GAAP > standard error of estimate of regression)	$19,441	$19,208
Average difference in dispersion of successful items (regression better than GAAP)	$ 4,881	$ 6,314

If $S < \sigma$, then $A_r > V_g \geq A_g$ or $A_r > A_g$. Thus, for all items where the dispersion of the regression is less than the dispersion of GAAP ($S < \sigma$), the accuracy of the regression must be greater than the "accuracy" of the GAAP.

If $\sigma < S$, then $A_g \leq V_g > A_r$. This tells nothing about the relationship of A_g and A_r unless the assumption is made that $A_g = V_g$. This would mean that $B_g = 0$ or that the mean book value was exactly equal to the true measure of the attribute being measured.[11] This would seem to be an unsupportable assumption. Therefore the conclusion must be that for all items where $S < \sigma$, the regression method is more accurate, but where $\sigma < S$, either method may be more accurate. This means the regression method was more accurate for three-fourths of the items measured by regression and may have been more accurate for the other fourth.

A similar result is obtained for the accuracy, A_R, of all items measured by the regression compared to the accuracy, A_g, for the same items measured according to GAAP. From Tables 4 and 5:

	1966	1967
A_R	2.26×10^{-4}	2.27×10^{-4}
$V_G (\geq A_G)$	2.00×10^{-5}	1.58×10^{-5}

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[11] This is the condition for equality of A and V as proven in the Appendix.

The regression technique in total has an accuracy measure more than ten times the "accuracy" measure of GAAP. The factor of ten indicates to some extent the extreme accuracy (and thereby verifiability since the accuracy measure includes verifiability) of the regression technique relative to alternative GAAP.[12]

Valuation by Reference to Published Market Values

If a market price could not be determined for an asset using the regression technique, an attempt was made to determine the market price by reference to published materials generally available which give market prices for many assets at specific points in time.[13] Unfortunately, the lack of data on market prices of individual items of a particular model prevented computation of measures of dispersion and accuracy for this technique.

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[12]It is verifiability of which many accountants speak when they discuss objectivity. Since objectivity is strictly a mental freedom from bias which cannot be measured directly, verifiability (as defined in the Appendix) is generally accepted as evidence of objectivity.

[13]All assets which were valued by the regression technique could have been valued by reference to published materials. The regression method was used instead mainly because it provided more data for purposes of comparison with alternative generally accepted accounting principles.

Automobiles owned by X Company were valued by reference to either of two publications. The one which was preferred was the Black Book which is published weekly and contains prices of cars sold at auction in a particular state over the previous week.[14] These prices are averaged over the state for cars of a particular model, year, and condition. The auction price was used, not because X Company would sell directly at the auction, but because dealers, who can sell at the auction, will generally be willing to pay (or allow on trade-in) a price which they feel they can recover at auction. The January 2, 1967 and January 1, 1968 issues were used because they are the issues to which the dealer would have referred to value an automobile the first week in January. The price reported for rough condition was used for automobiles used on construction jobs. The average price was chosen for the autos used by company officials.

The automobiles which could not be priced using the Black Book were valued by use of the Red Book which is published every six weeks reporting average wholesale prices prevailing in the previous six-week period in a twenty-one

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[14] Black Book (Gainesville, Georgia: National Auto Research, Inc., 1967, 1968).

state area for a particular model and year.[15,16] There was no gradation as to condition. Light trucks were valued where possible from the same publication. In this case the figure reported was "average finance value" which is the average amount for which a vehicle of this model and year could be financed. Since the average finance value for automobiles is reported at ninety percent of the reported average wholesale price, it was assumed that this ratio was also applicable to the truck market. Therefore, the wholesale price was obtained by multiplying the average finance value by 10/9.

Those light trucks which could not be valued by use of the Red Book as well as the heavier trucks were priced from the Truck Blue Book.[17] This is published semi-annually and reports the average finance value prevailing in a twenty-one state region for a particular model and year as of the end of the previous six month period. Again no gradation as to condition is reported. The same

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[15]One automobile of foreign manufacture could not be valued from either source and is included in the indexed calculations in the next section.

[16]Red Book, Official Used Car Valuations (Chicago: National Market Reports, Inc., 1967, 1968).

[17]Truck Blue Book, Official Used Truck Valuations (Chicago: National Market Reports, Inc., 1967, 1968).

adjustment from average finance value to average wholesale value (multiplying by 10/9) was used.

All other assets which were valued by use of published materials were priced by use of the Green Guide, mentioned as a source of data in the previous section. This publication reports current average wholesale prices for various assets based upon their model and age. Average condition is all that is reported, but again there is no reason to believe that this is not a reasonable assumption.

Over forty per cent of the plant assets were valued by use of the above methods, but the total value of this group was substantially less than forty percent for the December 31, 1966 balance sheet and slightly less than forty percent for the December 31, 1967 balance sheet. These and other data are reported in Table 7.

No measure of dispersion or verifiability was computed for the revised figures because any measurers following the method described would report the same figures. This will be discussed in more detail in Chapter V when the reports of five measurers will be presented.

Valuation by Use of Indexed Calculations

Chambers does not deal specifically with the case of vendible assets when no market price can be determined. He makes the assumption that if there is a secondhand

Table 7. Direct Valuation by Reference to Published Sources

DECEMBER 31, 1966

	Reported	Revised
(a) Number of items valued		160
(b) Total items to be valued		385
Percentage of total (by number) (a/b)		41.6
(c) Valuation of items in (a)	$197,356	$299,056
(d) Total valuation of all items	$930,155	$1,035,985
Percentage of total ($) (c/d)	21.2	28.9
Average valuation of items in (a) (c/a)	$1,233	$1,869
(e) Dispersion	$37,360	*
Average dispersion ($e/\sqrt{a}$)	$2,954	*
Verifiability	2.68×10^{-5}	*

DECEMBER 31, 1967

(f) Number of items valued		188
(g) Total number to be valued		436
Percentage of total (number) (f/g)		43.1
(h) Valuation of items in (f)	$323,433	$427,197
(i) Total valuation of all items	$926,808	$1,122,918
Percentage of total ($) (h/i)	34.9	38.0
Average valuation of items in (f) (h/f)	$1,720	$2,272
(j) Dispersion	$38,447	*
Average dispersion ($j/\sqrt{f}$)	$2,804	*
Verifiability	2.60×10^{-5}	*

*Data were not available to compute the dispersion or verifiability of the revised valuations.

market, the market prices of the durable assets can be ascertained.[18] He then indicates that, theoretically, goods for which there is no secondhand market have no opportunity cost, and therefore, no current cash equivalent should be assigned to them.[19] He then outlines a possible method of approximation which can be used if it is desired to place a current cash equivalent on nonvendible assets.[20] This method was used to value the remaining assets even though they do not fit the category "non-vendible."

Briefly the method shown by Chambers can be described as adjusting the book value at a particular point in time for the change in specific prices from date of purchase to the balance sheet date. Chambers indicates that the result of this computation stands in place of an ascertained market price.[21] This must then be adjusted for tax effects.

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[18]"... the case where there is a ready secondhand market, so that market prices of a durable inventory may be ascertained. Many firms, however, will acquire and hold some assets which are so highly specialized that there is no used goods market." Chambers, op. cit., p. 243.

[19]Ibid.

[20]Ibid., pp. 245-249.

[21]Ibid., p. 246.

For the actual computation the price index chosen was the construction machinery and equipment index available monthly in the Survey of Current Business.[22] The book value used was the book value of X Company at the same balance sheet date.[23] Using this method, 110 items (29%) were valued for the December 31, 1966 balance sheet resulting in total net realizable value of $105,685 (Table 8). For December 31, 1967, 131 items (30%) were valued at a total of $108,044. All items had a larger verifiability using the revised measurement method than under conventional methods.[24] The average valuation for the items under both measurement systems and for both years was under $1,000, and the total valuation of items valued by this technique was approximately ten percent

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[22] Survey of Current Business, Vol. 47, January, 1967, p. S-8.
Business Statistics (Washington, D.C.: Office of Business Economics, 1963), p. 43.
Business Statistics (Washington, D.C.: Office of Business Economics, 1965), p. 45.
Survey of Current Business, Vol. 46, January, 1966, p. S-8.
Survey of Current Business, Vol. 48, February, 1968, p. S-8.

[23] This means that the X Company estimates of life and depreciation methods were accepted.

[24] The dispersion for the revised technique is roughly 52% of the GAAP dispersion, since the major cause of dispersion using indexed calculations is the different possible depreciation methods.

Table 8. Summary of Valuation by Indexed Calculations

DECEMBER 31, 1966

	Reported	Revised
(a) Number of items valued		110
(b) Total number to be valued		385
Percent valued (number) (a/b)		28.6
(c) Valuation of items in (a)	$100,361	$105,685
(d) Total valuation of all items	$930,155	$1,035,985
Percentage valued ($) (c/d)	10.8	10.2
Average valuation of items in (a) (d/a)	$912	$961
(e) Dispersion	$20,827	$11,981
Average dispersion ($e/\sqrt{a}$)	$1,986	$1,142
Verifiability	4.80×10^{-5}	8.34×10^{-5}
Number of items for which dispersion of measures obtainable under GAAP was lower		0

DECEMBER 31, 1967

	Reported	Revised
(f) Number of items valued		131
(g) Total number to be valued		436
Percent valued (number) (f/g)		30.0
(h) Valuation of items in (f)	$102,597	$108,044
(i) Total valuation of all items	$926,808	$1,122,918
Percentage valued ($) (h/i)	11.1	9.6
Average valuation of items in (f) (h/f)	$783	$825
(j) Dispersion	$20,784	$12,516
Average dispersion ($j/\sqrt{f}$)	$1,816	$1,094
Verifiability	4.81×10^{-5}	7.98×10^{-5}
Number of items for which dispersion of measures obtainable under GAAP was lower		0

of the total valuation of all items. All of these figures indicate that the plant assets for which no market price could be determined were the relatively less significant items (smaller in value than items measured by use of regression or reference to published sources). This is further demonstrated by a comparison of the average valuation under each method (Table 9). Also reported in Table 9 are the summary results for all three methods of valuation. Here is emphasized the fact that whenever accuracy or verifiability could be determined for one of the revised methods, these measures were greater than the verifiability of generally accepted accounting principles. This means that the revised methods were more "objective" in terms of the normal connotation of observable objectivity. Also for each year only ten percent of the assets (by value) were not valued by direct valuation (either by regression or from published figures).

Treatment of Tax Carryforwards

As mentioned in Chapter II in the section dealing with marketable securities, X Company had an unallocated tax loss carryforward at both balance sheet dates. This carryforward amounted to $289,700 at December 31, 1966 and $1,067,858 at December 31, 1967. The existence of this loss means that the net of tax computations of

Table 9. Summary of Valuation of Plant Assets

DECEMBER 31, 1966

	Regression	Publication	Index	Total
Number of items	115	160	110	385
Percentage (number)	29.9	41.6	28.6	100.0
REVISED:				
Valuation	$631,244	$299,056	$105,685	$1,035,985
Percentage (valuation)	60.9	28.9	10.2	100.0
Average valuation	$5,489	$1,869	$961	$2,691
Dispersion	$4,427	*	$11,981	*
Average dispersion	$413	*	$1,142	*
Accuracy	2.26×10^{-4}	*	$<8.34 \times 10^{-5}$	*
GAAP:				
Book value	$632,438	$197,356	$100,361	$930,155
Percentage (book value)	68.0	21.2	10.8	100.0
Average valuation (book)	$5,499	$1,233	$912	$2,416
Dispersion	$49,922	$37,360	$20,827	$65,740
Average dispersion	$4,655	$2,954	$1,986	$3,350
Accuracy (<Verifiability)	$<2.00 \times 10^{-5}$	$<2.68 \times 10^{-5}$	$<4.80 \times 10^{-5}$	$<1.52 \times 10^{-5}$
UNSUCCESSFUL ITEMS:				
(a) Number of items for which dispersion of GAAP was lower	29	*	0	*
Book value of items in (a)	$0	*	$0	*
Revised value of items in (a)	$6,465	*	$0	*
Average valuation of items in (a) (Revised)	$223	*	$0	*

*Insufficient data.

Table 9 (cont'd)

DECEMBER 31, 1967

	Regression	Publication	Index	Total
Number of items	117	188	131	436
Percentage (number)	26.8	43.1	30.0	100.0
REVISED:				
Valuation	$587,677	$427,197	$108,044	$1,122,918
Percentage (valuation)	52.3	38.0	9.6	100.0
Average valuation	$5,023	$2,272	$825	$2,576
Dispersion	$4,396	*	$12,516	*
Average dispersion	$406	*	$1,094	*
Accuracy	2.27×10^{-4}	*	$<7.98 \times 10^{-5}$	*
GAAP:				
Book value	$500,778	$323,433	$102,597	$926,808
Percentage (book value)	54.0	34.9	11.1	100.0
Average valuation	$4,280	$1,720	$783	$2,126
Dispersion	$63,264	$38,447	$20,784	$76,893
Average dispersion	$5,849	$2,804	$1,816	$3,682
Accuracy (<Verifiability)	$<1.58 \times 10^{-5}$	$<2.60 \times 10^{-5}$	$<4.81 \times 10^{-5}$	$<1.30 \times 10^{-5}$
UNSUCCESSFUL ITEMS:				
(a) Number of items for which dispersion of GAAP was lower	30	*	0	*
Book value of items in (a)	$0	*	$0	*
Revised value of items in (a)	$7,072	*	$0	*
Average valuation of items in (a) (Revised)	$236	*	$0	*

*Insufficient data.

current cash equivalents of marketable securities and plant assets must be adjusted.[25]

The adjustment will not be applied directly to the assets involved, but will, instead, be reported as a separate asset on the balance sheet. There are several reasons for this procedure:

1. The additional net realizable value of assets, due to the loss carryforward, does not attach directly to any specific assets since the total possible gain is greater than the loss carryforward. This means that, if this procedure were not followed, the order in which the assets were expected to be sold after the balance sheet date would affect the carrying value of the assets. This is contrary to common sense and, more importantly in this context, contrary to Chambers' definition of the domain of accounting as excluding anticipatory calculations.[26]

2. The adjustment is not tied to the particular asset but rather is a result of previous misfortunes of the entity. Therefore both the asset and the loss carryforward must exist for the additional net realizable value to exist.

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[25]An adjustment is necessary because a tax was assessed on a prospective gain on the sale of an asset under the assumption that a tax would have to be paid on the gain. However, the gain would not be taxed if it were offset against the loss carryforward. Thus, the net realizable value of the asset would be equal to the proceeds from the sale.

[26]"The domain of accounting is the range of retrospective and contemporary measurements and calculations." Chambers, op. cit., p. 182.

3. If this procedure were not followed, the current cash equivalent of an asset would vary depending on the taxable income of the entity. This result seems neither reasonable nor useful especially in light of 2.

4. The amount of the additional net realizable value (which is in some respects a valuation of the loss carryforward) should be disclosed separately. If the two figures were not reported, a reader would not know the valuation of the assets exclusive of the loss carryforward; i.e., the question, "How much of the net realizable value of the assets will remain after the loss carryforward is absorbed by profitable operation?", can only be answered if the loss carryforward and assets are reported separately.

Even after making the decision to report the effect (on net realizable value of assets) of a loss carryforward separately, the accountant will still be faced with a problem unless the loss carryforward is greater than or equal to the total of the prospective gains on sales of all assets. If this were the case, the effects of the carryforward would equal the discounted value of the taxes which otherwise would be paid upon disposal of all of the assets. The problem which arises under other circumstances (total gains > loss carryforward) is that the loss carryforward offsets a certain amount of gains, thereby rendering the gains non-taxable. This, however,

does not determine the amount of tax which is saved by the existence of the carryforward because of the different tax rates applicable to long-term capital gains.

For example, assume total expected gains from sale of assets are $2 million of which $1 million are eligible for special long term capital gains tax rates. If the loss carryforward is $2 million or more, the additional net realizable value of assets due to the loss carryforward is $730,000:

$1,000,000 x .48	(ordinary income rate)	$480,000
$1,000,000 x .25	(long term capital gains rate)	250,000
		$730,000

There is no problem here because the loss carryforward is large enough to offset all prospective gains.

The situation is not nearly so simple if the loss carryforward is less than $2 million. If, for instance, the loss carryforward is $1 million, the effect on net realizable value of assets may be $480,000 or $250,000 or anything between. If all assets whose gains do not qualify for the 25 percent rate are sold in the year following the balance sheet, the taxes saved by the offset of the loss carryforward will be $480,000. If all assets whose gains <u>do</u> qualify for the 25 percent rate are sold and no ordinary income is reported for the year, the tax savings due to the loss carryforward will be

$250,000.[27] These are extreme examples, but they demonstrate that the tax savings (from the loss carryforward) on sale of assets can range from 25 to 48 percent of the carryforward.[28]

This problem was handled in an arbitrary but completely reasonable manner. The expected gain on each asset was offset against that fraction (of the loss carryforward) which equaled the fraction which is the expected gain on the asset divided by the total possible gain on all assets. This means that an asset whose gain is ten percent of the total possible gain would have its gain offset against ten percent of the loss carryforward. This procedure leads to the same result as dividing the loss carryforward by the total possible gains (yielding the fraction of possible gains which <u>could</u> be offset) and offsetting that fraction of each asset's possible gains. The computation of this figure is easily accomplished by the following formula:

$$ANRV = LC \left[\left(\frac{T25\%}{TG} \right) .25 + \left(\frac{T48\%}{TG} \right) .48 \right]$$

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[27] An operating profit during the period will increase benefits of the loss carryforward, but this is unrelated to additional net realizable value of assets (and furthermore involves an anticipatory calculation).

[28] There is the slight possibility of a 22 percent figure entering here if the total gains are less than $25,000.

where ANRV = additional net realizable value due to unabsorbed loss carryforward
LC = unabsorbed loss carryforward
T25% = total possible gains which qualify for the 25% tax rate
T48% = total possible gains taxable as ordinary income
TG = total possible gain = T25% + T48%.

For December 31, 1966:

$$\$289,700 \left[\left(\frac{\$1,647,509}{\$1,824,108}\right) .25 + \left(\frac{\$176,599}{\$1,824,108}\right) .48\right] = \$78,876$$

For December 31, 1967:

$$\$1,067,858 \left[\left(\frac{\$1,853,493}{\$2,247,494}\right) .25 + \left(\frac{\$394,002}{\$2,247,494}\right) .48\right] = \$310,021$$

These figures must then be discounted to the payment dates since the original deduction for taxes was handled that way. After this adjustment the figures will be:

December 31, 1966	$75,404
December 31, 1967	$296,374

X Company has an additional potential benefit from its tax situation. At each balance sheet date, X Company had an investment credit carryforward which would take effect after the loss carryforward was absorbed. This type of carryforward directly reduces the tax so that there is no uncertainty as to applicable rates. The only adjustment necessary is discounting the future payment benefits back to the balance sheet dates.

	December 31, 1966	1967
Investment credit carryforward	$21,922	$39,047
Discounted investment credit carryforward	$20,957	$37,373
Additional net realizable value of assets due to unabsorbed loss carryforward	75,404	296,374
Total additional net realizable value of assets due to tax carryforwards	$96,361	$334,747

It is difficult to measure the accuracy of the additional net realizable value mainly because of the inability to measure the accuracy of the measurement of fixed assets by either reference to published figures or indexed calculations. A further bar to measurement of accuracy is the necessity of an arbitrary formula for computation of the effects of the unabsorbed loss carryforward. It might help, however, to point out the extreme possible values and the accuracy and separation of these. The lower limit at both balance sheet dates is 25 percent of the loss carryforward plus the investment credit carryforward (with zero dispersion).[29] The upper limit for each year is equal to the gross amount of the lower limit plus 23 percent of the prospective ordinary income

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[29]Assuming that the true possible gain on sale of securities plus the long-term gain on sale of machinery and equipment is greater than or equal to the loss carryforward. In order for this assumption to be incorrect, the true valuation of securities would have to be at least forty percent lower than the indicated market value (even more for December 31, 1966).

from sale of assets.[30] The dispersion, S', of the maximum can be computed as:

$$S' = .23\, p \sqrt{\sum_{\text{all } i \text{ where } t_i = .48} \left[\frac{d_i}{(1-t_i p)}\right]^2}$$

where S' = the dispersion of the maximum benefit
p = the discounting factor $\sim .95$
d_i = the dispersion of the revised measurement of asset i[31]
t_i = marginal tax rate applicable to prospective gain on asset i.

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[30]The maximum benefit of the loss carryforward occurs when as much ordinary income as possible is offset against the loss carryforward. In each case this means that all assets with prospective gains taxable at 48 percent are sold and the rest of the loss carryforward is offset against gains taxed at 25 percent, thus the maximum benefit, MB, is computed as:

$$MB = (.48)\ T48 + .25(LC - T48)$$

$$MB = (.48)\ T48 + .25\ LC - .25\ (T48)$$

$$MB = (.48 - .25)\ T48 + .25LC$$

$$MB = (.23)\ T48 + .25\ LC$$

The lower limit, mb, is computed as

$$mb = .25\ LC$$

so $$MB = .23\ T48 + mb.$$

The benefit of the investment credit carryforward is not affected by the type of gain since this carryforward is applied directly to the tax.

[31]For assets valued by reference to published figures, the dispersion used was an estimate computed as

$$d_i = \sqrt{\left(\frac{RV_i}{T_R + T_I}\right)(D_R^2 + D_I^2)}$$

where d_i = the estimated dispersion of the RV_i for asset i which was valued by reference to published figures
RV_i = the revised valuation of asset i
T_R = total revised valuation of those assets valued by regression
T_I = total revised valuation of those assets valued by indexed calculations
D_R = total dispersion of measurement by regression
D_I = total dispersion of measurement by indexed calculations

As shown in Table 10, the difference between the minimum and maximum benefit of the tax carryforward is $78,830 for December 31, 1966 and $86,631 for December 31, 1967 with dispersions of the maximum of $5,598 and $6,300 respectively. Also shown are the dispersions of the arbitrary measurements, $803 for December 31, 1966 and $2,472 for December 31, 1967.[32]

The Residual Equity Section

The residual equity section of the balance sheet is divided into three sections: constituents contributions (invested capital), retained earnings, and income for the immediately preceding period.[33] The invested capital is shown adjusted for changes in the dimension of the monetary unit from the date of investment. The retained earnings is adjusted in a similar fashion from the end of the period in which the income was earned. The income for the period just elapsed is equal to the ending residual equity minus the beginning residual equity (adjusted for general price change).

When preparing the residual equity section of X Company's December 31, 1966 balance sheet, the income from the preceding period section was omitted mainly

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[32] See note 31.

[33] Chambers, op. cit., pp. 258-259.

Table 10. Estimation of Accuracy of ANRV

	December 31, 1966	1967
(a) Minimum benefit	$69,237	$255,213
Dispersion of minimum benefit	$0	$0
(b) Maximum benefit	$108,067	$341,844
Dispersion of maximum benefit	$5,598	$6,300
Range of benefits (b-a)	$38,830	$86,631
Arbitrary measurement of benefit (by allocation)	$96,361	$334,747
Dispersion of arbitrary measurement*	$803	$2,472

*See note 31.

because computation of this figure would have required preparation of the December 31, 1965 balance sheet, but also because segregation of this figure was not considered necessary. Separation of the other two components of residual equity can be accomplished without the apparently indicated computation of income for preceding years. The invested capital section was first computed by adjusting the investment to current dollars. The retained income amount is then the total residual equity minus the invested capital. (The total residual equity is computed by subtracting liabilities from assets.)

Residual equity	
Invested capital	$1,535,170
Retained income	473,034
Total Residual Equity	$2,008,204

For December 31, 1967, the two amounts above were adjusted for the change in purchasing power between December 31, 1966 and December 31, 1967. This total was subtracted from the total residual equity (assets minus liabilities) of December 31, 1967 to determine income for the year.

Residual equity	
Invested capital	$1,584,692
Retained income	488,293
Income for the preceding period	(177,320)
Total Residual Equity	$1,895,665

The Full Revised Balance Sheet

The full revised balance sheets are shown and compared with the conventional balance sheets in Table 11. The major difference in each year is the change in current assets (which results in a change in Retained Earnings). The major change in current assets is due to the increase in Marketable Securities. Machinery and Equipment is also increased while a new asset, Additional Net Realizable Value Due to Tax Carryforwards, is created. This is really an additional increase in Marketable Securities and Machinery and Equipment. This makes the total increase in these two items about $1.4 million at December 31, 1966 and $1.8 million at December 31, 1967. Accounts Receivable and liabilities (and Inventories in 1967) are decreased.

As far as accuracy is concerned the receivables and liabilities have an additional source of error as far as the estimate of payment date. In the case of liabilities this is determined by contract in some cases and company intentions in some others. The receivables and remaining payables are basically determined by the weather. The money will start changing hands shortly after work begins in the spring. The error in this estimate is not likely to be more than one month so the error in discounting of receivables will be a maximum

Table 11. Conventional and Revised Balance Sheets

X Company
Balance Sheets
December 31, 1966

	Conventional	Revised
ASSETS		
Current Assets		
Cash	$1,272,637	$1,272,637
Marketable securities	474,979	1,675,013
Accounts receivable	2,382,415	2,289,876
Inventories		40,000
Total Current Assets	$4,130,031	$5,277,526
Deferred Charges		
Construction supplies	$40,000	
Prepaid interest	70,000	
Total Deferred Charges	$110,000	
Total Current Assets and Deferred Charges	$4,240,031	
Other Assets		
Machinery and equipment	$2,798,530	
Less: Accumulated depreciation	1,868,375	
Net machinery and equipment	$930,155	$1,035,985
Additional net realizable value of assets due to tax carryforwards		96,361
Total Assets	$5,170,186	$6,409,872
LIABILITIES AND STOCKHOLDERS' EQUITY		
Current Liabilities		
Accounts payable	$1,571,466	$1,538,999
Notes payable - current	145,000	140,164
Accrued payroll	12,497	12,497
Accrued interest payable	40,141	40,141
Accrued taxes payable	61,918	61,918
Total Current Liabilities	$1,831,022	$1,793,719
Long-term Liabilities		
Notes payable	$2,662,500	$2,607,949
Total Liabilities	$4,493,522	$4,401,668
Stockholders' (Residual) Equity		
Paid in (invested) capital	$1,200,000	$1,535,170
Retained earnings	(523,336)	473,034
Total Stockholders' (Residual) Equity	$676,664	$2,008,204
Total Liabilities and Stockholders' Equity	$5,170,186	$6,409,872

Table 11 (cont'd)

X Company
Balance Sheets
December 31, 1967

	Conventional	Revised
ASSETS		
Current Assets		
Cash	$624,137	$624,137
Marketable securities	495,183	1,859,538
Accounts receivable	2,394,982	2,243,424
Inventories		196,333
Prepaid expenses		4,815
Total Current Assets	$3,514,302	$4,928,247
Deferred Charges		
Work in process	174,317	
Lumber and supplies	40,000	
Prepaid interest	93,000	
Prepaid expenses	4,815	
Total Deferred Charges	$312,132	
Total Current Assets and Deferred Charges	$3,826,434	
Other Assets		
Machinery and equipment	3,233,408	
Less: Accumulated depreciation	2,306,600	
Net machinery and equipment	$926,808	$1,122,918
Additional net realizable value of assets due to tax carryforward		334,747
Total Assets	$4,753,242	$6,385,912
LIABILITIES AND STOCKHOLDERS' EQUITY		
Current Liabilities		
Accounts payable	$1,616,312	$1,503,267
Notes payable - current	232,000	224,263
Accrued payroll	5,499	5,499
Accured interest payable	40,816	40,816
Accrued taxes payable	34,442	34,442
Total Current Liabilities	$1,929,069	$1,808,287
Long-term Liabilities		
Notes payable	$2,742,250	$2,681,960
Total Liabilities	$4,671,319	$4,490,247
Stockholders' (Residual) Equity		
Paid in (invested) capital	$1,200,000	$1,584,692
Retained earnings	(1,118,077)	488,293
Income for past year		(177,320)
Total Stockholders' (Residual) Equity	$81,923	$1,895,665
Total Liabilities and Stockholders' Equity	$4,753,242	$6,385,912

of about .58 per cent or about $13,000.[34] The Inventory amount is as good as the records supporting it. The Marketable Securities only source of error is the different prices prevailing on one trading day. The average should be very close with over fifty issues involved.[35]

The measurement of Machinery and Equipment has already been shown to be more accurate than conventional methods for the items measured by regression and indexed calculations. Using the dispersion estimating procedure described in footnote 31 of this chapter, the total dispersion for those items measured by reference to published sources was computed.

The complete comparison of dispersions as shown on the following page.

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[34] If there is a necessity for estimating bad receivables, the net receivables would be affected by a smaller amount than the gross receivables.

[35] No holding of any security is a significant fraction of the issue.

	December 31, 1966		December 31, 1967	
	Conventional	Revised	Conventional	Revised
Regression	$49,922	$4,427	$63,264	$4,395
Price reference	$37,360	$8,137	$38,447	$9,521
Indexed calculation	$20,827	$11,982	$20,784	$12,516
Total machinery and equipment	$65,740	$15,143	$76,893	$16,329
Dispersion of additional net realizable value due to tax carryforwards		$803		$2,472
Total dispersion of additional net realizable value of marketable securities and machinery and equipment		$15,166		$16,515

The dispersion of the revised figures is smaller for each group in each year. The total dispersion for Machinery and Equipment is less than one-fourth of the dispersion of the conventional measurements. This holds true even after the dispersion of the Additional Net Realizable Value is added.

The conclusion must be that the accuracy of the revised balance sheets compares favorably with the accuracy of the conventional balance sheets and that the figures reported are substantially different. In fact, they are different enough that the prediction might be made that a reader of the revised balance sheets might form a significantly different opinion than he would if he had read the conventional balance sheets.

CHAPTER IV

THE INCOME STATEMENT

Chambers gives a sample income statement on page 256:

Revenues:	from sales of short-term inventory	_____
	from sales of durables	_____
	Total revenues	
Costs:	(i) current cash equivalent, at time of sale, of short-term inventories and durables	
	(ii) price adjustments to short-term inventories and durables (Cr. if prices have risen)	
	(iii) depreciation and obsolescence	
	(iv) purchase prices of services not assigned to short-term inventory	
	(v) capital maintenance adjustment	_____
	Total costs	_____
Business income:	Total Revenues minus Total Costs	
Windfalls:		_____
Total Income:	Business Income plus Windfalls	_____ [1]

This sample statement is a starting point and employs interesting terminology, but several adjustments in wording and concept are necessary before the actual statement will either make sense or report the same income as was shown on the ending balance sheet. These adjustments will be introduced and explained together with the appropriate section of the income statement.

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[1] R.J. Chambers, Accounting, Evaluation and Economic Behavior, p. 256.

Revenues

Revenues are "receipts of money or claims to money."[2] This includes payment for all goods sold and services rendered by X Company. Chambers mentions specifically only revenues resulting from sales of short-term inventory and durables. Revenue from sales of short-term inventory is the construction revenue, but X Company also earns and receives interest revenue both from its security holdings and from accepting deferred payment for goods and services. This addition is the first necessary adjustment of the sample statement. Similarly we must add dividend revenue.

The revenue from sales of durables would be receipts upon sales of machinery and equipment. This does not include revenue from sales of marketable securities (which are short-term assets). Therefore we must add a section for revenue from sales of marketable securities.

The resulting revenue sections of the income statements are:

	Conventional	Revised
Construction revenue	$15,826,951	$15,243,065
Interest revenue	8,413	533,279
Dividend revenue	82,212	82,212
Proceeds from sale of machinery and equipment	15,994	19,724
Proceeds from sale of securities	539	736
Total Revenues	$15,934,109	$15,879,017

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[2] Ibid., p. 257.

Construction revenue is discounted by use of the same procedure used for receivables in Chapter II. That is, the amounts summed are the current cash equivalents of the claims to money at the time of sale. Thus the gross revenue of $15,826,951 becomes $15,243,065.

Interest revenue is computed as the beginning receivables discount plus the discounts of construction revenue during the period, less the ending receivables discount. To this result is added the amount of interest earned on securities held.

Discount on beginning receivables	$ 92,538
Discount of construction revenue	583,886
	$ 676,424
Less: Discount on ending receivables	151,558
Total interest earned through acceptance of deferred payments	$ 524,866
Interest revenue on bonds	8,413
Total Interest Revenue	$ 533,279

One further comment on construction and interest revenue as far as the revision is concerned: The sum of construction and interest revenue is entirely independent of the discount computed on the construction revenue. It depends entirely upon the gross construction revenue and the beginning and ending discounts on receivables.[3]

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[3]In succeeding years, a record of the divergence of management's discount expectations and results might be deemed useful. In this case the construction revenue plus the interest revenue plus the divergence would be independent of the discount of the construction revenue.

The point is that an error in estimation of the discount on construction receivables will result in an error in classification of revenue only and will not affect net income.

The other revenue items are simply the amounts received. The conventional figures for sales of equipment and securities are different because current practice is to show only the gain on the disposal of a non-inventory item.

Costs

Costs is a rather misleading title for this section of the income statement. A more descriptive title might be something like "Deductions from revenue" or "Charges against revenue."

Section (i) of the costs must be augmented by the current cash equivalent of the securities sold, plus the amount of the additional net realizable value due to tax carryforwards which was used to avoid taxes on disposal of equipment and marketable securities.[4] Section (ii) must be almost completely redefined since it excludes price adjustments to marketable securities and additional net realizable value. Further, section (iii) includes price adjustments to durables which for most durables are properly included under section (iii).

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[4]Again marketable securities and additional net realizable value are neither short-term inventories nor durables.

Sections (iii), (iv) and (v) need only one adjustment. The capital maintenance adjustment [section (v)] must be reduced by the amount of the adjustment for general price level change included in depreciation and obsolescence [section (iii)].[5] The cost sections of the income statement which result are:

	Conventional	Revised
Costs:		
(i) Current cash equivalent of jobs sold	$16,327,210	$14,273,353
Current cash equivalent of equipment sold		15,119
Current cash equivalent of securities sold		607
Amount of ANRV used in sales of equipment and securities		4,734
(ii) Price adjustment of marketable securities (CR.)		(164,732)
Price adjustment to ANRV (CR.)		(243,120)
(iii) Depreciation and obsolescence		467,000
(iv) General and administrative expense		1,178,487
Interest expense	201,640	504,813
(v) Capital maintenance adjustment		64,781
Less: Adjustment included in (iii)		(44,705)
Total Costs	$16,528,850	$16,056,337

[5] In other words, Chambers' formulation of the income statement double counts part of the capital maintenance adjustment. The adjustment included in sections (iii) and (v) could easily be more than twice the proper adjustment. (The primary discussion and several later comments on depreciation and obsolescence, Chambers, Op. Cit., pp. 209, 218, 242, 265, clearly include general price level adjustments as part of depreciation and obsolescence. However, the section concerning entries to be made for implementation, Ibid., pp. 254-256, could be inconsistent on this point, if Chambers does not intend to include general price level effects upon durables as part of depreciation, there is no double counting.)

The current cash equivalent of jobs sold was computed by deducting from the gross cost of jobs ($16,501,528) the indirect costs, the discount on the direct costs and the direct cost of the ending inventory.[6]

Gross cost	$16,501,528
Less: Indirect costs[7]	1,702,451
Direct Costs	$14,799,077
Less: Discount on direct costs	369,391
Direct costs of short-term inventory	$14,429,686
Less: Direct cost of ending inventory	156,333
Current Cash Equivalent of Jobs Sold	$14,273,353

The current cash equivalents of the equipment and securities sold are simply the proceeds less the discounted tax payments. The use of the additional net realizable value (ANRV) results from the fact that the tax payments need not be made.

The price adjustment to marketable securities is simply the change in current cash equivalent of securities adjusted for disposals and additions.

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[6]The direct costs were discounted by the same procedure used in Chapter II to discount Accounts Payable.

[7]Includes both general and administrative expenses and rent for owned equipment. (The "profit" or "loss" on the equipment yard is closed to general and administrative expense.)

Marketable securities-December 31, 1967	$1,859,538
Current cash equivalent of securities sold	607
	$1,860,145
Less: Additional investment in securities	20,400
	$1,839,745
Less: Marketable securities-December 31, 1966	1,675,013
Price Adjustment to Marketable Securities (credit since prices have risen)	$ 164,732

The price adjustment to additional net realizable value due to unabsorbed tax carryforwards (ANRV) was computed in a similar manner.

ANRV-December 31, 1967	$ 334,747
ANRV used to reduce tax payments on sale of equipment and securities	4,734
	$ 339,481
ANRV-December 31, 1966	96,361
Price Adjustment to ANRV (credit since prices have risen)	$ 243,120

The computation of depreciation and obsolescence will be covered in the next section since it is a major test of the revised income statement.

The general and administrative expense was the total of the general and administrative expense and the rental of owned equipment exclusive of depreciation on machinery and equipment since the depreciation was entered in section (iii) under Costs.

General and administrative expense		$908,446
Rental of owned equipment	$794,005	
Less: Depreciation of machinery and equipment	523,964	270,041
General and Administrative Expense		$1,178,487

The interest expense consists of the interest actually paid on the notes payable plus a computation involving discounts on Accounts Payable and direct costs of jobs similar

to the computation of interest revenue which involved discounts on Accounts Receivable and construction revenue.[8]

Discount on beginning Accounts Payable		$ 32,467
Discount on direct cost of jobs		363,391
		$401,858
Less: Discount on ending Accounts Payable		113,045
Total amount of value received from suppliers and subcontractors through their willingness to accept deferred payment		$288,813
Interest expense on Notes Payable		
Note One	$28,656	
Note Two	10,704	
Note Three	176,640	
Total interest expense on Notes Payable		216,000
Total Interest Expense		$504,813

The capital maintenance adjustment is that amount by which residual equity would have had to increase if X Company were to exactly maintain its purchasing power. Chambers has indicated that his choice of index (of the general level of prices) for use in computation is the consumer price index.[9] The consumer price index at December 31, 1966 was computed as the average of the December, 1966 and January, 1967 indices or 114.7 (1957-1959 =100).[10] The comparable figure for December 31, 1967 was 118.4.[11] The total capital maintenance adjustment was then computed as the product of the beginning

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[8]For Notes One and Two the interest was computed simply as the reduction in discount, but this is valid only when the effective rate of interest does not change.

[9]Chambers, op. cit., p. 229.

[10]Survey of Current Business, Vol. 48, February, 1968, p. S-7.

[11]Survey of Current Business, Vol. 48, March, 1968, p. s-7.

residual equity, $2,008,204, and the fraction (118.4 - 114.7)/114.7 yielding as a result $64,781. Of this amount $44,705 was included in the depreciation and obsolescence total so that the net adjustment in section (v) was $20,076.

Depreciation and Obsolescence

Chambers indicates that there are two separate components of depreciation and obsolescence, change in measurement due to relative price change and change due to wear, tear and technical obsolescence.[12] He then states that these two components need not be shown separately.[13] Thus the depreciation and obsolescence of an asset is equal to the beginning current cash equivalent, adjusted for general price change, minus the ending current cash equivalent.[14] For equipment held the entire year, this figure is equal to the decrease in current cash equivalent plus the increase in dollars necessary to maintain the amount of purchasing power implicitly refused when the asset was not sold at the beginning of the year.

Using this formula, the depreciation and obsolescence for

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[12] Chambers, op. cit., pp. 239-240.

[13] Ibid., p. 242.

[14] It is possible that "negative depreciation" might result from relative price changes offsetting wear, tear, and technical obsolescence.

X Company was $467,000 of which $44,705 was adjustment for change in the general price level. This amount must be deducted from the capital maintenance adjustment section [section (v) of the income statement] to avoid double counting the adjustment for general price level change.

The accuracy and tabulation of "unsuccessful" items are shown in Table 12. The same conclusion must be drawn from this measurement as was drawn from the original measurement of current cash equivalent: The revised methods only fail on the least significant items. These unsuccessful items again have a total book value of $0. The majority (16 of 23) result from one of the four disadvantage situations listed in Chapter III.

The Complete Income Statement

The complete revised income statement, its dispersions, and the conventional income statement appear in Table 13. The dispersion of revised net income is less than the dispersion of the GAAP depreciation alone. Thus the accuracy of revised net income is more than four times a generous estimate of the verifiability of conventional net income.

The dispersion of the sum of construction revenue and interest revenue is computed directly from estimated dispersions of the beginning and ending accounts receivable since the sum is independent of the discount of construction revenue during the year. The dispersions of the accounts receivable were estimated assuming the true measure had equal probability

Table 12. Depreciation and Obsolescence

	Regression	Publication	Index	Total
Number of items	121	202	131	454
Percentage (number)	26.7	44.4	28.9	100.0
Revised depreciation and obsolescence	$233,656	$178,475	$64,869	$467,000
Dispersion (revised)	$1,603	$3,962*	$4,763	$6,399*
Accuracy	6.24×10^{-4}	$< 2.52 \times 10^{-4}$*	$< 2.10 \times 10^{-4}$	$< 1.56 \times 10^{-4}$*
Dispersion	$35,297	$20,772	$10,800	$42,355
Accuracy (GAAP) (Verifiability)	2.83×10^{-5}	4.81×10^{-5}	9.26×10^{-5}	2.36×10^{-5}
Unsuccessful items				
Number of items for which dispersion of GAAP was lower	23	+	0	+
Total book value	$0	+	$0	+
Reasons for unsuccessful items				
1. Unknown purchase price	8			
2. Lack of realistic purchase price	1			
3. Extreme age	0			
4. Negative prediction of current cash equivalent at December 31, 1966	10			
5. None of the above	7			

Table 12 (cont'd)

	Regression
Largest difference in dispersion	$101
Difference in average dispersion	$31
Successful items:	
Largest difference in dispersion (dispersion regression<dispersion GAAP)	$11,464
Difference in average dispersion	$3,573

*Dispersion of items valued by reference to published figures estimated by the method described in Footnote 28 of Chapter III (except that the weights and dispersions are based on depreciation for the year instead of current cash equivalent at a certain date).

+Insufficient data. (The estimation mentioned in * is for comparison of totals only.)

Table 13. Comparison of Income Statements

X Company
Income Statement
for the Year Ended December 31, 1967

	Conventional	Revised	Dispersion of Revised
REVENUES:			
Construction revenue	$15,826,951	$15,243,065	$11,096[a]
Interest revenue	8,413	533,280	a
Dividend revenue	82,212	82,212	0
Proceeds from sale of equipment	15,994	19,724	0
Proceeds from sale of securities	539	736	0
Total Revenues	$15,934,109	$15,879,017	$11,096
COSTS:			
Cost of jobs	$16,327,210	$14,273,353	$ 7,204[b]
Current cash equivalent of equipment sold		15,119	0
Current cash equivalent of securities sold		607	0
Current cash equivalent of ANRV used		4,734	0
Price adjustment to securities		(164,732)	~ 0
Price adjustment to ANRV		(243,120)	2,599
Depreciation and obsolescence		467,000	6,399
General and administrative expense		1,178,487	0
Interest expense	201,640	504,813	b
Capital maintenance adjustment (net)		20,076	510
Total Costs	$16,528,850	$16,056,337	$9,993
Total Income (Loss)	($594,741)	(177,320)	$10,072
Accuracy of total income	$<2.36 \times 10^{-5}$	[c] 9.93×10^{-5}	

a. The dispersion of the sum of construction revenue and interest revenue is shown opposite construction revenue.

b. The dispersion of the sum of the cost of jobs and interest expense is shown opposite cost of jobs.

c. The figure opposite accuracy of total income for conventional is the verifiability of depreciation under GAAP.

of being any amount within the error range (± .58 per-cent).[15] The measures of beginning and ending receivables were assumed to be independent. A similar procedure was followed for the computation of the dispersion of the sum of cost of jobs and interest expense.

The dispersion of the adjustment to additional net realizable value was derived assuming that the beginning and ending measurements were independent.[16] The dispersion of depreciation and obsolescence was computed directly and reported in Table 12.

The dispersion of the capital maintenance adjustment is the adjusting fraction (.03226) times the dispersion of the beginning residual equity (estimated in Table 14). In Tables 13 and 14 all items whose dispersions are $0 result either from counts or legal liabilities whose date of payment is specified by contract. The rectangular distribution is assumed for all other obligations. The dispersion of residual equity is computed assuming all items except estimates receivable and estimates payable to subcontractors are independent. The estimates receivable

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[15]This assumption of a rectangular distribution probably gives an overly generous estimate since if a normal distribution is assumed with the probability of the error exceeding .58 per cent being less than .05, the dispersion would decrease 13.4 per cent.

[16]This assumption is not valid, but is again a generous estimate of dispersion.

Table 14. Estimation of Dispersion of Balance Sheet Figures

	December 31, 1966	December 31, 1967
Cash	$0	$0
Marketable securities	~0	~0
Accounts receivable	668	7,512
Inventories	0	0
Prepaid expense	0	0
Machinery and equipment	15,145	16,329
Additional net realizable value	803	2,472
Accounts payable	5,154	5,034
Other liabilities	0	0
Residual equity	15,826	17,229
Accuracy of residual equity	6.32×10^{-5}	5.80×10^{-5}

and payable to subcontractors are not independent since X Company acts as collection agent for the subcontractor. Therefore, any error in measurement of a receivable which will be paid to a subcontractor is offset (in the computation of residual equity) by an equal error in the measurement of the corresponding liability. This adjustment is also made for the computation of the dispersion of revised net income. The figures labeled "accuracy" for net income in Table 13 and residual equity in Table 14 are not quite estimates of accuracy because the dispersion measure for machinery and equipment valued by use of price indices yields only the verifiability measure. These figures have been labeled "accuracy" because that is their only component which is not an estimate of dispersion from the true figure.

The conclusion must again be that in accuracy and verifiability the revised income statement compares favorably with the conventional statement and that an informed reader might form significantly different opinions concerning the statements.

CHAPTER V

DISPERSION OF DIFFERENT MEASURERS

In order to test empirically the dispersion of measurements according to the Chambers model, four doctoral candidates at Michigan State University were asked to give measurement rules. These four students were selected because they were familiar with the Chambers model. The results may be biased by the fact that all four were attending the same graduate school. This tendency toward bias would probably be mitigated by the fact that they attended four different undergraduate schools.

Each of the four subjects was interviewed independently and informed of the type and quantity of data available. He was then asked to place himself in the position of the controller of X Company and give instructions for the preparation of financial statements based on the data available. The resulting four sets of statements and the author's statements (shown in the previous chapter) were compared and dispersions and averages computed. These averages and dispersions are presented in Table 15.

Current Assets and Revenues

In all cases cash was simply accepted as the count shown in the records and therefore has no dispersion.

Table 15. Results of Measurement by Five Measurers

X Company
Balance Sheet
December 31, 1966

	Average (A)	Standard Deviation (SD)	$\frac{SD}{A} \times 100$
Assets			
Current Assets:			
Cash	$1,272,637	$ 0	
Marketable securities	1,675,013	0	
Accounts receivable	2,294,238	2,187	.10
Inventories	40,000	0	
Total Current Assets	$5,281,888	2,187	.04
Other Assets:			
Machinery and equipment	1,024,977	7,825	.76
Additional net realizable value	95,750	370	.39
Total Assets	$6,402,615	6,906	.11
Liabilities and Residual Equity			
Current Liabilities:			
Accounts payable	$1,541,577	2,111	.14
Notes payable-current	140,164	0	
Accrued payroll	12,497	0	
Accrued interest payable	40,141	0	
Accrued taxes payable	61,918	0	
Total Current Liabilities	$1,796,297	2,111	.12
Long-term Liabilities:			
Notes payable - non-current	2,607,949	0	
Total Liabilities	$4,404,246	2,111	.05
Residual Equity:			
Invested capital	1,535,170	0	
Retained earnings	463,199	6,691	1.44
Total Residual Equity	1,998,369	6,691	.33
Total Liabilities and Residual Equity	$6,402,615	6,906	.11

Table 15 (cont'd.)

X Company
Balance Sheet
December 31, 1967

	Average (A)	Standard Deviation (SD)	$\frac{SD}{A} \times 100$
Assets			
Current Assets:			
Cash	$ 624,137	$ 0	
Marketable securities	1,859,538	0	
Accounts receivable	2,245,908	2,103	.09
Inventories	196,333	0	
Prepaid expenses	4,815	0	
Total Current Assets	$4,930,731	2,103	.04
Other Assets:			
Machinery and equipment	1,110,292	9,159	.82
Additional net realizable value	332,004	1,579	.48
Total Assets	$6,373,027	8,623	.14
Liabilities and Residual Equity			
Current Liabilities:			
Accounts payable	$1,502,265	818	.05
Notes payable-current	224,263	0	
Accrued payroll	5,499	0	
Accrued interest payable	40,816	0	
Accrued taxes payable	34,442	0	
Total Current Liabilities	$1,807,285	818	.04
Long-term Liabilities:			
Notes payable - non-current	2,681,960	0	
Total Liabilities	$4,489,245	818	.02
Residual Equity:			
Invested capital	1,584,692	0	
Retained earnings	478,141	6,907	1.44
Income for prior year	(179,051)	4,196	2.34
Total Residual Equity	$1,883,782	8,676	.46
Total Liabilities and Residual Equity	$6,373,027	8,623	.14

Table 15 (cont'd.)

X Company
Income Statement
For the Year Ended December 31, 1967

	Average (A)	Standard Deviation (SD)	$\frac{SD}{A} \times 100$
Revenues:			
Construction revenue	$15,237,695	$3,152	.02
Interest revenue	536,771	3,902	.73
Dividend revenue	82,212	0	
From sales of equipment	19,724	0	
From sales of securities	736	0	
Total Revenues	$15,877,138	2,065	.01
Costs:			
Current cash equivalent of jobs sold	$14,290,439	13,951	.10
Current cash equivalent of equipment sold	15,119	0	
Current cash equivalent of securities sold	607	0	
Current cash equivalent of ANRV used	4,734	0	
Price adjustment to securities	(164,732)	0	
Price adjustment to additional net realizable value	(240,987)	1,248	.52
Depreciation and obsolescence	468,269	3,368	.72
General and administrative expense	1,178,487	0	
Interest expense	484,146	16,875	3.48
Adjustment for change in general price level	64,463	216	.34
Less: Adjustment included in depreciation	(44,356)	252	.57
Total Costs	$16,056,189	5,413	.03
Income (Loss) for the Year	($179,051)	4,196	2.35
Current Cash Equivalent of Jobs Sold + Interest Expense	$14,775,855	2,881	.02

All measurers saw no need to adjust inventories for price changes, and all chose the same method for removing indirect costs from ending work-in-process inventory. Therefore, these items had no dispersion.

Marketable securities show no dispersion since all measurers computed the market price in the same manner and used the same procedure for arriving at net of tax from a given market price.[1]

Similarly no dispersion appears in the price adjustment to securities or the current cash equivalent of securities sold.

The accounts receivable and construction revenue were discounted using instructions from the measurers. Four used the same rates but different minimum periods for discount or methods of computing the discount. The fifth measurer used a rate, 2 per cent per quarter, which was slightly higher than X Company's cost of debt capital, .62281 per cent per month. Number Five also had a

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[1]One measurer directed that the effects of tax carryforwards be added directly to the assets involved, but his method of computation yielded the same total for marketable securities plus machinery and equipment plus additional net realizable value. The means and standard deviations were computed using the results which would have been obtained if the additional net realizable value had been reported separately. This procedure does not affect total assets, residual equity or net income.

different minimum discount period. Obviously these different instructions yielded different measurements of accounts receivable and construction revenue. These in turn caused a dispersion in interest revenue. These standard deviations, ranging from $2,100 to $3,900 (or .02 per cent to .73 per cent of the corresponding average), must be considered acceptable to all but the penny-hunters.[2]

Prepaid expense, and the other revenues were accepted by all measurers at the amounts shown in the conventional books. Since no adjustments were made, the dispersions are zero. The dispersion of total current assets was less than $2,200 and .04 per cent for each year.

Liabilities and Related Costs

Four of the measurers gave the same instructions for discounting liabilities as they had given for discounting receivables. The fifth measurer changed the rate to be used for discounting. This means that all measurers used the same discount rate but different periods. These different periods caused dispersions in accounts payable, cost of jobs, and interest expense ranging from $818 to $16,875 or .05 per cent to 3.48 per cent. Note that as

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[2]Note also that the standard deviation of the sum of construction revenue and interest revenue is less than .02 per cent of the average sum.

far as effect on income is concerned the dispersion of the sum of cost of jobs and interest expense is $2,881 or .02 per cent.

The five measurers all discounted the notes payable (current and long-term) in the same fashion so there is no dispersion for the notes payable. The other current liabilities were all due within one month of the balance sheet date which meant that none of them were discounted by any of the measurers. The dispersions of total liabilities were $2,111 and $818 for the two balance sheets. The percentage dispersions were .05 per cent and .02 per cent respectively.

Other Assets and Related Costs

Machinery and Equipment. All measurers chose regression as their primary valuation procedure. This did not produce common results since different regression procedures were specified by different measurers. As Table 16 shows, the dispersion of the five measurers is less than one-tenth the dispersion of the measures obtained from application of generally accepted accounting principles in total. The percentage of unsuccessful items is slightly over ten percent for each balance sheet date, but again these items are among the least valuable items

Table 16. Valuation by Regression (by Different Measurers)

December 31, 1966

	Reported	Revised (Average)
(a) Number of items valued by regression		115
(b) Total number to be valued		385
Percent valued by regression (number) (a/b)		29.9
(c) Valuation of items in (a)	$632,438	$620,236
(d) Total valuation of all items	$930,155	$1,024,977
Average valuation of items in (a) (c/a)	$5,499	$5,393
Percent valued by regression ($) (c/d)	68.0	60.5
(e) Dispersion of items in (a)	$49,922	$3,913
Average dispersion ($e/\sqrt{a}$)	$4,655	$365
Verifiability *	2.00×10^{-5}	2.56×10^{-4}
(f) Number of items for which dispersion of GAAP was lower		12
(g) Number of items for which dispersion of five measurers was lower		103
Percent of (f) to total (a)		10.4
(h) Valuation of items in (a)	$0	$4,217
Average value per item (h/f)	$0	$351
(i) Valuation of items in (b)	$632,438	$616,019
Average value per item (i/g)	$6,140	$5,981
Percent of valuation accounted for by successful items (i/c)	100.0	99.3

*As defined in Appendix.

Table 16 (cont'd.)

December 31, 1967

	Reported	Revised (Average)
(j) Number of items valued by regression		117
(k) Total number to be valued		436
Percent valued by regression (number) (j/k)		26.8
(m) Valuation of items in (d)	$500,778	$575,050
(n) Total valuation of all items	$926,808	$1,110,292
Average valuation of items in (d) (m/j)	$4,280	$4,915
Percent valued by regression ($) (m/n)	54.0	51.8
(p) Dispersion of items in (j)	$63,264	$4,391
Average dispersion ($p/\sqrt{j}$)	$5,849	$406
Verifiability *	1.58×10^{-5}	2.28×10^{-4}
(q) Number of items for which dispersion of GAAP was lower		14
(r) Number of items for which dispersion of five measurers was lower		103
Percent of (q) to total (j)		12.0
(s) Valuation of items in (q)	$1,806	$5,674
Average valuation per item (s/q)	$129	$405
(t) Valuation of items in (r)	$498,972	$569,376
Average valuation per item (t/r)	$4,844	$5,528
Percent of valuation accounted for by successful items (t/m)	99.6	99.0

*As defined in Appendix.

Table 16 (cont'd.)

ANALYSIS OF UNSUCCESSFUL ITEMS

	1966	1967
1. Unknown purchase price	6	4
2. Extreme age	3	3
3. None of the above	3	7
Largest difference in dispersion of items in 3.	$39	$32
Difference in average dispersion of items in 3.	$20	$9
Largest difference in dispersion of successful items	$19,984	$18,574
Difference in average dispersion of successful items	$4,505	$5,802

in this group.[4] Further the difference in average dispersions and largest difference in dispersion (favoring GAAP) of the unsuccessful items are insignificant compared to the same figures for the successful items (favoring revised figures). The verifiability of the five measurements was greater than 2.25×10^{-4} compared to the verifiability of the GAAP measurements which was less than or equal to 2.00×10^{-5}.

The five measurers chose reference to published figures as their second measurement method. All instructions yielded the same results as were shown in Table 7 (Chapter III, p. 53). These results are also presented in Table 17. The uniformity of results means that the verifiability measure is not defined.[5] This verifiability, however, is greater than the verifiability of any set of measurements with a positive standard deviation.

All measurers directed the same procedure for valuing items which could not be valued directly by either of the above methods.

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[4]This can be seen by comparing the average valuations (book value or revised) of the successful items with the average of the unsuccessful items.

[5]The measure of verifiability derived in the Appendix yields $\frac{1}{0}$ which is not a valid number.

Table 17. Summary of Valuation of Plant Assets by Five Measurers

December 31, 1966

	Regression	Publication	Index*	Total
Number of items	115	160	110	385
Percentage (number)	29.9	41.6	28.6	100.0
REVISED:				
Valuation	$620,236	$299,056	$105,685	$1,024,977
Percentage (revised valuation)	60.5	29.2	10.3	100.0
Average valuation	$5,393	$1,869	$961	$2,662
Dispersion	$3,913	$0	$11,981	$12,604
Average dispersion	$365	$0	$1,142	$642
Verifiability	2.56×10^{-4}	+	8.34×10^{-5}	7.9×10^{-5}
GAAP:				
Book value	$632,438	$197,356	$100,361	$930,155
Percentage (book value)	68.0	21.2	10.8	100.0
Average book value	$5,499	$1,233	$912	$2,416
Dispersion	$49,922	$37,360	$20,827	$65,740
Average dispersion	$4,655	$2,954	$1,986	$3,350
Verifiability	2.00×10^{-5}	2.68×10^{-5}	4.80×10^{-5}	1.52×10^{-5}
UNSUCCESSFUL ITEMS:				
(a) Number of items for which dispersion of measures obtainable under GAAP was lower	12	0	0	12
Book value of items in (a)	$0	$0	$0	$0
Revised value of items in (a)	$4,217	$0	$0	$4,217
Average valuation of items in (a) (Revised)	$351	$0	$0	$351

Table 17 (cont'd.)

December 31, 1967

	Regression	Publication	Index*	Total
Number of items	117	188	131	436
Percentage (number)	26.8	43.1	30.0	100.0
REVISED:				
Valuation	$575,050	$427,197	$108,044	$1,110,292
Percentage (valuation)	51.8	38.5	9.7	100.0
Average valuation	$4,915	$2,272	$825	$2,547
Dispersion	$4,391	$0	$12,516	$13,264
Average dispersion	$406	$0	$1,094	$635
Verifiability	2.28 x 10-4	+	7.98 x 10-5	7.53 x 10-5
GAAP:				
Book value	$500,778	$323,433	$102,597	$926,808
Percentage (book value)	54.0	34.9	11.1	100.0
Average book value	$4,280	$1,720	$783	$2,126
Dispersion	$63,264	$38,447	$20,784	$76,893
Average dispersion	$5,849	$2,804	$1,816	$3,682
Verifiability	1.58 x 10-5	2.60 x 10-5	4.81 x 10-5	1.30 x 10-5
UNSUCCESSFUL ITEMS:				
(b) Number of items for which dispersion of GAAP was lower	14	0	0	14
Book value of items in (b)	$1,806	$0	$0	$1,806
Revised value of items in (b)	$5,674	$0	$0	$5,674
Average valuation of items in (b) (Revised)	$129	$0	$0	$129

*All methods outlined by measurers yielded the same result. In order to remove the advantage of an existing depreciation schedule the adjusted dispersion of book values was used in this column.

+The measure of verifiability is not defined when the dispersion is zero. However, if the dispersion is zero, the verifiability is greater than the verifiability of any measurement whose dispersion is greater than zero.

The method and results are the same as those described in Chapter III (pp. 52-55) and reported in Table 8 (Chapter III, p. 56). The results are also summarized in Table 17. Although the actual dispersion is zero, the dispersions shown are those which would result if the indexed calculations were performed using all reasonable depreciation methods. This was done because the measurers directed that the existing depreciation methods be used. If these depreciation methods had not already been in use for these particular assets, the measurers would have had to choose from the set of "reasonable" depreciation methods (acceptable to the CPA). The resulting dispersion would probably have approximated the adjusted dispersion of book values (Chapter III, pp. 55-57). The indicated dispersion thus puts the revised methods on the same basis as GAAP as far as choosing a depreciation method.[6]

Table 17 shows that the total GAAP dispersion for Machinery and Equipment is at least five times the dispersion of the revised measures at each balance sheet date. In other words, the verifiability of the revised measures is five times as great as the verifiability of the GAAP measurements.

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[6]Note that this is the only method which requires a choice of depreciation procedures. The other revision methods do not require the accountant to exercise judgment in the choice of depreciation procedures. Thus an element of subjectivity is removed. The removal of this element of subjectivity accounts for a large part of the difference in dispersion of the conventional and revised valuation methods.

The measurers gave equivalent directions for computation of depreciation and obsolescence and ending current cash equivalents. Thus the dispersions of items measured by reference to published sources or indexed calculations were zero. These were adjusted upward in the case of the items measured by indexed calculations for the reasons mentioned above.

The dispersions for items measured by regression are a direct result of the dispersions in current cash equivalents at the balance sheet dates. The total of these dispersions is $3,226 for the revised and $35,297 for GAAP giving the revised measurement a verifiability more than ten times the verifiability of the GAAP measurements. There were only ten unsuccessful items out of 121 with six of these items having a zero dispersion for GAAP due to unknown purchase prices and one item which had an unrealistically low purchase price. The difference in average dispersion for the other three items of $17 indicates that when the dispersion of GAAP was lower, it was not lower by very much (largest difference in dispersion was $37). (See Table 18.)

Additional Net Realizable Value Due to Tax Carryforwards. Four measurers gave instructions which resulted in the same values for Additional Net Realizable Value Due to Tax

Table 18. Depreciation and Obsolescence by Five Measurers

	Regression	Publication	Index*	Total
Number of items	121	202	131	454
Percentage	26.7	44.4	28.9	100.0
Revised depreciation and obsolescence	$224,925	$178,475	$64,869	$468,269
Average	$1,859	$884	$495	$1,018
Dispersion (revised)	$3,226	$0	$4,763	$5,752
Verifiability	3.1×10^{-4}	+	2.1×10^{-4}	1.7×10^{-4}
Dispersion (GAAP)	$35,297	$20,772	$10,800	$42,355
Verifiability	2.83×10^{-5}	4.8×10^{-5}	9.26×10^{-5}	2.36×10^{-5}
Unsuccessful items				
(a) Number of items for which dispersion of GAAP was lower	10	0	0	10
Reasons for unsuccessful items				
1. Unknown purchase price	6	0	0	6
2. Lack of realistic purchase price	1	0	0	1
3. None of the above	3	0	0	3
Largest difference in dispersion of items in 3	$37	$0	$0	$37
Difference in average dispersion of items in 3	$17	$0	$0	$17
Depreciation of items in 3	$794	$0	$0	$794
Percentage of total depreciation	.4	0	0	.2
Successful items:				
Largest difference in dispersion (dispersion regression < GAAP dispersion)	$10,647			
Difference in average dispersion	$3,077			

*All methods outlined by measurers yielded the same result. In order to be generous, the adjusted dispersion of book values was used in this column.

+The measure of verifiability is not defined when the dispersion is zero. However, if the dispersion is zero, the verifiability is greater than the verifiability of any measurement whose dispersion is greater than zero.

Carryforwards and its price adjustment. The fifth measurer instructed that the additional net realizable value be disclosed, not separately, but as a part of the current cash equivalent of the assets involved. The method of computation yielded the same total result for ANRV as would be the case if computed in total under instructions from one of the other measurers. Therefore, for comparability, the ANRV for this measurer was shown separately and adjusted separately on the income statement.[7] The effect of this was to alter for this measurer the values reported for marketable securities, machinery and equipment and ANRV, but not total assets. Items affected on the income statement were current cash equivalents of equipment and securities sold, current cash equivalent of ANRV used, price adjustment to securities and ANRV and depreciation and obsolescence. Neither total costs nor net income was affected.

With this change in instructions, the computations of the ANRV were performed in the manner described in Chapter III (pp. 63-65). The dispersion of prospective gains inherent in the dispersion of current cash equivalents of equipment caused dispersions of $370 and $1,579 in the ANRV at December 31, 1966 and December 31, 1967 respectively. Both of these dispersions were less than

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[7]This was the only case where the measurers' instructions were not followed.

one-half of one percent of the average ANRV, $95,750 and $332,004 respectively. The dispersion of the price adjustment to ANRV was $1,248 or about one-half of one percent of the average adjustment, $240,987.[8]

Residual Equity and the Remainder of the Income Statement

The total residual equity is simply the difference between total assets and total liabilities. Since total assets and total liabilities have dispersions, residual equity also has a dispersion on each balance sheet. This dispersion is in each case less than one-half of one percent of the average residual equity. Within residual equity, invested capital has no dispersion since all measurers directed identical general price level adjustments of prior investments using the same index. The retained earnings at December 31, 1966 (total residual equity minus invested capital) thus shows all of the dispersions of residual equity.[9] At December 31, 1967, the dispersion of total residual equity has two sources, retained earnings and prior year's income. At this date, dispersion of residual equity $8,676, is still less than one-half of one percent of average residual equity but the dispersion

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[8]The dispersions of the current cash equivalents of equipment sold and ANRV used are zero since the market value is observed not estimated.

[9]Translation of a distribution does not affect its standard deviation.

of prior year's income, $4,196, is 2.35 percent of the average prior year's income. This is the highest ratio of dispersion to average for any attribute reported in Table 15 (except interest expense which acts in conjunction with cost of jobs sold to produce a much smaller effect on total costs).

The adjustment for change in general price level showed a dispersion due to the dispersion in beginning residual equity. This can be checked by multiplying the dispersion of beginning residual equity, $6,691, times the adjustment factor $\frac{P_1-P_0}{P_0}\left(\frac{118.4 - 114.7}{114.7}\right)$ to verify dispersion of the price level adjustment, $216. The ratio of the standard deviations to the averages were equal as a result of this relationship. The dispersion of the portion of the general price level adjustment included in depreciation and obsolescence results mainly from the dispersion in valuation of Machinery and Equipment held at December 31, 1966.[10]

General and administrative expense was accepted without adjustment by all measurers due to the short period of time between receipt of services and payment for those services.

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[10]The absolute value of adjustment for change in general price level included in depreciation and obsolescence varies almost directly with the weighted average investment in assets during the period.

Total costs averaged $16,055,947 with a standard deviation of $5,413 (.03 percent of the average). This deviation certainly must be classified as acceptable. The deviation of net income (resulting from the dispersions of total revenues and total costs) was $4,196 compared to the average loss of $179,051. This should also be considered as acceptable especially in light of the dispersion of depreciation measures possible under alternative generally accepted accounting principles, $42,355.

The dispersions of measurements as directed by five independent measurers and reported in Table 15 were in each case less than the estimated dispersions of revised measurements presented in Tables 8 and 14 (Chapters III, IV, pp. 56, 89). The results of this test then should further reinforce the results and conclusions of Chapters III and IV, namely, that the revised statements report the financial position and the results of operations of X Company with more verifiability than conventional statements. Further the reader of the revised statements would probably form a significantly different conclusion regarding X Company if he were presented with the revised rather than the conventional statements.

CHAPTER VI

COST AND CONCLUSIONS

Cost. One property of any application of a new accounting technique or system, which should be determined, is the cost. In this case the cost was computed as the additional expenditure necessary to restate the two conventional balance sheets and one income statement. This will basically be the cost of the operations described in Chapters II, III, and IV. The total cost of conversion was $1,975 as detailed in Table 19. The times shown are actual hours of each type of labor or computer use.[1] The hourly rates are the rates at which X Company was being charged at that time for that class of labor. The hourly rate for the computer usage was the rate chargeable for the computer on which the conversion was actually performed (a CDC 3600) rather than the rate for the machine X Company used at the time (an IBM 1401).

Clerical work included coding of regression observations, coding of parameters of actual equipment,

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[1]The keypunch-verify time, the actual time, is generous since the operators were not as skilled as the operators who would have been used by X Company.

The computer time is, to some extent, an estimate because the actual runs computed and compared dispersions and did the computations for Chapter V as well as the work necessary for the preparation of one set of statements. This adjustment did not effect the amount charged for regression, which was the major part of the computer usage.

Table 19. Cost of Conversion

Function	Rate	Hours	Total
Total Conversion Costs			
Clerical	$4.00/hr.	137.48	$550
Keypunch-verification	$10.50/hr.	15.03	158
Programming	$10.00/hr.	5.00	50
Computer	$245.00/hr.	4.97	$1,217
Total Conversion Costs			$1,975
Regression Costs			
Clerical	$4.00/hr.	17.48	$70
Keypunch-verification	$10.50/hr.	11.66	123
Programming	$10.00/hr.	3.00	30
Computer	$245.00/hr.	4.87	$1,192
Total Regression Costs			$1,415
Conversion costs not using regression			$560
One-Time Costs*			
Clerical	$4.00/hr.	115.00	$460
Keypunch-verification	$10.50/hr.	2.38	25
Programming	$10.00/hr.	4.00	40
Computer	$245.00/hr.	.05	12
			$537
Conversion costs after first year			$1,438

*Assuming no savings on regression after first year.

valuing equipment by price reference, and coding (for discounting) intervals between incurrence and payment of obligations. The keypunch and verify work transferred the coded data to cards. The programming and computer time performed the regressions, discounted the receivables and payables, applied the regressions to the equipment parameters to determine estimated current cash equivalents, performed the indexed calculations, and used the previously determined beginning and ending current cash equivalents to determine depreciation and obsolescence.

The major part of the cost of conversion was the cost associated with the regressions, $1,415. Thus if the regression method of valuation were deemed unnecessary, the cost of conversion would be $560.[2]

Another side of the cost picture is the amount of costs which would only be incurred at the time of initial conversion. These are the costs associated with the discounting procedure. These costs would be avoided after the initial conversion because the records would be kept showing expenses and revenues at net rather than gross amounts. The discounting costs avoided in later years (one-time costs) totaled $537 making the recurring costs $1,438 (assuming the regression technique was used in these years). This is probably an overestimate since the

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[2]Remember that the published figures were available for all items valued by regression.

knowledge gained from the regressions run at initial conversion would probably reduce the costs of regression in later years.

The question of the advisibility of incurring this $2,000 of additional cost must be answered by comparing this cost to the benefits of the conversion. The benefits will not be measured here, but with $16 million plus of costs any improvement in management due to the information provided by the revised statements would be almost certain to exceed $2,000.

Conclusions. All of the evidence in Chapters II - V indicates that, in this situation, the revised measurements show dispersion which should be acceptable to statement users. The dispersion of revised net income was about five percent when estimated in Chapter IV.[3] The actual dispersion of five measurements of net income was 2.35 percent.[4]

Most of the adverse predictions in Chapter I indicated the belief that the major problem would be the valuation of fixed assets.[5] The results showed very clearly that the

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[3]Table 13, p. 87.

[4]Table 15, p. 92.

[5]Pp. 2-3.

revised methods were more objective (verifiable) than the methods acceptable under generally accepted accounting principles. The regression technique provided the greatest amount of comparative data. Under this method, the accuracy was ten times greater than the accuracy of generally accepted accounting principles.[6] Unsuccessful items (those for which the dispersion of methods acceptable under GAAP was less than the dispersion of the regression) had a total book value of zero and total revised value of about one percent of the revised value of the items valued by regression.[7] The comparison of dispersions of depreciation emphatically support the conclusion that regression was able to measure these assets more objectively than conventional depreciation methods.[8]

Further, seventy percent of the items were valued directly with their total value (book or revised) equalling approximately ninety percent of the value of fixed assets. This figure would probably be increased if the Chambers model was widely used since increased demand for sale data and published resale prices would cause increased and more diversified supply.

The conclusions stated above do not prove that the Chambers model is generally applicable in all situations.

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[6]Tables 4 and 5, pp. 40-41.

[7]Ibid.

[8]Table 12, p. 85. and Table 13, p. 87.

They indicate that the model was practical in this particular situation. The further statement could be made that the model would probably be applicable to companies similar to X Company. The one overriding general conclusion is that a large scale study should investigate a wider sample of companies (possibly over a longer period of time) to determine the extent of the situations in which the model is practical.

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APPENDIX

APPENDIX

ACCURACY AND VERIFIABILITY

Ijiri and Jaedicke have defined a measure they call reliability.[1] Unfortunately, this measure requires that the decision maker's predictive function be known. This means that the measure of reliability depends upon the decision-maker. For this study (and probably other purposes), it is more useful to define a measure of accuracy which is independent of the decision-maker and his predictive function.[2]

Thus accuracy, A, is defined by

$$A^{-2} = \frac{1}{n} \sum_{i=1}^{n} (x_i - T)^2 \qquad (1)$$

where the x_i are a set of n measurements of the same attribute of a particular item or entity.
T is the true measure of the attribute.

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[1] Yuji Ijiri and Robert K. Jaedicke, "Reliability and Objectivity of Accounting Measurements," The Accounting Review, July, 1966, pp. 474-483.

[2] The reliability measure combines two factors, verifiability and accuracy of predictive function. If the predictive function chosen is poor, the set of measurements is automatically very low in reliability regardless of the susceptibility to measurement of the attribute being measured and the precision of the methods used. Since this study is concerned with the susceptibility to measurement of certain attributes of a firm and the precision of the methods which can be employed to measure these attributes, the reliability measure must be rejected.

The concept of accuracy can also be related to the accountant's concept of objectivity. Because objectivity is a state of mind (freedom from bias), it cannot be measured directly. This does not present a problem since the average accountant considers a measurement to be objective if many different accountants, measuring the same attribute, would give the same or similar measures as their result. The concept might more properly be called verifiability and could be defined as:

$$V^{-2} = \frac{1}{n} \sum_{i=1}^{n} (x_i - \bar{x})^2 \qquad (2)$$

where: the x_i are a set of n measurements of the same attribute of a particular item or entity

$\bar{x} = \frac{1}{n} \sum_{i=1}^{n} x_i$ = the mean of the measurements.

or $$V = \sqrt{\frac{n}{\sum_{i=1}^{n} (x_i - \bar{x})^2}} = \frac{1}{\sigma}$$

σ = the standard deviation of the x_i.

from (1) $$A^{-2} = \frac{1}{n} \sum_{i=1}^{n} (x_i - T)^2$$

$$A^{-2} = \frac{1}{n} \sum_{i=1}^{n} [(x_i - \bar{x}) + (\bar{x} - T)]^2$$

$$A^{-2} = \frac{1}{n} \sum_{i=1}^{n} [(x_i - \bar{x})^2 + 2(x_i - \bar{x})(\bar{x} - T) + (\bar{x} - T)^2]$$

$$A^{-2} = \frac{1}{n} \sum_{i=1}^{n} (x_i - \bar{x})^2 + \frac{2}{n} \sum_{i=1}^{n} [(x_i - \bar{x})(\bar{x} - T)] + \frac{1}{n} \sum_{i=1}^{n} (\bar{x} - T)^2] \qquad (3)$$

but $\sum_{i=1}^{n} (x_i - \bar{x}) = 0$

and $\bar{x} - T$ is constant over all i so

$\frac{1}{n} \sum_{i=1}^{n} (\bar{x} - T)^2 = (\bar{x} - T)^2$ so (3) becomes

$$A^{-2} = \frac{1}{n} \sum_{i=1}^{n} (x_i - \bar{x})^2 + (\bar{x} - T)^2 \qquad (4)$$

substituting from (2)

$A^{-2} = V^{-2} + (\bar{x} - T)^2$ or,

$$A^{-2} = V^{-2} + B^2 \qquad (5)$$

where $B = \bar{x} - T$ = bias (6)

Since $B^2 \geq 0$,

$A^{-2} \geq V^{-2}$ or

$\frac{1}{A^2} \geq \frac{1}{V^2}$

inverting $A^2 \leq V^2$

taking positive square root $A \leq V$ (7).

Therefore the measure of accuracy, A, is less than or equal to the verifiability, V, of the same set of measurements. The condition for equality of (7) is that B (from (6)) = 0. This would be the case where the mean of the measurements was equal to the true measure of the attribute, i.e., where bias is zero. Otherwise A < V.

Groups of Items

The measure of accuracy A_s of the sum of a group of n items which were independently measured will be defined as:

$$A_s^{-1} = \sqrt{\sum_{i=1}^{n} A_i^{-2}} \qquad (8)$$

Similarly the verifiability of such a sum is:

$$V_s^{-1} = \sqrt{\sum_{i=1}^{n} V_i^{-2}} \qquad (9)$$

from (7) $A_i \leq V_i$ for each i, $i = 1,2,\ldots,n$.

Since each element in the sum in (8) is less than or equal to each element of the sum in (9),

$$A_s \leq V_s \qquad (10)$$

The condition for equality in (10) is the $\sum_{i=1}^{n} B_i = 0$, or that the mean of the measures for each item in the group must be exactly equal to the true measure of that item. If this seemingly rather improbable condition does not exist, the more likely relationship is $A_s < V_s$.