Business Valuation Review

Volume 22, No. 2 June 2003
The Quarterly Journal of the Business Valuation Committee of the American Society of Appraisers

Forecasting Cash Flow: Mathematics of the Payout Ratio

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Introduction

We all have used the Discounted Cash Flow (DCF) method. Many of us would agree that it is generally the best, most comprehensive, theoretically correct valuation model. It also has an empirical reason to be the best, which is that many of us calculate our discount rates using the Ibbotson data in the SBBI annual yearbooks, which are based on publicly traded stock data. Those stock returns are cash returns—the dividend yield plus the capital gains, which can be converted to cash at any time.[1] Thus, it is consistent to discount cash flow with discount rates on cash returns. So far, everything is well and good.

Difficulties in Forecasting Cash Flow

Well, almost. The problem is that forecasting net income is work, and forecasting net free cash flows ("net cash flows" or "cash flows") is detailed, exacting work. Few well-adjusted people really like doing it. The most disciplined of us keep a stiff upper lip and do it—especially in the large valuation firms with clients who are willing to pay for doing it right. The American Society of Appraisers' business valuation courses teach DCF, not discounted net income. Nevertheless, in the real world, as we decline in firm size, client budgets, and personal discipline, cash flow often goes by the wayside, and many of the smaller valuation firms end up discounting forecast net income, gross cash flow (net income + depreciation + amortization), EBIT, or EBITDA—and that is always inconsistent. Discounting forecast net income or any of the other above-mentioned measures of earning power normally leads to a guaranteed overvaluation.

In his article, Greg Gilbert states that if you discount net income or some larger number such as gross cash flows, then you must add a premium to the discount rate, and the premium has to increase with the degree to which the measure of economic earning power exceeds net cash flows.[2] In my opinion, he is absolutely right.

There are two problems with adding the premiums. The first problem is that almost nobody does it, even though it is common to discount forecast net income. The second problem is that there is no empirical evidence as to the appropriate magnitude of the premium. In my opinion, this is reason enough to state that we should never discount forecast net income, gross cash flows, EBIT, EBITDA, or any other measure of economic earning power other than net cash flows. This brings us right back to the DCF and the need to forecast cash flows.

Purpose of this Article

The main purpose of this article is to provide the mathematics that will simplify the mechanics of forecasting cash flow in many situations, thus making the DCF easier to do and reducing the temptation to take the shortcuts that lead to overvaluations.

The Mathematics

This is the main part of this article. We will use the following symbols in our mathematics:

Cap Exp = *CE* = Capital Expenditures

CF = Cash Flow, the increase or decrease in cash from one accounting period to another

Depr = *D* = Depreciation expense

Δ = "Delta", meaning "the change in" a balance sheet account over time

LTD = Long term debt

NI = Net income

NWC = Net Working Capital. It is the increase (or decrease) in *NWC* that is a cash flow item, not the absolute amount of *NWC*. This should include the amount of cash that the business needs to maintain to pay its bills adequately, and it should exclude excess cash that could be paid to shareholders as dividends without impairing the operations of the business.

POR = Payout Ratio = CF/NI, i.e., the payout ratio is the percentage of net income that the company can pay to shareholders in dividends, whether directly or disguised. Disguised dividends are excess compensation (i.e., above arm's length) paid to owners. POR = 1 – RR, i.e., out of total net income, the percentage the owners retain for reinvestment back into the business is the Retention Ratio, and the remaining percentage is the Payout Ratio.

PP&E = Property, Plant & Equipment

RR = Retention Ratio

The Cash Flow Equation

Let's begin with the complete cash flow equation.[3]

[1] *Cash Flow = Net Income – Gain on Sale of Assets + Depreciation – Δ Required Net Working Capital – Capital Expenditures + Cash Received for Sale of Fixed Assets + Δ Long-Term Debt + Sale of Stock – Purchase of Treasury Stock – Dividends Paid – Additional Equity Transactions.*

Equation [1] contains many terms that are unusual items or immaterial in amount. The stock transactions generally are rare, as are dividends in private firms.[4] The cash proceeds from, and the accounting gain or loss on the sale of, fixed assets generally are small and can be ignored in most situations for forecasting cash flows. For practical purposes, let's work with the terms that are material and ordinary.

The one item that is regular and material, but can be treated as in or out of the cash flow equation is increases in long-term debt. Some valuators prefer to value the firm debt-free, and one can always add in a premium for the tax-shield value of the debt afterwards. In the mathematics that follow, we will keep it in the equation, but it is easy to back it out at the end. Thus, the shortcut cash flow equation is:

[2] $$CF = NI + Depr - Cap\ Exp - \Delta NWC + \Delta LTD$$

Another way of looking at equation [2] is to split the latter four terms into two pairs, each set off in parentheses, as in equation [2a]. Also, the order of depreciation and capital expenditures is reversed, as is the sign in front of the parentheses.

[2a] $$CF = NI - (Cap\ Exp - Depr) - (\Delta NWC - \Delta LTD)$$

Capital expenditures and depreciation is a logical unit of analysis. Today's depreciation results from capital expenditures that we made over the past several years. The amount by which capital expenditures exceeds depreciation is a subtraction from cash flow, as is the amount by which the increase in net working capital exceeds the increase in long-term debt. Another way of looking at the terms in parentheses in equation [2a] is that the first set deals with changes in fixed assets, which is a use of cash, while the second set deals with the changes in current assets net of current liabilities and long-term debt, which is also a use of cash.

Defining Cash Flow through the Payout Ratio

We can derive cash flow from net income in an alternate format, i.e., as a percentage adjustment to net income. It will turn out that normally this will be a much easier calculation than forecasting all the elements of cash flow, i.e., depreciation, capital expenditures, and changes in net working capital and long-term debt. For valuation purposes, the Payout Ratio (POR) is the portion of net income that can be distributed to owners without impairing operations.[5] The portion of net income that is required for operating and growing the business is called the Retention Ratio (RR), which equals one minus the Payout Ratio.

In this article, we will develop an exact set of formulas, equations [8] and [9] for the Payout Ratio and the Retention Ratio, respectively, that relate back to equation [2] for the definition of cash flow. Unfortunately, equations [8] and [9] are computationally intensive, as they require forecasting capital expenditures, depreciation, and the increase in required net working capital. This gives rise to the need for easier equations to use. Thus, the second goal is to develop an accurate formula to estimate the Payout Ratio.

Payout Ratios—Exact Equations

In this series of equations, we develop an exact formula for the Payout Ratio. Equation [3] is the definition of the Payout Ratio.

[3] $$CF = NI \times POR$$

Since the left hand side of equations [2] and [3] are equal, then their right hand sides also must be equal. We state this in equation [4].

[4] $$NI + Depr - Cap\ Exp - \Delta NWC + \Delta LTD = NI \times POR$$

Next we subtract *NI* from both sides of the equation and factor *NI* on the right hand side.

[5] $$Depr - Cap\ Exp - \Delta NWC + \Delta LTD = NI(POR - 1)$$

Dividing through by *NI*, we get:

[6] $$\frac{Depr - Cap\ Exp - \Delta NWC + \Delta LTD}{NI} = POR - 1$$

Adding 1 to both sides of the equation leads to:

[7] $$1 + \frac{Depr - Cap\ Exp - \Delta NWC + \Delta LTD}{NI} = POR$$

Finally, we change the plus sign on the left hand side of the equation to a minus sign, reverse the signs of the variables in the numerator, and switch the two sides of the equation to arrive at our final solution in [8].

[8] $$POR = 1 - \frac{(Cap\ Exp - Depr) + \Delta NWC - \Delta LTD}{NI}$$

The net income should be a normalized net income, i.e., a long-term income base. As mentioned earlier, the retention ratio is one minus the payout ratio. Thus the retention ratio in equation [9] equals one minus equation [8].

[9] $$RR = \frac{(Cap\ Exp - Depr) + (\Delta NWC - \Delta LTD)}{NI}$$

Equation [9] is intuitively appealing, as the greater the amount by which our capital expenditures, which is current investment, exceeds depreciation, which is our past investment, and the greater our investment in new net working capital in excess of long-term debt financing, the higher is the retention ratio.

Developing an Estimation Formula for *POR*

In this section, we do the following:

(1) Discuss benchmarks for Payout Ratios of publicly and privately held firms

(2) Develop an alternative formula for the Payout Ratio to make estimation easier

(3) Analyze tables that use the alternative formula to demonstrate its accuracy and to provide the specific percentage by which capital expenditures exceeds depreciation for a variety of different growth rates and equipment lives

(4) Discuss the curveballs that occur in using the alternative formula

Benchmarks for the Payout Ratio

We look at two different benchmarks for Payout Ratios. The first is the historical average Payout Ratios of publicly held firms, and the second is the Moskowitz-Vissing-Jorgensen guesstimate for privately held firms.

The dividend Payout Ratio for publicly held firms was 47% at the beginning of 1926 and decreased to 32% by the end of 2000.[6] Thus, publicly traded firms now retain on average 68% of their income for cash flow and growth. Over the last 75 years, publicly held firms experienced an average growth of approximately 7% to 8%, which is much faster than private firms—certainly due to their much larger Retention Ratio and greater business opportunities.[7]

Moskowitz and Vissing-Jorgensen[8] (MVJ) guesstimate an average 60% Payout Ratio for privately held C corporations and 80% for privately-held S corporations and other non-tax entities. If you have difficulty using the Payout Ratio formula later on in equation [24], then it would make sense to use their guesstimate as a benchmark. However, your clients' Payout Ratios may vary from 60% or 80%.

MVJ emphasize that external financing is more expensive for privately held C corporations than it is for privately-held C corporations, because of their smaller size. They further wrote that the non-tax entities tend to be smaller yet, and external financing should be even more expensive for them than for the larger, privately owned C corporations. However, counterbalancing this is the likelihood that the smaller, non-tax entities probably have fewer growth opportunities than the larger firms, which is their reasoning for assuming a lower retention.

It is clear from reading between the lines in their article and logically that the main determinants in the earnings retention decision are size and cost of external financing, not the form of organization. Thus, a one-person C corporation should retain as little—and, thus, pay out as much—as a sole proprietorship with no employees. I have valued no-growth clients with historical Payout Ratios as high as 99.8%. It is important to use common sense. The higher your forecast growth rate, the lower your Payout Ratio should be, and vice-versa.

We now proceed with the mathematics necessary to develop the alternative POR formula. There are two steps necessary to accomplish this. The first step is to develop an expression for the excess of capital expenditures over depreciation, and the second step is to develop the mathematics for the increase in net working capital and long-term debt.

The Mathematics of Capital Expenditures over Depreciation

For simplicity, we will begin by assuming property, plant and equipment (PP&E) has an average five-year life. Later we will relax that assumption. We will assume the company has five machines and uses straight-line depreciation. It buys its first machine at the beginning of year 1, its second machine at the beginning of year 2, its third machine at the beginning of year 3, its fourth machine at the beginning of year 4, and its fifth machine at the beginning of year 5. At the beginning of year 6, the company retires machine #1 and buys a replacement machine for it. From then on, it always runs five machines, replacing the oldest one at the beginning of the next year.

Thus, year 5 is the first year that the company reaches a constant status, i.e., there is no real growth afterwards. During year 5, 1/5 of the equipment was bought at the beginning of years 1, 2, 3, 4, and 5. We will assume the equipment cost $1,000 at the beginning of year 1, and prices increase at a rate of g each year. We will for the moment assume a stagnant industry, which means it has inflationary, but no real, growth. Later we will modify that assumption. Since inflation in the U.S. has been approximately 3% per year, we will assume g = 3%.

Our procedure will be first to develop a mathematical expression for capital expenditures at the beginning of year 6. Then we will develop an expression for depreciation in year 5. Finally, we will divide the former by the latter, which will give us a ratio of the two. We will be able to use that to our practical advantage later.

In this simple model, from year 5 and on capital expenditures differ from the previous year's depreciation by a multiplicative factor, i.e., CE_6 = (1+k) D_5, where normally 0 < k < 200% and is typically is between 6% and 20% for most businesses. Therefore, CE_6 - D_5 = (1+k) D_5 - D_5 = k D_5. Therefore, the percentage by which capital expenditures in year 6 exceeds depreciation expense in year 5 (or, more generally, in year t+1 versus year t) is the ratio of the two minus one, i.e.:

[10] $$\%\ Difference = \frac{CE_6}{D_5} - 1$$

Capital expenditures in year 6 will be the original purchase price in year 1 of $1,000 multiplied by one plus the growth rate to the fifth power, or:

[11] $$CE_6 = \$1{,}000\left(1+g\right)^5$$

That was easy. Next we proceed to develop an expression for depreciation in year 5, which, again, generalizes to year t. It will be helpful to look at Table 1 to understand the depreciation patterns.

Depreciation Pattern in Table 1

The first piece of equipment cost $1,000 (B5) at the beginning of year 1. Its depreciation will be $200 per year in years 1 – 5, which appears in cells B6 through F6. Since we are assuming a 3% (B13) inflation-only growth rate in the price of equipment, the second piece of equipment cost $1,030 (C5). Depreciation on it is $206 per year, which you can see in row 7.[9] Depreciation on the third piece of equipment is $212.18 per year (row 8), etc.

Now, let's look down column F—year 5. Depreciation in year 5 is $200 (F6) on the equipment bought at the beginning of year 1, $206 (F7) on the equipment bought at the beginning of year 2, …, and $225.102 (F10) on the equipment bought at the beginning of year 5. Total depreciation expense is $1,061.827 (F11). Depreciation on the equipment bought at the beginning of year t is $\$200(1+g)^{t-1}$. Now, we return back to the mathematics to develop an alternative POR formula.

Equation [12] is the depreciation expense for year 5:

[12] $$D_5 = \$200\left[1+(1+g)+(1+g)^2+(1+g)^3+\left(1+g\right)^4\right]$$

Multiplying the above equation by (1+g) on both sides, every term on the right hand side of the equation increments by one in its exponent, and we get:

[13] $$(1+g)D_5 = \$200\left[\begin{array}{l}(1+g)+(1+g)^2+(1+g)^3 \\ +\left(1+g\right)^4+\left(1+g\right)^5\end{array}\right]$$

Subtracting [13] from [12], on the right hand side, all the intermediate terms drop out, and we get:

[14] $$\left[1-(1+g)\right]D_5 = \$200\left[1-\left(1+g\right)^5\right]$$

This simplifies to:

[15] $$-gD_5 = \$200\left[1-\left(1+g\right)^5\right]$$

Multiplying through by – (1/g), we get:

[16] $$D_5 = \$200\left[\frac{\left(1+g\right)^5-1}{g}\right]$$

Substituting equations [11] and [16] into [10], the percentage by which capital expenditures in year 6 exceeds depreciation in year 5 is:

[17] $$\frac{C_6}{D_5} - 1 = \frac{\$1{,}000\left(1+g\right)^5}{\$200\left[\frac{\left(1+g\right)^5-1}{g}\right]} - 1$$

This simplifies to:

[18] $$\frac{C_6}{D_5} - 1 = \frac{5g\left(1+g\right)^5}{\left(1+g\right)^5-1} - 1$$

We can generalize the formula for any equipment life. Letting n = average years of equipment life, the general formula is:

[19] $$\frac{C_{t+1}}{D_t} - 1 = \frac{ng\left(1+g\right)^n}{\left(1+g\right)^n-1} - 1$$

Analysis of Table 1

Table 1 shows the calculation of the difference by brute force, i.e., the long way, and the short way using equation [18], which is the same as equation [19], with n = 5. Let's look first at the brute force method.

We transfer the purchase price of the equipment at the beginning of year 6 of $1,159.274 from G5 to B15. Then we add the depreciation in year 5 coming from each individual piece of equipment, which is in F6 through F10, and totals $1,061.827 in F11. We transfer that to B16. In B17, we divide B15 by B16, i.e., we divide the cost of new equipment in year 6 by depreciation in year 5, to calculate the ratio of 1.092. Subtracting one from that, the difference between capital expenditures in year 6 and depreciation expense in year 5 is 9.2% (B18).

Now we can confirm the accuracy of equation [18], because we use it in cell B19, which also equals 9.2%—the same result as the brute force method. The advantage of the formula, though, is that we can perform sensitivity analysis and see how the difference varies as the growth rate in the price of equipment varies.

Rows 23 through 32 show that sensitivity analysis. We can see that the difference of capital expenditures and the previous year's depreciation expense is 3.0% (B23) for a 1% growth rate, 6.1% (B24) for a 2% growth rate, 9.2% (B25 = B19),[10] and generally grows 3.2% for each additional percentage in the growth rate.[11]

Table 2: How Capital Expenditures Exceeds Depreciation

Table 2 shows the results of the general formula in equation [19] for a variety of assumptions of average equipment life and annual growth in equipment prices. Note that the results in column C are identical with the sensitivity analysis in Table 1. Also note that the percentage by which capital expenditures in year $t+1$ exceed depreciation in year t increases as we move southeast in the table, i.e., as average equipment life and annual growth increase.

The Meaning of the Results

Let's take a minute to understand the meaning of the results in Table 2. Let's start with the assumption that most businesses have an average equipment life of five years, which is a reasonable assumption. Assuming for the moment that this is true, the difference for a 3% growth rate, which is inflationary only, is 9.2% (C8). This means that in a stagnant business, we can forecast the difference between capital expenditures and depreciation expense as being 9.2% $\times$ depreciation expense. This result was a surprise to me! I always thought that a stagnant business would have capital expenditures exceeding depreciation only by inflation itself, or 3%. However, there is no substitute for rigorous analysis.

It is reasonable to expect that many businesses face real growth in their prices, not just inflation only. Thus, 5% to 7% growth in equipment prices is fairly common. At 5% annual price growth, the difference of capital expenditures and depreciation expense for an average 5-year equipment life is 15.5% (C10), while at 7% it is 21.9% (C12). Therefore, the differences in the two can be substantial.

The differences are even more pronounced for longer-lived equipment. For an average 7-year equipment life, the differences are higher—and all the more so the higher is the growth rate in equipment prices. A 3% inflationary-only price growth implies a 12.4% (D8) difference, while 5% and 7% annual price increases imply differences of 21.0% (D10) and 29.9% (D12).

Some manufacturing firms may have heavy equipment with very long lives—perhaps much longer than seven years. Therefore, it is necessary to adjust the analysis to the realities of the subject company.

Handling the Curveballs

There are a few curveballs that can arise in estimating the excess of capital expenditures over depreciation. The first one is the existence of fully depreciated assets, which arises when depreciable life is less than the economic life of the asset. For example, suppose your client has a large piece of equipment that cost $1 million, has a 10-year life, and he or she depreciated it over 5 years. In years 6 – 10, depreciation expense will be zero. We are doing our valuation as of the beginning of year 11. In this case, equation [19] will underestimate capital expenditures, because it will totally miss the replacement of this expensive machine. Assuming a 5% annual growth in equipment costs, that would be a $1.6 million underestimate of capital expenditures in year 11. For very expensive, long-lived equipment, it may be necessary to consider its cash flow separately from the ordinary cash flows of the business, and add its effect into the valuation separately.

The second curveball is more apparent than real. It occurs when the client uses accelerated depreciation. This causes depreciation to be higher in the earlier years and lower in the later years than straight-line depreciation.

Table 3: Analysis of MACRS versus Straight-line Depreciation

For example, let's analyze Table 3, which shows 5-year MACRS and straight-line depreciation for the same assets that appear in Table 1, row 5. In year 1, we buy the first piece of equipment for $1,000 (B5). Straight-line depreciation is $200 per year (row 8). Five-year MACRS depreciation is 150% declining balance, with a switch to straight-line in year 3, when straight-line is higher than declining balance. Year 1 MACRS is 150% × 20%[12] = 30% of the tax basis of the asset, or 30% × $1,000 = $300 (B6).

We subtract that from the $1,000 purchase price, which leaves a depreciable basis of $700 (B7) at the end of year 1. In year 1, MACRS depreciation is $300/ $200 = 150% (B9) of straight-line. In year 2, depreciation is 30% × $700 (the depreciable basis in B7) = $210 (C6). The depreciable basis at the end of the year is $700 – $210 = 490 (B7 – C6 = C7). The 150% declining balance in year 3 would be 30% × $490 = $147; however, from this point on, straight-line depreciation at $490/3 = $163.33 (D7 through F7) is higher, and we use that.

Now, let's proceed with the equipment bought in year 2. It costs $1,030 (C5). Five-year straight-line depreciation is $206 (row 13) per year. MACRS depreciation in year 2 for the year 2-purchased equipment is 30% × $1,030 = 309 (C11). The depreciable basis at the end of the year is $1,030 – $309 = $721 (C5 – C11 = C12). MACRS depreciation in year 3 will be 30% × $721 = $216.3 (D11). After that, we use straight-line depreciation for years 4 through 6 at $168.2333 (B11, C11). (Note, we stop in this analysis at year 5, even though depreciation on the equipment bought in year 2 goes on to year 6.)

We subtotal straight-line depreciation row 13 for equipment bought in years 1 and 2, and we do the same for MACRS depreciation in row 14. MACRS depreciation in year 2 is $519 (C6 + C11 = C14), and straight-line depreciation is $406 (C8 + C13 = C15). Thus, while MACRS depreciation is 150% (B9, B16) of straight-line in year 1, it is only 128% (C16) in year 3.

The analysis rolls forward in the same fashion for years 3 through 5. The final result in year 5 is that MACRS depreciation is only 1% higher than straight-line, i.e., 101% (F37) of it. Thus, equation [19] normally should do a good job of forecasting depreciation when the firm is either stagnant or growing slowly in real terms, i.e., it has reached a reasonable steady-state in its base of fixed assets.

The third curveball, which also is more apparent than real, is the effect of the policy of taking a half-year depreciation in the year of purchase and one-half year in the year of sale or retirement. The effects of this policy should average out over the long run to be the same as taking depreciation according to the month of placement in service, although it can distort the calculation for a particular year for an expensive piece of equipment. In such cases, you may have to make an adjustment to correct the distortion. Once the Company has reached a steady state—in this example, year 6 and on—normally that should not be a material issue.

The Mathematics of the Increase in Required Net Working Capital and LT Debt

Now let's turn to the increase in required net working capital (NWC) and long-term debt (LTD). Let's make some simplifying assumptions:

- Sales grow at a constant rate, g_s
- NWC and LTD grow as a constant percentage of sales

The formula for the increase in NWC is:

$$\Delta NWC = NWC_1 - NWC_0, \tag{20}$$

where NWC_0 is last year's net working capital and NWC_1 is the first forecast year. However, NWC grows at the rate g_s. Therefore, we can substitute that into [20], which results in:

$$\Delta NWC = [NWC_0\,(1+g_s) - NWC_0] = NWC_0\,[(1+g_s) - 1] \tag{21}$$

This expression simplifies to:

$$\Delta NWC = NWC_0 \times g_s \tag{22}$$

The mathematics of the change in long-term debt is identical to that of net working capital, although its effect on cash flow is the opposite. While an increase in net working capital is a use of cash, an increase in long-term debt is a source of cash. Thus, the only difference is that the sign in the Payout Ratio formula for ΔLTD is the opposite of the one for ΔNWC. The formula for the change in long-term debt is in equation [23]:

$$\Delta LTD = LTD_0 \times g_s \tag{23}$$

The Estimation Formula for the Payout Ratio

Substituting equations [19], [22], and [23] into [8], we get:

$$POR = 1 - \frac{\left[\dfrac{ng(1+g)^n}{(1+g)^n - 1} - 1\right] Depr_0 + [NWC_0 - LTD_0]\, g_s}{NI_1} \tag{24}$$

Note that depreciation, net working capital, and long-term debt are historical amounts, with appropriate adjustments, as discussed earlier, while net income is a normalized amount. This means that if you forecast net income to be unusually high or low next year, because of a specific item that is a one-time event, it is best to calculate the Payout Ratio as if that item did not exist, value the firm accordingly, and then make an adjustment to the valuation at the end of the process. Otherwise, a one-year anomaly becomes forever enshrined in the valuation, causing a valuation error. Also note that net income must be positive and material in amount for this formula to work.

Assuming a reasonable 5% annual growth in equipment costs and sales and a 5-year life, this simplifies to:

$$[25] \quad POR = 1 - \frac{(15.5\% \times Depr_0) + (NWC_0 - LTD_0) \times 5\%}{NI_1}$$

where the 15.5% comes from Table 2, C10. This is a much easier calculation than equation [8], as it is not necessary to do the detailed forecast of capital expenditures, depreciation, and net working capital.

Let's do an example. If depreciation last year was $50,000, required net working capital was $250,000, long-term debt was $50,000, and net income was $100,000, then our estimate of the Payout Ratio would be:

$$[26] \quad \begin{aligned} POR &= 1 - \frac{(15.5\% \times 50{,}000) + (250{,}000 - \$50{,}000) \times 5\%}{\$100{,}000} \\ &= 1 - \frac{7{,}750 + 10{,}000}{\$100{,}000} = 82.25\%. \end{aligned}$$

Equation [26] has several very specific assumptions behind it, so it is important to modify the formula if there are any of the four significant deviations in your fact pattern. The main deviations would be:

- Average equipment life is not 5 years
- The growth rate in equipment prices (combined with real growth in the subject company) or in sales significantly differ from 5%
- You do not expect sales to grow at a constant rate
- You do not expect net working capital or long-term debt to grow as a constant percentage of sales

Even when the immediate facts differ from these assumptions, it is still quite possible that equations [24] through [26] may be a reasonable long-term estimate. Actual cash flow frequently rises and falls in extremes from one year to the next. Therefore, historical cash flow is often not a viable basis from which to forecast a future Payout Ratio. If we view equations [24] through [26] as norms, they become more reasonable. While actual cash flows may vary considerably year-to-year from the average, it is reasonable to forecast the average Payout Ratio—unless you are able to be more accurate and forecast exact cash flows year-by-year, which is equivalent to varying the Payout Ratio annually according to your more specific forecast.

Forecasting Gross Cash Flow is Incorrect

Now it is clear to see the fallacy of an article [13] ("the first article") that argues for capitalizing gross cash flow. In light of equation [19] and Table 2 in this article, we can see that the author's assumption on page 33 of the first article that depreciation equals capital expenditures is unrealistic even for a stagnant firm. Such an assumption is appropriate only for a firm in severe decline.

Imagine a firm with zero net cash flow. Such a firm never would generate any cash to pay its shareholders dividends. It is logical that this firm should have a zero fair market value—at least on an Income Approach. Yet capitalizing or discounting gross cash flow (or net income, for that matter) would lead to a positive valuation. Thus, net cash flow is the appropriate measure of economic earning power to capitalize or discount.

Conclusion

In this article, we have developed an exact expression for the Payout Ratio in equation [8] and a good approximation formula in equation [24], the latter of which should be much easier to use in forecasting cash flows. Hopefully this should not only save time, but increase valuation accuracy by breaking the bad habit of discounting net income (or other similar measures of economic earning power). Also, we have covered why net cash flow is the appropriate measure of economic earning power for capitalization or discounting.

Endnotes

1. This applies equally as well for those using an ex-ante approach, such as the Merrill-Lynch Dividend Discount Model. The point is that we are still being consistent by using expected returns on cash flows (as opposed to realized historical returns—but nevertheless still on cash flows) to discount cash flows.
2. Gilbert, Gregory A., "Discount Rates and Capitalization Rates—Where Are We?" *Business Valuation Review*, December 1990, p. 108.
3. For a detailed mathematical derivation, see Abrams, Jay B., *Quantitative Business Valuation: A Mathematical Approach for Today's Professionals*, McGraw-Hill, 2001, pp. 5-18. The above equation is from equation (1-20a), p. 18. For an earlier version of the mathematics, see "Cash Flow: A Mathematical Derivation," *Valuation*, January 1994. To download, go to www.abramsvaluation.com, select "Articles", then "Articles in .PDF."
4. Also, since we are trying to forecast the maximum dividends the firm can pay without impairing its operations, the dividends actually paid do not matter in

a DCF at the Company level. They do matter in a Discounted Dividends Model.

5. In calculating the Payout Ratio historically, it is simply dividends paid divided by net income, regardless of whether or not the owner did impair operations by paying out too much in dividends. However, for valuation purposes, in forecasting ahead we consider only the dividends that can be paid without impairing operations.
6. Ibbotson, Roger G., and Peng Chen, "The Supply of Stock Market Returns," Yale ICF Working Paper No. 00-44, p. 7 and Figure 4.
7. According to Ibbotson and Chen (cited above), page 5, equation (6), geometric average capital gains in the public equity markets from 1926 to 2000 were 3.02% in real terms and approximately 6.2% in nominal terms. Arithmetic returns are always higher than geometric returns, and the former is the correct measure for valuation purposes. Thus, I estimate nominal capital gains of approximately 7% to 8%. Income returns were 4.28%.
8. Moskowitz, Tobias J. and Annette Vissing-Jorgensen. 2002, "The Private Equity Premium Puzzle," *American Economic Review*, September 2002, Volume 92, No. 4. See especially p. 755, second column.
9. Table 1 does not show depreciation expense after year 5, even though it does continue for the second through the fifth pieces of equipment.
10. This equality shows the accuracy of the sensitivity analysis and is why row 25 is in bold
11. The difference begins to accelerate at higher growth rates. Thus, the difference is 3.3% for g = 8% and 9% and 3.4% for g = 10%.
12. Straight-line depreciation is 20% per year for five years, so 150% DB is always 30% for five-year equipment.
13. Lerch, Mary Ann "Are We Capitalizing the Right Measure of Cash Flow?" *Business Valuation Review*, September 2001, pp. 32-34.

The author wishes to thank Roger J. Grabowski, as well as other anonymous referee's, for their insightful comments and helpful suggestions.

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	A	B	C	D	E	F	G
1	**Table 1**						
2	**Analysis of Depreciation and Capital Expenditures**						
3							
4		1	2	3	4	5	6
5	Purchase Price of Equip [1]	1000	1030	1060.9	1092.727	1125.509	**1159.274**
6	Depr of Equip Bought Yr 1	200	200	200	200	200.000	
7	Depr of Equip Bought Yr 2		206	206	206	206.000	
8	Depr of Equip Bought Yr 3			212.18	212.18	212.180	
9	Depr of Equip Bought Yr 4				218.5454	218.545	
10	Depr of Equip Bought Yr 5					225.102	
11	Total Depreciation					**1061.827**	
12							
13	Growth Rate-Price of Equip = *g*	3%					
14							
15	Purchase of New Equip-Yr 6 (G5)	1159.274					
16	Divide by Depr-Yr 5 (F11)	1061.827					
17	Ratio (B15/B16)	**1.092**					
18	Difference = Ratio Minus 1 = Cap Exp - Depr	**9.2%**					
19	**Equation [18]: $[5*g*(1+g)^5/((1+g)^5-1)]-1$**	**9.2%**					
20							
21	**Sensitivity Analysis: How the Difference Varies with Changes in the Growth Rate**						
22							
23	1%	3.0%					
24	2%	6.1%					
25	**3%**	**9.2%**					
26	4%	12.3%					
27	5%	15.5%					
28	6%	18.7%					
29	7%	21.9%					
30	8%	25.2%					
31	9%	28.5%					
32	10%	31.9%					
33							
34	[1] We assume we buy equipment at the beginning of each year. Thus, we replace the first piece at						
35	the beginning of year 6.						

	A	B	C	D	E	F	G	H
1	**Table 2**							
2	**How Capital Expenditures Exceeds Depreciation [1]**							
3								
4	**Avg Annual Growth in**	**Avg Equip Life (Yrs)**						
5	**Equipment Prices [2]**	**3**	**5**	**7**	**10**	**15**	**20**	**25**
6	1%	2.0%	3.0%	4.0%	5.6%	8.2%	10.8%	13.5%
7	2%	4.0%	6.1%	8.2%	11.3%	16.7%	22.3%	28.1%
8	**3%**	6.1%	9.2%	12.4%	17.2%	25.6%	34.4%	43.6%
9	4%	8.1%	12.3%	16.6%	23.3%	34.9%	47.2%	60.0%
10	5%	10.2%	15.5%	21.0%	29.5%	44.5%	60.5%	77.4%
11	6%	12.2%	18.7%	25.4%	35.9%	54.4%	74.4%	95.6%
12	7%	14.3%	21.9%	29.9%	42.4%	64.7%	88.8%	114.5%
13	8%	16.4%	25.2%	34.5%	49.0%	75.2%	103.7%	134.2%
14	9%	18.5%	28.5%	39.1%	55.8%	86.1%	119.1%	154.5%
15	10%	20.6%	31.9%	43.8%	62.7%	97.2%	134.9%	175.4%

16
17 [1] CE_{t+1} - $Depr_t$, = k * $Depr_t$, and k is the factor in the table above. The formula is from equation
18 [19].
19
20 [2] You should add in real growth in your business. For example, if equipment prices increase
21 an average 5% per year and you expect your sales to increase at 6%, which is 3% real growth
22 above expected inflation, you should use the annual growth of 5% + 3% = 8%, i.e., row 13 in the
23 above table.

	A	B	C	D	E	F	G
1	**Table 3**						
2	**Analysis of Depreciation and Capital Expenditures**						
3							
4		1	2	3	4	5	**Total**
5	Purchase Price of Equip	1000	1030	1060.9	1092.727	1125.509	
6	MACRS Depr-Equip Bought Year 1	300	210	163.33	163.3333	163.3333	**1000**
7	Depreciable Basis-End of Year	700	490	163.33	163.3333	163.3333	
8	S-L Depr-Equip Bought Year 1	200	200	200	200	200	**1000**
9	MACRS Depr/Straight-Line	**150%**	**NM**	**NM**	**NM**	**NM**	
10							
11	MACRS Depr-Equip Bought Year 2		309	216.3	168.2333	168.2333	
12	Depreciable Basis-End of Year		721	504.7	336.4667	168.2333	
13	S-L Depr of Equip Bought Yr 2		206	206	206	206.000	
14	Total MACRS Depr-Equip Bought Years 1 & 2	300	519	379.63	331.5667	331.5667	
15	Total S-L Depr-Equip Bought Years 1 and 2	200	406	406	406	406	
16	MACRS Depr/Straight-Line	**150%**	**128%**	**NM**	**NM**	**NM**	
17							
18	MACRS Depr-Equip Bought Year 3			318.27	222.789	173.2803	
19	Depreciable Basis-End of Year			742.63	519.841	346.5607	
20	S-L Depr of Equip Bought Yr 3			212.18	212.18	212.180	
21	Total MACRS Depr-Equip Bought Years 1-3	300	519	697.9	554.3557	504.847	
22	Total S-L Depr-Equip Bought Years 1-3	200	406	618.18	618.18	618.18	
23	MACRS Depr/Straight-Line	**150%**	**128%**	**113%**	**NM**	**NM**	
24							
25	MACRS Depr-Equip Bought Year 4				327.8181	229.4727	
26	Depreciable Basis-End of Year				764.9089	535.4362	
27	S-L Depr of Equip Bought Yr 4				218.5454	218.545	
28	Total MACRS Depr-Equip Bought Years 1-4	300	519	697.9	882.1738	734.3197	
29	Total S-L Depr-Equip Bought Years 1-4	200	406	618.18	836.7254	836.7254	
30	MACRS Depr/Straight-Line	**150%**	**128%**	**113%**	**105%**	**NM**	
31							
32	MACRS Depr-Equip Bought Year 5					337.6526	
33	Depreciable Basis-End of Year					787.8562	
34	S-L Depr of Equip Bought Yr 5					225.102	
35	Total MACRS Depr-Equip Bought Years 1-4	300	519	697.9	882.1738	1071.972	
36	Total S-L Depr-Equip Bought Years 1-4	200	406	618.18	836.7254	1061.827	
37	MACRS Depr/Straight-Line	**150%**	**128%**	**113%**	**105%**	**101%**	
38							
39	Growth Rate-Price of Equip = *g*	3%					