An alternative approach to fundamental analysis: The asset side of the equation

Here's a model for measuring discounted cash flows from the firm's assets instead of their liabilities.

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The primary approach to establishing a common stock's fundamental value is to estimate the discounted value of dividends. When the discounted value of dividends exceeds the market value of the security, either the issue is undervalued by the market, or the investor's assessment overstates true discounted value. A shortcoming of this approach is that in only the simplest of conditions can the dividend stream be modeled within a general equilibrium framework.

An alternative approach is to measure fundamental value as the discounted sum of the underlying asset cash flows. There are a number of theoretical justifications for this approach. First, Tobin [1969] provides convincing arguments that the fundamental values of assets and total claims (liabilities plus stockholders' equity) are equal, at least from a balance sheet perspective. This equality is effectively an economic restatement of the accounting identity between total assets and total claims.

Second, Jorgenson [1967] establishes that in competitive and complete capital markets the economic income generated by capital assets just equals the economic cost of using capital. As Jorgenson points out, this is a restatement, from an income perspective, of the Modigliani and Miller [1963] result that arbitrage behavior is assurance that the return on capital is exhausted by financing costs, regardless of financial structure. Third, and most significantly, the cash flows from real assets can be linked to an array of structural and economic variables in a general equilibrium framework.

This study describes a cash flow model for estimating real asset values. Empirical estimates from the real asset cash flow model are used to compare the market value of financial claims and fundamental asset values.

Results indicate that, on average, market values significantly undervalue asset values in Textile Products, Primary Metals, Electric Utilities, and Gas Utilities (even though in some years securities were overvalued). Conversely, average market values significantly overvalue average asset values in Food Products, Paper Products, Chemicals, Non-electrical Machinery, and Electrical Machinery. Average market values were indistinguishable from fundamental asset values in Petroleum Products, Stone-Clay-Glass, Rubber-Plastics, and Telephone-Telegraph. Results also show substantial interindustry variation in the response of fundamental asset values to changes in ex-

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pected inflation or corporate tax law.

DISCOUNTED CASH FLOW MODELS

Farrell [1985] in a primer on the discounted dividend model shows that the fundamental value at time s of a common stock equals the discounted value of the infinite dividend stream, as in

$$V_s = \sum_{t=1}^{\infty} D_{s+t}(1 + k)^{-t}, \qquad (1)$$

where V denotes fundamental equity value, D_t is the dividend expected at time t, and k is the equity financing rate.

Operationalizing this model requires measurement of k and of the dividend stream (D_{s+t}, t = 1, . . ., ∞). k might be estimated either as the sum of the dividend yield plus capital gains yield or within the framework of the Capital Asset Pricing Model (CAPM). The dividend often is assumed to grow at the rate g, so that Equation (1) is rewritten as

$$V_s = \sum_{t=1}^{\infty} D_s[(1 + g)/(1 + k)]^t \qquad (2)$$

$$= \frac{D_{s+1}}{k - g}. \qquad (2a)$$

Equation (2a) is the well-known discounted dividend model equating fundamental value (left-hand side) to the present value of the expected dividend stream (right-hand side), with the simplifying assumption that dividends grow smoothly at a constant rate. In general, though, any pattern of expected dividends may be specified, and fundamental value is easily computed as the stream's discounted value.

The discounted dividend model relies on the existence of market equilibrium only to the extent that estimates of k might be derived within a CAPM framework. There are no restrictions on the pattern or the size of the dividend stream. While proper estimates of k may take account of the systematic risk component of expected cash flows, the specification of the dividend stream is otherwise ill-defined.[1]

An alternative discounted cash flow model can be developed that specifies the expected cash flow stream subject to the restriction that the market for real assets is at equilibrium. One advantage of this restriction is internal consistency. Furthermore, imposition of an equilibrium condition introduces a dependency between fundamental value and factors shaping asset cash flows, such as tax depreciation schedules or economic depreciation patterns, for example.

This alternative model proceeds by specifying the cash flows that are expected to be produced by accumulated real assets. There are other studies (LeBaron and Speidell [1987] is one) that focus on the values of the firm's assets in order to make inferences about whether securities are "properly priced." The real asset cash flow model is unique in that an array of economic variables are combined in a rigorous, equilibrium setting. Because the model focuses on cash flows from real assets, it is most applicable for firms or industries having substantial fixed assets, such as manufacturing or utility companies.

The real asset cash flow model computes the fundamental value of a firm's fixed assets at time s (FV_s) as the discounted sum of its expected pre-tax cash flows (before interest), denoted $PVEBDT_s$, minus proportional taxes, plus the tax savings from depreciation deductions, denoted $\tau PVTXD_s$ (τ is the statutory corporate income tax rate):

$$FV_s = (1 - \tau)PVEBDT_s + \tau PVTXD_s. \qquad (3)$$

The discount rate used in computing present values is the weighted average of after-tax debt and equity financing rates. Therefore, FV equals the intrinsic worth of debt and equity claims.[2]

At each particular time, computation of FV_s requires the estimation of $PVEBDT_s$ and $PVTXD_s$. These estimations require construction of the cash flows expected to accrue beyond time s. The versatility of the real asset cash flow model arises because the pre-tax cash flow stream is determined as the unique one that is consistent with equilibrium in the real asset market.

Computing the present value of pre-tax cash flows, PVEBDT, involves two steps. The first is deducing the amount of pre-tax cash flow per unit of asset that is sustainable in an equilibrium setting. That information can be extracted from the zero net present value investment equilibrium in the market for real assets. The equilibrium equates the (observable) price of a unit of new asset to its (unobservable) pre-tax cash flows, (observable) tax liabilities, and (observable) capacity depreciation schedule.[3] The pre-tax cash flow per unit of asset is the only unobservable variable in the zero net present value equilibrium condition, and it can be backed out; it equals the user cost of capital.[4] The user cost is also referred to in the literature as the rental price of capital; its derivation is detailed in an Appendix available from the author on request.

The second step in computing PVEBDT is to deduce the total pre-tax cash flow generated by all assets. This is obtained by measuring the amount contributed to future potential productive capacity by each unit of existing asset. Historical real capital expenditures are depreciated into the future according to the capacity depreciation schedule characteristic of the asset. This yields the quantity of assets existing at time t that were already in place at time s, denoted $K_{s,t}$. Each period, the total pre-tax cash flow equals the quantity of assets multiplied by the user cost of capital.[5] The stream is discounted at the weighted average financing rate, thereby yielding PVEBDT.

Computing the present value of depreciation tax savings, τPVTXD, requires construction of the stream of expected tax depreciation deductions on existing assets.[6] This is done by depreciating all historical capital expenditures (gross capital investments) using the tax practices in effect at times of installation. The investments are depreciated into the future, thereby yielding the stream of expected tax depreciation deductions. Each period, the tax savings from depreciation equal the deduction multiplied by the statutory income tax rate. The stream is discounted at the weighted average financing rate, thereby yielding PVTXD.

A restatement of the fundamental value of fixed assets at time s is:

$$FV_s = \sum_{t=1}^{\infty} [(1 - \tau)(1 + r - p)^{-t} c_s K_{s,s+t}$$

$$+ \tau (1 + r)^{-t} \sum_{u=1}^{\infty} q_{s-u+1} I_{s-u+1} z_{s-u+1,t+u-1}]. \qquad (4)$$

Equation (4) is an empirically usable model that expresses the equilibrium fundamental value of assets as the sum of discounted pre-tax cash flows net of proportional taxes plus discounted tax savings from the depreciation tax shield. The variables are defined as:

- τ = statutory corporate income tax rate;
- r = weighted average financing rate;
- p = expected inflation rate;
- c = pre-tax cash flow per unit of asset;
- $K_{s,t}$ = quantity of real assets in-place at time s that remain productive at time t;
- q = unit price of a new asset;
- I = real capital expenditures; and
- $z_{s,t}$ = proportion of time s capital expenditures deductible for tax purposes at time s + t.

Furthermore, the pre-tax cash flow, c, is derived from an equilibrium condition that preserves the identity of the additional variables:

- v = rate of the investment tax credit (if any);
- D = a statistic computed from the capacity depreciation schedule; and
- Z_s = present value of tax depreciation deductions per dollar of time s capital expenditure.

COMPARISON OF FINANCIAL AND FUNDAMENTAL VALUES

I use the real asset cash flow model to construct estimates of fundamental values for assets in several different industries between 1975 and 1985. The model is applied at the industry rather than the firm level because only at the industry level are data readily available on investment expenditures by type of asset. The model summarized in Equation (4) is used to estimate (separately) the fundamental values of structures and equipment, FV(P&E).

Results: Telephone and Telegraph

Results for the Telephone and Telegraph Industry (SIC 481) illustrate application of the model. Industry components of FV(P&E) for each year, 1975–1985, are listed in Table 1. The first column gives the present value of tax depreciation deductions, PVTXD. In 1975, the discounted sum of expected tax depreciation deductions was equal to $49,834 million. This number is obtained by using tax depreciation schedules (discussed in the Appendix) to allocate beyond 1975 the capital expenditures from all previous years.

For example, expenditures from 1948 are depreciated by the tax practices in effect in 1948, and the deductions remaining beyond 1975 are measured. Likewise, expenditures from 1949 that allow deductions remaining beyond 1975 are measured, as are deductions on expenditures from 1950, and so on. The total deductions (structures and equipment) expected beyond 1975 constitute the tax depreciation stream relevant for the computation of $PVTXD_{1975}$. The stream is discounted at the weighted average financing rate (construction described in the Appendix), which yields a present value of $49,834 million. This is equal to about one-half the current cost of fixed assets in this industry ($101,505 million).[7]

The present value of pre-tax cash flows, PVEBDT, is shown in column 2 of Table 1. Assets in 1975 promise discounted pre-tax cash flows equal to $95,931 million. Obtaining this entry requires modeling the productive capacity that existing assets will possess beyond 1975. Real investments from all years prior to 1975 are depreciated according to their capacity depreciation schedule, and the quantity surviving in each year beyond 1975 is computed. The quantity surviving until 1975 + t is denoted in Equation (4) as $K_{1975,t}$. The amount of cash flow produced per unit of asset is deduced from the zero net present value investment equilibrium.

In 1975, the price of new assets is observable, as are the expected tax and capacity depreciation schedules for new investments. The equilibrium pre-tax cash flow that is consistent with the observed price

TABLE 1

Components of the Overvalue Ratio in the Telephone and Telegraph Industry, 1975–1985

Year	PVTXD -1-	Fundamental Value PVEBDT -2-	FV(P&E) -3-	FV(TOTAL) -4-	Market Value MV(EQUITY) -5-	MV(TOTAL) -6-	Overvalue Ratio MV/FV -7-
1975	$49,834	$95,931	$72,020	$84,286	$32,026	$81,616	0.97
1976	55,054	107,765	80,381	93,940	42,399	98,560	1.05
1977	60,982	118,918	88,895	103,970	44,570	108,366	1.04
1978	71,354	122,929	96,110	113,789	47,427	118,801	1.04
1979	80,109	143,516	111,477	131,835	46,056	128,565	0.98
1980	86,898	167,475	127,799	150,241	46,594	135,810	0.90
1981	93,886	176,198	135,314	161,402	63,792	157,201	0.97
1982	103,665	218,524	160,107	190,175	77,420	176,654	0.93
1983	113,027	238,815	175,305	217,755	93,994	217,967	1.00
1984	117,680	245,849	186,891	252,474	114,529	260,465	1.03
1985	126,374	257,119	196,976	252,801	141,019	303,664	1.20

Notes:

All dollars are in millions.
PVTXD is the present value of tax depreciation deductions expected over the life of existing fixed assets.
PVEBDT is the present value of pre-tax cash flows (before interest).
FV(P&E) is the fundamental value of fixed assets.
FV(TOTAL) is the fundamental value of total assets.
MV(EQUITY) is the market value of equity.
MV(TOTAL) is the market value of all financial claims.

and expected tax and capacity depreciation schedules is the user cost of capital. The total pre-tax cash flow expected at time 1975 + t equals the user cost times the quantity of assets. The pre-tax cash flow stream is discounted at the weighted average financing rate, resulting in an estimated $PVEBDT_{1975}$ equal to $95,931 million.

Proportional taxes are subtracted from pre-tax cash flow at a corporate income tax rate of 0.5187 (tax rate sources are described in the Appendix), but discounted depreciation deductions reduce taxable income by $49,834 million. Thus, the total discounted value of Telephone and Telegraph industry after-tax cash flows expected from fixed assets in-place as of 1975 (column 3) is $72,020 million: $46,171 million from pre-tax cash flows net of proportional taxes [$(1 - \tau)PVEBDT_{1975}$] and $25,849 million from the tax savings on the depreciation tax shield [$\tau PVTXD_{1975}$].

The fundamental value of the total assets in the Telephone and Telegraph industry, denoted FV(TOTAL), is equal to the sum of FV(P&E) plus the fundamental value of other assets, denoted FV(OTHER). FV(OTHER) is set to its book value and obtained by sampling balance sheet data for the firms in this industry that are contained in the Compustat data base. The items "Total Assets" and "Net Fixed Assets" are summed across all firms, and FV(OTHER) is set equal to their difference, i.e., FV(OTHER) = Total Assets − Net Fixed Assets. For the Telephone and Telegraph industry in 1975, FV(OTHER) equals $12,266 million. Therefore, FV(TOTAL) equals $84,286 million.[8]

FV(TOTAL) constitutes a subjective estimate of the intrinsic worth of assets in the Telephone and Telegraph industry. Comparison of this estimate with the market value of the industry's financial claims can yield information that may be useful in formulating investment strategy — whether, for example, the assets can sustain current financial market values.

The next step is to construct estimates of market value for the Compustat sample of firms in this industry in 1975 using a procedure for converting from book to market value based on von Furstenberg, Malkiel, and Watson [1980]. The procedure values short-term debt at par and long-term debt by sampling trading prices from *Moody's Bond Record*. Common equity value equals its market price times shares outstanding, and preferred equity is valued through conversion with dividend–price ratios. That process yields an industry market value of debt, denoted MV(DEBT), equal to $49,590 million, and a market value of equity, denoted MV(EQUITY) and listed in column 5, equal to $32,026 million. The total market value of the Telephone and Telegraph industry in 1975, denoted MV(TOTAL) and listed in column 6, is $81,616 million.

The ratio of total market value to total fundamental value, MV(TOTAL)/FV(TOTAL), is referred to as the "overvalue ratio."[9] The overvalue ratio for the Telephone and Telegraph industry in 1975 is 0.97 ($81,616 million divided by $84,286 million). The observable market value of securities is reconcilable to within 3% of the fundamental value of the assets in the industry. This evidence suggests that the securities are "properly priced."

These procedures are repeated for successive years. As Table 1 shows, the overvalue ratio remains fairly stable through 1978. It then begins a steep decline, falling to 0.98 in 1979 and then 0.90 in 1980. That is, securities prices undervalued fundamental asset values by 10% in 1980. This information may have been useful in formulating a successful investment strategy, because in 1981 the ratio rebounded seven percentage points. After a slight aborted recovery in 1982, the overvalue ratio climbed steadily to reach a peak of 1.20 in 1985, the last year in the sample period. Between 1982 and 1985, the fundamental value of assets in Telephone and Telegraph rose an average 9.9% per year, while the market value of financial claims rose an average 19.8%.

Throughout the eleven-year sample period, the overvalue ratio averages 1.01, indicating that on average securities in Telephone and Telegraph are reconcilable to within 1% of fundamental asset values. The null hypothesis that the mean overvalue ratio equals unity cannot be rejected. The results nevertheless do not establish that it is profitable to buy securities when the overvalue ratio is less than unity, or conversely, that it is profitable to short them when the overvalue ratio exceeds unity. The point to be made is that the real asset cash flow model can provide information bearing on whether underlying assets can sustain observed financial market values.[10]

Comparative Results: Other Industries

The real asset cash flow model next is used to estimate fundamental values for the thirteen industries listed in Table 2. Several representative measures from 1980 for each industry are shown. Inspection of the measures reveals wide differences across industries. For example, the fundamental value of structures and equipment [FV(P&E)] represents a different proportion of total fundamental value [FV(TOTAL)] in each industry. Recall that the real asset cash flow model is used to value P&E, while the fundamental values of other assets are set equal to their book values. Throughout the thirteen industries the average ratio of FV(P&E)/FV(TOTAL) is 55%; over half of all assets, that is, are being valued with the real asset cash flow model.

In Electrical Machinery (SIC 36), however, that ratio is 30%, implying that the overvalue ratio probably has characteristics akin to a price-to-book ratio. Conversely, in Electric Utilities (SIC 491), the ratio of FV(P&E)/FV(TOTAL) is 87%. In such a case, the overvalue ratio provides unique information about underlying fundamental asset values.

Following the process I have outlined, and applying industry-unique data on capital expenditures for structures and equipment, tax depreciation schedules, and cost of capital, I have constructed tax shields and pre-tax cash flow streams for each industry and for each year. The resulting estimated overvalue ratios are listed in Table 3.

There are substantial differences among industries. Comparison of the ratios between the first two listed industries, SICs 20 and 22 (Food Products and Textile Products), highlights the most obvious difference. In the first industry all ratios exceed unity; in the second, most ratios are less than unity. SIC 20

TABLE 2

List of Industries in Sample Set and Representative Statistics for 1980

Industry	FV(P&E)	FV(TOTAL)	MV(EQUITY)	MV(TOTAL)
Food Products, SIC 20	$33,023	$84,230	$44,162	85,705
Textile Products, SIC 22	10,328	30,547	11,037	24,564
Paper Products, SIC 26	24,598	43,890	29,313	47,723
Chemicals, SIC 28	53,003	122,379	99,157	152,687
Petroleum Products, SIC 29	24,227	45,075	24,951	47,514
Rubber and Plastics, SIC 30	13,597	33,104	11,219	25,351
Stone, Clay, and Glass, SIC 32	16,255	30,655	17,840	31,150
Primary Metals, SIC 33	37,887	84,633	39,826	77,304
Nonelectrical Machinery, SIC 35	35,968	119,946	95,548	156,782
Electrical Machinery, SIC 36	26,612	89,829	77,098	120,980
Telephone and Telegraph, SIC 481	127,799	150,241	46,594	135,810
Electric Utilities, SIC 491	136,317	156,468	34,730	121,396
Gas Utilities, SIC 492	38,746	59,538	25,606	59,180

Notes:

All dollars are in millions.
FV(P&E) is the fundamental value of fixed assets.
FV(TOTAL) is the fundamental value of total assets.
MV(EQUITY) is the market value of equity.
MV(TOTAL) is the market value of all financial claims.

TABLE 3

Overvalue Ratios in Thirteen Industries, 1975–1985

YEAR	SIC 20	SIC 22	SIC 26	SIC 28	SIC 29	SIC 30
1975	1.31	0.73	1.11	1.59	0.97	0.97
1976	1.28	0.77	1.39	1.50	1.05	0.98
1977	1.18	0.67	1.19	1.31	0.95	0.85
1978	1.14	0.79	1.22	1.28	0.96	0.81
1979	1.04	0.78	1.06	1.24	1.01	0.77
1980	1.02	0.80	1.09	1.25	1.05	0.77
1981	1.01	0.76	0.91	1.14	0.92	0.77
1982	1.14	0.87	0.99	1.19	0.84	0.97
1983	1.19	1.04	1.21	1.33	0.93	1.09
1984	1.25	0.86	1.16	1.32	1.00	1.07
1985	1.53	1.07	1.27	1.56	1.04	1.17

YEAR	SIC 32	SIC 33	SIC 35	SIC 36	SIC 481	SIC 491	SIC 492
1975	0.86	0.90	1.14	1.42	0.97	0.89	0.84
1976	1.07	1.01	1.26	1.46	1.05	0.91	0.95
1977	0.98	0.91	1.16	1.31	1.04	0.94	0.94
1978	0.96	0.91	1.12	1.27	1.04	0.88	0.91
1979	0.97	0.85	1.16	1.22	0.98	0.84	0.99
1980	1.02	0.91	1.31	1.35	0.90	0.78	0.99
1981	0.92	0.88	1.12	1.25	0.97	0.79	0.89
1982	0.90	0.84	0.96	1.93	0.93	0.76	0.82
1983	1.07	1.05	1.17	2.21	1.00	0.84	0.95
1984	1.05	1.07	1.13	1.88	1.03	0.82	0.96
1985	1.29	1.05	1.18	1.87	1.20	0.95	1.05

Notes:

The overvalue ratio equals the ratio of MV(TOTAL)/FV(TOTAL).
MV(TOTAL) is the market value of the industry's financial claims.
FV(TOTAL) is the fundamental value of total assets.

is one of four industries where the overvalue ratio has a range that does not encompass unity. The ratio lies exclusively above unity also in Chemical Products (SIC 28) and Electrical Machinery (SIC 36), and it is exclusively below unity in Electric Utilities (SIC 491).

It is anomalous that for eleven years the overvalue ratio in an industry has a range that does not encompass unity. With SIC 20, for example, the implication is that 1) the industry is consistently overvalued throughout the eleven-year sample period, or 2) the fundamental values of "other assets" are not equal to their book values (and so the overvalue ratio is biased), or 3) the real asset cash flow model understates the true fundamental value of structures and equipment.

The first of these explanations seems untenable. The second explanation likely accounts for the majority of the anomaly because the empirical estimations assign a zero value to intangibles and to the present value of growth opportunities. The third explanation may explain some of the discrepancy, but it seems unlikely that a systematic bias in the model would result in overvalue ratios that are exclusively less than unity in one industry, that are exclusively greater than unity in three industries, and that equal unity at one time or another in nine industries.

Table 4 gives some distribution statistics for overvalue ratios across industries. In six of the thirteen industries the overvalue ratio averages less than unity, in six industries it exceeds unity, and in one industry it equals unity. By making some standard assumptions about the probability distribution governing the overvalue ratio, a statistic can be constructed for testing the hypothesis that an industry's mean overvalue ratio equals unity. This test statistic

TABLE 4

Distribution Statistics About the Overvalue Ratios, 1975–1985

Industry	Mean	Standard Deviation	t-Statistic on Mean = 1	Lower Confidence Endpoint	Upper Confidence Endpoint
Food Products, SIC 20	1.19	0.15	4.15**	0.85	1.53
Textile Products, SIC 22	0.83	0.12	−4.53**	0.56	1.11
Paper Products, SIC 26	1.15	0.13	3.61**	0.85	1.44
Chemicals, SIC 28	1.34	0.15	7.51**	1.01	1.67
Petroleum Products, SIC 29	0.97	0.06	−1.31	0.83	1.12
Rubber and Plastics, SIC 30	0.93	0.14	−1.64	0.61	1.25
Stone, Clay, and Glass, SIC 32	1.00	0.12	0.23	0.75	1.27
Primary Metals, SIC 33	0.94	0.08	−2.21*	0.75	1.13
Nonelectrical Machinery, SIC 35	1.16	0.09	5.87**	0.96	1.35
Electrical Machinery, SIC 36	1.56	0.34	5.39**	0.79	2.33
Telephone and Telegraph, SIC 481	1.01	0.08	0.42	0.83	1.19
Electric Utilities, SIC 491	0.85	0.06	−7.47**	0.71	1.00
Gas Utilities, SIC 492	0.94	0.07	−3.18**	0.79	1.09

Notes:

The mean is the average overvalue ratio for the industry over the 1975–1985 annual sample period.
The t-statistic tests whether the mean equals 1.0 and has critical values of 1.81 at the 10% level (indicated with *) and 2.23 at the 5% level (indicated with **).
The lower and upper endpoints are for the 90% confidence intervals on likely values that the overvalue ratio may take in any given year.

is presented in the third column. The hypothesis cannot be rejected at the 10% significance level in four of the thirteen industries; that is, in four of the thirteen industries the securities are properly priced (on average). On the other hand, financial claims are (on average) significantly undervalued in four industries and overvalued in five.

It is interesting to examine the likelihood that during any given year the overvalue ratio may equal unity. This is deduced through inspection of the 90% confidence intervals around the industry means. As the last two columns of Table 4 show, the confidence intervals encompass unity in twelve of the thirteen industries. Even though a particular industry may have had a history of being over- or undervalued (on average), there is not 90% confidence that during any given year the overvalue ratio may differ from unity.

The 1985 overvalue ratio is greater than the 1975 ratio in twelve of thirteen industries. In fact, in 1985 the overvalue ratios for twelve industries exceed unity, and in seven cases the 1985 ratio represents the industry maximum throughout the sample period. Despite this common trend toward overvaluation in 1985, there are substantial differences in the year-to-year movement in overvalue ratios.

Inspection of the correlation coefficients among the thirteen industry series, presented in Table 5, shows that most correlations are generally positive, but several weakly positive or negative correlations occur. This is evidence of substantial interindustry variation in the movement of financial market values relative to fundamental asset values.

REAL ASSET VALUES AND CHANGES IN THE BUSINESS ENVIRONMENT

Auerbach and Kotlikoff [A&K, 1983] were perhaps the first to use the real asset cash flow model for simulating the impact of a change in business conditions on fundamental value. Their subject is the impact of the Economic Recovery Tax Act of 1981 (ERTA). In a comparison of the numerical value for the user cost of capital in the pre-ERTA environment with that in the post-ERTA environment, A&K infer the resulting change in fundamental value.[11] They conclude that the unanticipated enactment of ERTA caused a $200 to $300 billion decline in corporate asset values.

The primary reason for a decline in corporate asset values was that new assets were extended preferential tax treatment through the introduction of the Accelerated Cost Recovery System (ACRS). Because existing assets were not entitled to these tax benefits, their values declined. ERTA was beneficial to new investments, but equities largely represent claims on existing assets; existing assets were thereby disadvantaged. The real asset cash flow model simulation suggests that the fundamental value of existing assets declined because of the introduction of ACRS.

Downs and Hendershott [D&H, 1987] develop the real asset cash flow model further so that it can be used to simulate the impact of a change in any of its variables.[12] They employ the model to deduce the impact on corporate asset values of the Tax Reform Act of 1986 (TRA). D&H report that because TRA repealed the investment tax credit, lengthened asset tax lives, and reduced the corporate income tax rate, there was a 10% to 13% increase in fundamental equity values for the total corporate sector. TRA represents disincentive legislation; although new investments were penalized, existing assets benefit.

The studies by A&K and D&H present only simulation results. A study by Downs and Tehranian

TABLE 5

Correlation Matrix Between Overvalue Ratios in Alternative Industries, 1975–1985

	Industry SIC Code												
SIC	20	22	26	28	29	30	32	33	35	36	481	491	492
20	1.00												
22	0.49	1.00											
26	0.64	0.23	1.00										
28	0.86	0.21	0.68	1.00									
29	0.30	0.02	0.57	0.50	1.00								
30	0.84	0.74	0.49	0.62	0.05	1.00							
32	0.65	0.71	0.61	0.43	0.57	0.62	1.00						
33	0.64	0.62	0.68	0.50	0.43	0.78	0.76	1.00					
35	0.04	−0.06	0.49	0.33	0.86	−0.11	0.42	0.36	1.00				
36	0.46	0.82	0.19	0.17	−0.26	0.85	0.43	0.62	−0.28	1.00			
481	0.81	0.45	0.65	0.58	0.37	0.59	0.78	0.62	0.11	0.22	1.00		
491	0.70	0.01	0.74	0.74	0.43	0.33	0.46	0.37	0.30	−0.11	0.79	1.00	
492	0.27	0.41	0.46	0.20	0.77	0.19	0.84	0.54	0.66	0.05	0.55	0.37	1.00

Note: Each entry represents the correlation coefficient for the overvalue ratios, 1975–1985, between the respective industries.

[D&T, 1988] employs the real asset cash flow model to simulate the impacts of ERTA on fundamental equity values in three industries. The simulated outcomes are compared to actual stock return performance, using industry portfolios and examining excess returns around legislative events. In two of three interindustry comparisons the excess returns are significantly different from zero but not different from the simulated outcomes. The authors take this as evidence that the real asset cash flow model may be useful in deducing the impact on fundamental asset values of tax policy changes.[13]

The real asset cash flow model parameterizes an array of variables and specifies their interrelationships within a general equilibrium setting. Fundamental asset values are estimated by plugging in observed or plausible numerical values for all the variables. The impact on fundamental value of a particular variable can be deduced (in a static equilibrium setting) by altering the numerical value for that variable and reestimating fundamental value. In this way we test the sensitivity of fundamental value to that particular variable.

I have used the real asset cash flow model to simulate the impact of several changes to the business environment. First, I extend the simulation results from the tax policy studies (D&H and D&T) discussed above by presenting the impacts of ERTA and TRA on the thirteen-industry sample set. The methodologies are analogous to the ones in the earlier studies. Results are shown in Table 6.

The point to note is that there is substantial variation in the sensitivity of an industry's fundamental value to tax reform. With ERTA, for example, all industries incur losses, but the magnitude of shareholder losses is more than four times greater in Rubber and Plastics (SIC 32) than in Electrical Machinery (SIC 36). Likewise, all industries gain because of TRA, yet the gain is almost five times greater in Petroleum Products (SIC 29) than in Electrical Machinery (SIC 36). Whether actual changes in shareholder wealth are correlated with the simulated changes remains an unanswered question.

Another change to the business environment that I model is the response of fundamental value to an increase in the expected inflation rate. Table 6 shows the percentage change in shareholder wealth occurring if there were a permanent and unanticipated one percentage point increase in the rate of expected inflation at two benchmarks, 1975 and 1985.

There is substantial variation in industry sensitivities. In Telephone and Telegraph, for example, a one percentage point rise in the expected inflation rate in 1975 would have led to change in shareholder wealth of −0.89%. In 1985 there would have been a gain of 0.14%. Likewise, the mean sensitivity (1975–1985, not shown) to a one percentage point rise in inflation is −1.42% in Electric Utilities and −0.43%

TABLE 6

Impacts on Shareholder Wealth of Selected Changes in the Business Environment (%)

Industry	1981 Tax Act	1986 Tax Act	1975 Inflation Shock	1985 Inflation Shock	Proposed Deductibility Rules
Food Products, SIC 20	−4.02	4.19	0.11	0.11	16.31
Textile Products, SIC 22	−6.29	8.37	−0.38	0.06	29.22
Paper Products, SIC 26	−5.72	11.98	0.14	0.29	43.22
Chemicals, SIC 28	−2.84	5.12	0.16	0.21	18.47
Petroleum Products, SIC 29	−5.30	13.88	−0.03	0.03	54.18
Rubber and Plastics, SIC 30	−7.01	8.80	0.11	0.31	27.52
Stone, Clay, and Glass, SIC 32	−8.06	8.03	0.14	0.14	23.42
Primary Metals, SIC 33	−7.67	12.43	−0.13	0.22	35.35
Nonelectrical Machinery, SIC 35	−2.14	4.14	0.05	0.11	12.96
Electrical Machinery, SIC 36	−1.70	2.82	0.10	0.08	6.76
Telephone and Telegraph, SIC 481	−4.52	8.50	−0.89	0.14	27.54
Electric Utilities, SIC 491	−3.68	5.32	−1.56	0.02	19.20
Gas Utilities, SIC 492	−7.20	6.58	−1.17	−0.17	32.71

Notes:

Each entry represents the change in fundamental value as a percent of outstanding equity values occurring because of the change in business condition.

The 1981 Tax Act reflects changes enacted with the Economic Recovery Tax Act of 1981.

The 1986 Tax Act reflects changes enacted with the Tax Reform Act of 1986.

The inflation shocks reflect changes occurring as if there were an unanticipated permanent one percentage point increase in the expected inflation rate in the respective year.

The proposed deductibility rules include the indexing to inflation of corporate interest expense and the 50% deductibility of dividend distributions.

in Gas Utilities. The former is three times as sensitive to inflation as the latter.[14]

The final change simulated is the impact on corporate asset values of statutory changes in the rules governing the deductibility of corporate financing expenses. The Treasury Tax Reform Proposal of 1984 stipulated that corporate interest payments would be indexed to inflation and that dividend distributions would be 50% deductible from the corporate tax base. Although neither of these provisions was ever enacted, Congress has brought them up for rediscussion repeatedly.

These statutory changes are modeled in the real asset cash flow model, with the impact on industry shareholder wealth listed in Table 6.[15] Industry responses are uniformly positive, and range from windfall gains of 7% in Electrical Machinery to 54% in Petroleum Products. The existence of such large differences in sensitivity indicates that the real asset cash flow model should play a prominent role in analyzing impacts of changes in the business environment on real asset values, assuming future research establishes its reliability.

SUMMARY

This study discusses an alternative approach to fundamental analysis: specifying and measuring the cash flow streams expected from real assets in a setting of general economic equilibrium. Specifically, a pre-tax cash flow stream is derived to be consistent with a zero net present value investment equilibrium in the market for real assets, and the depreciation tax shield is constructed from historical capital expenditures data and tax practices.

The real asset cash flow model is used to generate estimates of fundamental value for thirteen industries over an eleven-year sample period. The results indicate that the model has potential discriminatory power because there is substantial time series and cross-sectional variation in the overvalue ratio (the ratio of market value to fundamental value). In nine of thirteen industries the overvalue ratio has a range that encompasses unity, letting us see when securities may be under- or overvalued. Future research should establish whether the real asset cash flow model provides information that can be used consistently in formulating successful investment strategies.

Application of the model to analyze impacts of a variety of tax reforms on industry fundamental values indicates that the real asset cash flow model generates diverse predictions about the equilibrium relationship between fundamental value and any one of a number of variables. Further research will confirm the extent to which the model is reliable in providing information on the effect of fundamental changes in the business environment.

[1] The discounted dividend model can be recast so that its cash flow stream is consistent with a simple equilibrium model. Partition g into the product fr, where f is the retention ratio and r is the internal rate of return on marginal investments. Long-run economic equilibrium requires that marginal investments promise zero net present values and that r and k are equal. Expressing the dividend, D_0, as $(1 - f)E_0$, where E is earnings, results in an equilibrium version of Equation (2a) that $V_0 = E_0/k$. The discounted value of dividends equals the current earnings valued as a perpetuity. Dividend payout policy is irrelevant because to shareholders the present values of a dollar of retained earnings and a dollar of dividends are equal.

[2] This model is a variant of the ones used by Downs and Hendershott [1987] and Downs and Tehranian [1988] for deducing the impact of tax reform on fundamental stock prices. The first of these studies models the fundamental value of debt and equity; the latter models the fundamental value of equity. I model the fundamental value of debt and equity because separating debt from equity is not essential, given my objectives.

[3] The depreciation definitions follow the standard notation as stated by Kim and Moore [1988, p. 111]: "We should distinguish between economic (physical) depreciation and economic (value) depreciation. The first refers to the loss in productive capacity of a physical asset, while the second refers to the asset's loss in monetary value." Using the terminology of the Bureau of Labor Statistics [1979] and the Bureau of Economic Analysis [1986], I refer to the first type as "capacity depreciation."

[4] The modern development of the user cost has been pioneered by Jorgenson [1963 and 1967]. Keynes wrote about the importance of the measure for asset valuation [1936, pp. 66, 69]: "User cost has, I think, an importance for the classical theory of value which has been overlooked. . . . [It] constitutes one of the links between the present and the future." Downs [1986] describes the relationship among capital budgeting decisions, net present value rules, and the user cost of capital.

[5] This assumes a constant real (quantity) marginal physical product of capital beyond time 0. In other words, the relative contribution to production of K remains the same as it is at time 0. In the framework devised by Thomas [1969], these assumptions result in a valuation model that can be categorized as a marginal contributions simultaneous allocation approach with restrictions on cost and revenue functions of continuity, constant returns to scale, and simultaneous successive expansion.

[6] With the zero net present value investment equilibrium and the constant returns to scale assumptions that are adopted in the construction of PVEBDT, the discounted values of incremental residual cash flows and incremental capital investment costs are equal. That is, my model assumes that the value of the firm reflects only the value of existing tangible assets. Evidence in favor of this assumption is provided at aggregate sector levels by Holland and Myers [1981] and Brainard, Shoven, and Weiss [1980]. Salinger [1984] provides evidence that labor unions in concentrated industries are effective in capturing the value of intangibles.

[7] My definition of "current cost" is the standard one as stated by Shriver [1987, p. 80]: "the cost of acquiring the same service potential (indicated by operating costs and physical output capacity) as embodied by the asset owned." Downs and Shriver [1990] present evidence that current cost overstates the discounted value of after-tax cash flows because new and old assets receive differential tax benefits.

[8] Data on Compustat are listed on an enterprise basis, while capital expenditures data from the Bureau of Economic Analysis [1986] used to construct fundamental value estimates are stated on an establishment basis. All data from Compustat are made conformable to the BEA data by multiplying the former with the ratio of BEA industry "historical cost net fixed assets" divided by Compustat industry sample sum of "net fixed assets." All estimates in the study are stated on an industry establishment basis.

[9] The overvalue ratio concept comes from Downs and Tehranian [1988], who conjecture that the overvalue ratio acts as a leverage ratio in that it amplifies the response of common stock returns to changes in fundamental value. To see this, suppose that two firms, one with a small overvalue ratio and the other with a large one, experience a one dollar decline in fundamental value that is correctly capitalized by the market. The percentage change in market value of equity is greater for the firm with the smaller overvalue ratio because the one dollar loss is applied against an equity base that is, relatively speaking, too small. Because all traders are price takers, no one can benefit from the divergence of the overvalue ratio from unity.

[10] If security prices do not follow fundamental values, then knowing even true fundamental values cannot enable better investment decisions. Summers [1986] and Campbell and Shiller [1988] question whether fundamental values are relevant to stock market valuations.

[11] Auerbach and Kotlikoff do not calculate pre-ERTA and post-ERTA fundamental values, but rather the *change* in fundamental value. Their results can be obtained under a restrictive version of the real asset cash flow model.

[12] Downs and Hendershott introduce methodology for measuring the level of fundamental value, rather than its change. The level can be computed under different assumptions, and the changes in value can be inferred.

[13] Several studies analyze the implications of the real asset cash flow model, even though they do not use the model. Cutler [1988] explains that repeal of the investment tax credit may diminish fundamental equity values to the extent that future investments have diminished net present values. Correlation of selected financial ratios and excess returns yields almost no evidence that is statistically significant, although some slight support for the real asset cash flow model. Lyon [1989a] uses a similar procedure to determine whether ACRS really caused stock prices to decline, but finds inconclusive evidence. In another study Lyon (1989b) correlates financial ratios and excess returns around statutory changes in the investment tax credit and finds weak evidence that the revaluation of existing assets (from the real asset cash flow model) is dominated by change in the net present value of future investments.

[14] Sweeney and Warga [1986, p. 408] also report that the electric utility industry is unusually sensitive to inflation: ". . . changes in government bond yields clearly affect *ex post* returns to electric utilities, and . . . this phenomenon is concentrated to a much larger extent in this particular industry than in NYSE firms as a whole." Downs and Hevert [1990] find that the inflation sensitivity of fundamental value in alternative years and industries is significantly correlated with the inflation betas estimated in a two-factor market model.

[15] The impact on aggregate shareholder wealth of the Treasury Proposal of 1984 is analyzed in Hendershott [1985].

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