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MAKING CASH FLOW COME ALIVE AND SENSIBLE IN THE CLASSROOM

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ABSTRACT

Cash flow problems are presented often to business students as difficult, abstract enigmas. Nothing could be further from the truth, and this paper presents several different models to demonstrate this conclusion. They range from the simplest accounting identity to the use of linear programming. Moreover, they demonstrate for students that projections of the future, and possible variations of the future, are easily comprehensible procedures. Also, using these models in the capstone business policy course demonstrates how to apply knowledge acquired previously in accounting, economics, and finance courses to total enterprise competitions.

INTRODUCTION

The purpose of this paper is to present models that simplify the teaching of cash flows in the capstone business policy course, especially for students engaging in total enterprise (TE) simulation competitions. Past experience (Colley, 1984) indicates that accounting and finance courses, while focusing on special cash flows for their particular interests, do not address the issues of importance to senior and general managers. In fact, they do not distinguish among the various levels of cash flow analysis, ranging from simplistic formulations to more complicated analytic and descriptive ones. The key point is that cash flow models are simple and lead easily to an infinite number of alternatives if students are only given a chance to pursue them.

STANDARD SIMPLE MODELS

An accounting identity provides the simplest definition of cash flow (CF). That is,

EndingCash =BeginningCash + Cashlnflows – Cash Outflows

Rearranging this identity leads to the following alternative cash flow definitions:

CF EndingCash - BeginningCash = Cashlnflows - CashOutflows (1)

The problem with this definition of cash flow, however, is that it does not specify the sources and uses of cash. It simply states what everyone knows.

$$CF = PAT + DP$$

So a more informative view is needed, and standard business school wisdom provides one. That is, CF = PAT + DP where PAT is profit after taxes and DP is depreciation. But, the problem is that the three assumptions that lie behind this wisdom are seldom explained.

Nevertheless, they are straightforward. They are that:

1. All revenue is received in cash,
2. All expenses are paid in cash, and
3. There are no balance sheet transactions that affect the cash account.

Balance sheet transactions that affect the cash account are obvious. For example, assets are purchased; long term debt is issued or repaid; or, stock is issued or repurchased. Said in another way, it is assumed that there are no balance sheet transactions affecting the cash account that are not included in the income statement.

This is hardly ever the case in the short run. But assuming this to be so, the standard income statement in Table 1 can be used to demonstrate this cash flow version. Simply use the definitions given in this statement, and the equation for profit after taxes is:

$$PAT = (REV - COS) - (MK + RD + IN + DP) - TX \quad (2)$$
$$PAT = GM - (MK + RD + IN + DP) - TX \quad (3)$$

Likewise, since DP is not a cash flow, the comparable equation for CF is:

$$CF = GM - (MK + RD + IN) - TX \quad (4)$$

Subtracting equation (3) from equation (4) yields:

$$CF - PAT = DP \quad (5)$$

$$CF = PAT + DP \quad (6)$$

When the Assumptions Fail

Most students have no difficulty understanding this derivation, but they tend to be baffled by the simplicity, rather than the complexity, of how to handle situations when the above three assumptions do not hold. Moreover, equation (6) still does not provide much information concerning the sources and uses of cash. It is almost never true that all revenues are received in cash, all expenses are paid in cash, and there are no balance sheet transactions that affect the cash account

Something has to give, and a realistic formulation can be established using the balance sheets and income statements in Table 2. The unique thing about Table 2 is that any firm's balance sheets and income statements can be forced into the set of accounts shown there. Some accounts may have to be combined in order to achieve the Table 2 format, but the task is almost always an easy one. Now, changes in accounts receivable, inventory, fixed assets, accounts payable, accrued taxes, tong term debt, and equity can be taken into account as sources and uses of cash. For example, the sources and uses of cash for the previous period to the current period are as follows, assuming a 10% depreciation rate on net fixed assets for the previous period; a constant long term debt to equity ratio of 1 .0; and a dividend payout ratio of 1/6 for the current period.

Sources		**Uses**		
PAT	36	Increase A/R	15	
DP	20	Increase INV	15	
CashFromOps	56	Increase Fixed Assets	60	
		Increase Other Assets	5	
Increase A/P	10	Pay Dividends	6	
Increas A/T	10			
Increase LTD	30			
Total Sources	106	**Total Uses**	101	
Sources – Uses	5			(7)
Beginning Cash	25			
Ending Cash	30			(8)

Since the new retained earnings in the current period, 30, increase the equity account to 180, there has been no new stock issued and the long-term debt to equity ratio remains at 1 .0. Other assumptions surround this particular model (Colley, 1984) that yield the basic information concerning the sources and uses of cash. However, they are not important for purposes of this paper.

Going Beyond History

What is important is that *the* ***preceding models are all aimed at historical analyses.*** They cannot be wrong since they are dealing with the data already available. Even the preceding or third one that does take major sources and uses of cash into account is historical.

What senior and general managers need, however, are models that are future oriented, ones that allow an analysis of several scenarios of what will or can happen under a given set of assumptions. The discussion in the next session is designed to demonstrate particular kinds of solutions to future cash flow problems.

Two kinds of cash flow models are demonstrated --analytical and descriptive. Both go beyond the first three discussed in this paper, and both provide important answers to specific future questions. The discussion will be limited, however, since brevity is a requirement of this article.

A FUTURE ORIENTATION

Most attempts to project a firm's financial position into the future are concerned with cash flow, growth, and profitability. Analytical projection models answer a large number of important questions, and descriptive models allow an unlimited look at the future. The tradeoff between the two is that brevity and simplicity in analytical models are sacrificed for flexibility and complexity in descriptive ones.

Analytical Models

The term "analytical-model" refers to a cash flow formulation that results in one or more equations that yield important cash flow consequences for a firm's top management. The cash flow consequences of interest are those related to issues such as operating profit, interest on debt, effective tax rates, tong term debt to equity ratios, growth rate, and assets employed. These are worthwhile formulations because they give management realistic projections of their current financial status.

For example, a most useful cash flow, growth, and profitability equation has been derived by Colley (1984). It is:

$$CF = (EBT - I)(1 - DPO)(1 + LTD/EQ)$$
$$(1 + G) - (NA)(G) \qquad (9)$$

where EBIT = Earnings Before Interest And Taxes

= Interest
t = Tax Rate
DPO = Dividends/PAT
LTD/EQ = Long Term Debt to Equity Ratio
G = Growth Rate
NA = Net Assets = Total Assets - Current Liabilities

In this form and in several others that may be derived from it. equation (9) provides answers for many questions of interest to senior managers. Among these are the cash flow consequences of changing dividend, growth, interest and tax rates; LTD/EQ policies and optimum LTD/EQ ratios; cash flow demands on several divisions of a firm or several product lines in a division; efficiency requirements in the use of assets and expense management; and the amount of external funding needed in various combinations of the preceding factors.

One simple example of equation (9) applications is provided by the data in Table 2. Using the previous period data in this table and equation (9), the cash balancing growth rate for this firm may be determined.

(10)

The cash balancing growth rate for the firm, the rate it can finance internally except for any new debt required to maintain a desired LTD/EQ ratio, is determined by setting CF = 0 and solving for G = .2 or 20%.

The last sentence, however, reveals one key weakness of analytical models. The user or forecaster is oftentimes constrained by the assumptions that generated a model such as the one given in equation (9). In fact, one of the assumptions behind equation (9) is that the firm maintains a constant LTD/EQ ratio. That is why the phrase ***"except for any new debt required to maintain a desired LTD/EQ ratio"*** in the preceding discussion of the firm's cash balancing growth rate.

Very often this sort of difficulty can be overcome with insightful modifications of the equation (9) model. But useful as they are, especially for fast answers to the above noted types of questions, most planners would prefer not to be so constrained.

Descriptive Models

One point needs to be made, however, before proceeding. That is, there are a infinite variety of descriptive models possible, given the infinite variety of problems that firms encounter. Nevertheless, a few fairly strong generalities that can be made about all of them.

First, looking at Table 3, they have four parts--assumptions, income statements, balance sheets, and cash flows. Second, only the assumptions entered into a spreadsheet such as Table 3 should contain numerical values. All other cells should contain formulas based upon the cells preceding them. In the future, it will be more than difficult to determine where in the various cell formulas constants need to be changed. Third, it is oftentimes necessary to use simultaneous equations to derive the necessary cell formulas. (See below.) And fourth, perfect models do not exist. Get one that solves the problem and quit.

Generality number one is the most important. It is concerned with the first four parts of Table 3 and the fact that income statements and the asset side of the balance sheet are simple to derive given the preceding assumptions. Current liabilities are equally easy. It is the long term financing of a firm that needs the most attention.

Looking back at the basic accounting identity that current assets (CA) plus fixed assets (FA) must be equal to current liabilities (CL) plus long term debt (LTD) plus equity (EQ), the next equation is simple:

$$CA + FA = CL + LTD + EQ \tag{11}$$

In other words, if CA, FA, and CL are determined easily, then the difference

$$(CA - CL) + FA = LTD + EQ \tag{12}$$

concerns choices regarding the long term funding of the firm, LTD + EQ. Since total assets minus current liabilities is net assets (NA) as defined previously; and since (CA - CL) is working capital (WC); equation (12) can be rewritten as

$$NA \equiv WC + FA = LTD + EQ \tag{13}$$

A Simple LTD + EQ Choice

The results in Table 3 and the formulas behind them in Table 4 are straightforward for the most part. They reflect the assumptions in the beginning section, but the desired ending cash in the balance sheets is typically an arbitrary decision. In the case of Table 4, the decision is to use the quick ratio to determine the cash balance. Most quick ratio calculations are as follows:

$$QuickRatio = (CA - INV - \text{Pr}epaids) / CL \quad (14)$$

where IV is the preceding period's ending inventory.

There are no Prepaids in Table 2, so equation (14) reduces to

$$QuickRatio = (CA - INV) / CL \quad (15)$$

But $CA = Cash + A/R + INV$, so the

$$QuickRatio = (Cash + A/R)CL \quad (16)$$

Setting the Quick Ratio to some value, say *a*, then

$$Cash = aCL - A/R$$

where is one of the assumptions, and CL and A/R from the previous period are increased by this period's growth rate.

All of this noted, and using the subscripts 0 and 1 for the previous and current period respectively, the final task is to expand equation (1 3) for net assets. Using $NA_1 = TA_1 - CL_1$ as the current period net assets, and NI_i = New Issue (or Buy Back) of stock in any period, it is clear that

$$TA_1 - CL_1 = LTD_1 + Stock_0 + NI_0 + NI_1 + RE_1 = a \quad (17)$$

where NI_1 is the variable that will balance the balance sheets and the cash flows. That is, whatever it takes to balance equations (11), (12) and (13), the purchase/buy-back of stock, NI_1, will do it.

Then, using RE_0 as the previous period's retained earnings and NRE_1 as the current period's new retained earnings

$$RE_1 = RE_0 + NRE_1 = d \quad (18)$$

Let $Stock_0 = b, NI_0 = c$, and $LTD_1 / EQ_1 = e$. This leaves the two unknowns, LTD_1 and NI_1, in two equations:

(19)

The constants a, b, c, d, and e are known quantities programmed into the spreadsheet and its underlying logic in Tables 3 and 4. The model works as can be noted in Table 3 by the facts that the balance sheets balance, and the ending cash in the cash flow statements matches the cash account in the balance sheets.

There is one problem however. New Issue, NI_1, may be positive or negative, as needs be in order to balance the balance sheets. Looking at Table 5, Period 5, this problem is apparent. Using widely varying growth rates and LTD/EQ ratios in this example, the initial stock value can be forced to a negative 46.46 in line 36, an impossible value. But, this problem can be solved using the constraint structure of linear programming.

A More Realistic Solution

Beginning again, the net assets equation has to hold:

$$a = TA_1 - CL_1 = LTD_1 + Stock_0 + NI_0 + NI_1 + RE_1$$

which is to say that

$$LTD_1 + NI_1 = a - b - c - d \quad (20)$$

but the LTD/EQ ratio is now an inequality

$$LTD_1 / EQ_1 \le e$$

Using equations (18) and (19) equation (21) can be rewritten as

$$LTD_1 - (e)(NI_1) \le (e)(b + c + d) \quad (21)$$

Likewise

$$Stock_1 = Stock_0 + NI_0 = b + c \quad (22)$$

Yet the Stock1 +NI1 at period 1 must be $\le$ 0, as already noted, so

$$Stock_1 + NI_1 \ge 0 \quad (23)$$

However, as already noted, NI may be positive or negative, and linear programming solutions require all non-negative values of the variables (Dantzig, 1 963). Therefore, NI_1 must be restated as the difference of two positive variables, $NI_1 = NI1_1 - Nl2_1$ which means using equation (23) that

$$Stock_1 + NI1_1 - MI2_1 \geq 0$$
$$b + c + NI1_1 - NI2_1 \geq 0$$

or

$$NI2_1 - NI1_1 \leq b + c \qquad (24)$$

Finally, the outcome looks like this:

$$LTD_1 + NI_1 - NI2_1 = a - b - c - d$$
$$LTD_1 - eNI1_1 + eNI2_1 \leq e(b + c + d)$$
$$Stock_1 = b + c$$
$$-NI1_1 + NI2_1 \leq b + c \qquad (25)$$

with all variables non-negative, and the objective function is the minimization of the slack variables, S_1 and S_2, necessary to transform the second and fourth equations in system (25) from inequalities to equalities.

SUMMARY

Tests of system (25) indicate that it works perfectly, eliminating negative stock values. More important, this is only one of an infinite number of solutions to cash flow problems. The particular situation--mergers, downsizing, compensation packages, and so forth--may all be analyzed using the types of procedures described in this paper.

The trouble is that students are not made aware very often of these possibilities. They enter the capstone policy course still thinking that cash flow analyses are a mysterious subject rather than a routine consequence of accounting definitions. For TE simulation users, this presents a difficult problem that must be solved early in the semester in order to enhance the simulation experience. But, as noted above, there is no reason for this problem..

REFERENCES

Colley, J. L., Jr. (1984) *Corporate and divisional planning: Text and cases.* Reston, VA: Reston Publishing.

Dantzig, G. B. (1963) *Linear programming and extensions.* Princeton, NJ: Princeton University Press.

TABLE 1
STANDARD INCOME STATEMENT SYMBOLS

Revenue		REV
Cost of Sales		COS
Gross Margin		GM
Expenses		
Marketing	MK	
Research & Development	RD	
Interest	IN	
Depreciation	DP	
Profit Before Taxes		PBT
Taxes	TX	
Profit After Taxes		PAT

TABLE 2
STANDARD FINANCIAL STATEMENTS*

	Previous Period	Current Period
BALANCE SHEETS		
Cash	25	30
A/R	25	90
Inventories	75	90
Current Assets	175	210
Net fixed Assets	200	240
Other Assets	25	30
Total Assets	400	480
A/P	50	60
Accrued Taxes	50	60
Current Liabilities	100	120
Long Term Debt	150	180
Equity	150	180
Total liabilities + OE	400	480
INCOME STATEMENTS		
Sales	500	600
Cost of Good Sold	400	480
Gross Margin	100	120
G & A Expense	20	24
Interest Expense	20	24
Profit Before Taxes	60	72
Profit After Taxes	30	36

*Source: Colley (1984)

TABLE 3
A BASIC CASH FLOW MODEL USING NEW ISSUES/STRANGE ENTRIES

B	C	D	E	F	G	H	I
5	**ASSUMPTIONS**	Period0	Period1	Period2	Period3	Period4	Period5
6	GrowthRate%		20.00	-10.00	30.00	-5.00	40.00
7	DeprRate%		10.00	10.00	10.00	10.00	10.00
8	InterestLTD%		16.00	16.00	16.00	16.00	16.00
9	TaxRate%		50.00	50.00	50.00	50.00	50.00
10	DPO%		16.67	16.67	16.67	16.67	16.67
11	Quick(>=1)#		1.00	1.00	1.00	1.00	1.00
12	LTD/EqRatio#		1.00	2.00	0.50	3.00	1.00
13	**IncomeStatement**						
14	Sales	500.00	600.00	540.00	702.00	666.90	933.66
15	CostOfSales	400.00	480.00	432.00	561.60	533.52	746.93
16	GrossMargin	100.00	120.00	108.00	140.40	133.38	186.73
17	Gen/Admin	20.00	24.00	21.60	28.08	26.68	37.35
18	Interest	20.00	24.00	28.80	34.56	22.46	48.02
19	PBT	60.00	72.00	57.60	77.76	84.24	101.37
20	Tax	30.00	36.00	28.80	38.88	42.12	50.68
21	PAT	30.00	36.00	28.80	38.88	42.12	50.68
22	Dividends	5.00	6.00	4.80	6.48	7.02	8.45
23	NewRetEarn	25.00	30.00	24.00	32.40	35.10	42.24
24	**BalanceSheet**						
25	Cash	25.00	30.00	27.00	35.10	33.35	46.68
26	A/R	75.00	90.00	81.00	105.30	100.04	140.05
27	Inv	75.00	90.00	81.00	105.30	100.04	140.05
28	CurrAssets	175.00	210.00	189.00	245.70	233.42	326.78
29	NetF/A	200.00	240.00	216.00	280.80	266.76	373.46
30	O/A	25.00	30.00	27.00	35.10	33.35	46.68
31	**TotalAssets**	400.00	480.00	432.00	561.60	533.52	746.93
32	A/P	50.00	60.00	54.00	70.20	66.69	93.37
33	A/T	50.00	60.00	54.00	70.20	66.69	93.37
34	CurrLiab	100.00	120.00	108.00	140.40	133.38	186.73
35	LTD	150.00	180.00	216.00	140.40	300.11	280.10
36	Stock	125.00	125.00	125.00	29.00	169.40	-46.46
37	***NewIssues***	0.00	0.00	-96.00	140.40	-215.86	137.83
38	R/E	25.00	55.00	79.00	111.40	146.50	188.73
39	**TotalLiabOE**	400.00	480.00	432.00	561.60	533.52	746.93
40	**CashFlow**						
41	PAT		36.00	28.80	38.88	42.12	50.68
42	DP		20.00	24.00	21.60	28.08	26.68
43	CashFromOps		56.00	52.80	60.48	70.20	77.36
44	IncA/P		10.00	-6.00	16.20	-3.51	26.68
45	IncAT		10.00	-6.00	16.20	-3.51	26.68
46	NewLTD		30.00	36.00	-75.60	159.71	-20.01
47	NewIssue		0.00	-96.00	140.40	-215.86	137.83
48	**TotalSources**		106.00	-19.20	157.68	7.02	248.53
49	IncA/R		15.00	-9.00	24.30	-5.27	40.01
50	IncInv		15.00	-9.00	24.30	-5.27	40.01
51	IncF/A		60.00	0.00	86.40	14.04	133.38
52	IncO/A		5.00	-3.00	8.10	-1.76	13.34
53	PayDD		6.00	4.80	6.48	7.02	8.45
54	**TotalUses**		101.00	-16.20	149.58	8.78	235.20
55	**Sources-Uses**		5.00	-3.00	8.10	-1.75	13.34
56	**BegCash**		25.00	30.00	27.00	35.10	33.35
57	**EndCash**		30.00	27.00	35.10	33.35	46.68

TABLE 4
A BASIC CASH FLOW MODEL USING NEW ISSUES/STRANGE ENTRIES

B	C	D		E
5	ASSUMPTIONS	Period0		Period1
6	GrowthRate%		20.00	
7	DeprRate%		10.00	
8	InterestLTD%		16.00	
9	TaxRate%		50.00	
10	DPO%		16.67	
11	Quick(>=1)#		1.00	
12	LTD/EqRatio#		1.00	
13	IncomeStatement			
14	Sales		500	+D14*(1+E6/100)
15	CostOfSales		400	+D15*(1+E6/100)
16	GrossMargin	+D14-D15		+E14-E15
17	Gen/Admin		20	+D17*(1+E6/100)
18	Interest		20	+D35*(E8/100)
19	PBT	+D16-D17-D18		+E16-@SUM(E17..E18)
20	Tax		30	+E19*(E9/100)
21	PAT	+D19-D20		+E19-E20
22	Dividends		5	@IF(E21>0,E21*(E10/100),0)
23	NewRetEarn	+D21-D22		+E21-E22
24	BalanceSheet			
25	Cash		25	+E11*((D34)*(1+E6/100))-D26*(1+E6/100)
26	A/R		75	+D26*(1+E6/100)
27	Inv		75	+D27*(1+E6/100)
28	CurrAssets	@SUM(D27..D25)		@SUM(E25..E27)
29	NetF/A		200	+D29*(1+E6/100)
30	O/A		25	+D30*(1+E6/100)
31	TotalAssets	@SUM(D30..D28)		@SUM(E28..E30)
32	A/P		50	+D32*(1+E6/100)
33	A/T		50	+D33*(1+E6/100)
34	CurrLiab	@SUM(D33..D32)		@SUM(E32..E33)
35	LTD		150	(E31-E34-D36-D37-D38-E23)+((-E31+E34)+(E12+1)*(D36+D37+D38+E23))/(E12+1)
36	Stock		125	+D36+D37
37	*NewIssues*		0	-((-E31+E34)+(E12+1)*(D36+D37+D38+E23))/(E12+1)
38	R/E		25	+D38+E23
39	TotalLiabOE	@SUM(D38..D34)		@SUM(E34..E38)
40	CashFlow			
	PAT			+E21
	DP			+E7*D29/100
43	CashFromOps			+E41+E42
44	IncA/P			+E32-D32
45	IncAT			+E33-D33
46	NewLTD			+E35-D35
47	NewIssue			+E37
48	TotalSources			@SUM(E43..E47)
49	IncA/R			+E26-D26
50	IncInv			+E27-D27
51	IncF/A			+E29-D29+E42
52	IncO/A			+E30-D30
53	PayDD			+E22
54	TotalUses			@SUM(E49..E53)
55	Sources-Uses			+E48-E54
56	BegCash			+D25
57	EndCash			+E55+E56