Accounting Income, Residual Income and Valuation

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Examiner in Strategic Corporate Finance

1. Introduction

The residual income (RI) for a firm for any year t is its accounting income for that year (X_t) less a capital charge equal to the equity cost of capital times opening book value (B_{t-1}). RI has been used for many years in management accounting as a performance evaluation tool to remind managers that the capital they have at their disposal is not free. This article will demonstrate how RI can be used to (i) value a project (ii) value a business and (iii) to reconcile accounting performance with net present value. The term residual income is often referred to as abnormal earnings or economic profit. It is also more or less equivalent to EVA®. The precise definition of RI is outlined below.

$RI_t = X_t - rB_{t-1}$

RI_t = Residual Income for year t

X_t = Equity Profit

r = Cost of Equity Capital

B_{t-1} = Book Value of Equity at beginning of period t (end of t-1)

This formula can be re-arranged to demonstrate that RI is also the spread between the return on equity (ROE) and the cost of equity times opening book value.

$$RI = \left[\frac{X_t}{B_{t-1}} - r\right] B_{t-1} = [ROE - r]B_{t-1}$$

2. Residual Income and the Valuation of a Project

The first property of RI that we will explore is that the present value of the RIs of a project is equal to its net present value (NPV).

We know that the NPV of the project outlined in Table 1 below is the present value (PV) of its future cash flows less its initial cost ($-C_0 + \sum_{t=1}^{t=T} C_t$). The project costs €1 million euro and yields positive cash flows for 4 years. Its NPV at 10% is readily computed at €202,830 (in terms of the above formula €1,202.83K – €1000K).

TABLE 1

Computation of NPV

Time	0	1	2	3	4
Net Cash Flows (in €'000)	-1000.00	370.00	460.00	420.00	250.00
Discount Factor	1.00	1.10	1.21	1.33	1.46
Discounted Cash Flow	-1000.00	336.36	380.17	315.55	170.75

If we track the above project through the accounting system the numbers will look at little different. Let's keep the accounting simple and only use two accounting accruals: depreciation and net accounts receivable or net trade debtors. We use straight line depreciation over the four years and allow credit sales so the cash received will lag sales. Table 2 outlines how the project will appear in the financial statements. The table assumes that all spare cash is paid out as dividends each year.

TABLE 2

Financial Statements for the Project

Income Statements

Time	1	2	3	4
Sales	462.5	482.5	410	145
Depreciation (1000/4)	250	250	250	250
Operating profit (X_t)	212.5	232.5	160	-105

Balance Sheets

	0	1	2	3	4
Fixed Assets	1000.0	750.0	500.0	250.0	0.0
Current Assets		92.5	115.0	105.0	0.0
Total Assets	1000.0	842.5	615.0	355.0	0.0
Opening Capital	1000.0	1000.0	842.5	615.0	355.0
Add Profit		212.5	232.5	160.0	-105.0
less Dividends		370.0	460.0	420.0	250.0
Closing Capital	1000.0	842.5	615.0	355.0	0.0

To transform the operating profit numbers into numbers that can be used for valuation we need to use the concept of residual income. From the RI formula above it is clear that we have X_t we also have the cost of capital (10%) so all we need is the opening book value of the project for each year, B_{t-1}.

The book value of the project can easily be tracked over time and it is outlined in Table 3. Having established the book value of the project at the beginning of each

year we can compute RI for each year. If we discount RI using the same discount factors as outlined in Table 1 above we find its present value (PV) is exactly the same as the NPV of the project.

TABLE 3

Calculation of Residual Income for the Project and it Present Value

Time	0	1	2	3	4
Opening Book Value (B_{t-1})		1000	842.5	615.0	355.0
Change in debtors		92.5	22.5	-10.0	-105.0
Depreciation		-250	-250	-250	-250
Closing Book Value (B_t)	1000	842.5	615.0	355.0	0.0
RI = $X_t - rB_{t-1}$		112.5	148.25	98.5	-140.5
NPV of RI @ 10%	202.83				

The above analysis illustrates that NPV = PV – Cost (B_0) = PV (RI). Therefore, the PV of the project is B_0 + PV (RI). That is at time 0 the project is worth its book value (historic cost) plus the present value of its RI (in numbers €1000 + €202.83 = €1202.83).

We now outline a simple proof of why this is so using a one period project. The cost of the project is $C_0 = B_0$: this is simply the historic cost convention. If the project gives cash flows equal to C_1 the following year its NPV is trivially computed at $-B_0 + C_1/(1+r)$. The earnings of the project are its cash flow adjusted for accruals: here earnings equal to C_1 – Depreciation (Depr). Since the project only lasts one year Depr = B_0. The RI for the project in its one year of operation is $[C_1 - B_0] - rB_0 = C_1 - (1+r) B_0$. The present value of RI = RI/ (1+r) = C_1 / (1+r) - B0, which is equal to the NPV as outlined above.

We could also have worked back to the free cash flows (FCF) of the project from the accounting profit and discounted them to get the same NPV (see Table 4). The only operating assets the project has are the fixed assets and trade receivables. FCF is operating income less (plus) the increase (decrease) in net operating assets (NOA). So for the first year of the project the fixed assets are reduced by €250K depreciation and receivables increase by €92.5K giving a net reduction of €157.50K which is added back to profit to give FCF of €212.5K + €157.5K = €370.

TABLE 4

Working back to Free Cash Flows from Accounting Income

Computing Free Cash Flows Time	0	1	2	3	4
Operating Profit		212.5	232.5	160	-105
plus decrease in NOA		157.5	227.5	260	355
Free Cash Flow		370	460	420	250

Note that the FCF are exactly equal to the cash flows that we outlined and discounted to get the NPV of the project in Table 1.

Another feature of residual income valuation is that is does not matter how the accounting is done: the present value of a project's RI will always be equal to its NPV. For example, suppose that the revenue recognition is done very conservatively in the above project and sales are not recognised until the cash is received. The profits are then deferred as outlined in Table 5 below but the present value of residual income does not change. The distribution of income and residual income throughout the period of the project does change since conservative accounting defers the income recognition. Table 5 outlines the profits, residual income and worth of the project assuming more the conservative revenue recognition mentioned above. Note that Table 5 also illustrates the alternative method of computing RI, i.e. $(ROE - r)B_{t-1}$.

TABLE 5

More Conservative Accounting

Time	0	1	2	3	4
Sales/ Cash Flows	-1000	370	460	420	250
Depreciation (1000/4)		250	250	250	250
Profit		120	210	170	0
ROE		0.12	0.28	0.34	0
B_{t-1}		1000	750	500	250
Cost of Capital (r)		0.1	0.1	0.1	0.1
Spread (ROE - r)		0.02	0.18	0.24	-0.1
RI = $(ROE-r).B_{t-1}$		20	135	120	-25
Discount Factor		1.1	1.21	1.331	1.4641
Discounted RI		18.18	111.57	90.16	-17.08
PV of RI	202.83				

3. Residual Income and the Valuation of a Business

Next we consider the use of RI to value a business. A business is just a collection of projects so the principles are just the same. On this occasion we will first deal with the general case but in a very simple scenario where a business is expected to operate for only one period before being sold on. Theoretically the value of a business is the present value of all its expected dividends. This gives the well-known present value of expected dividends formula (PVED).

$P_t = \frac{\sum_{\tau=1}^{\infty} D_{t+\tau}}{(1+r)^{\tau}}$

P_t is the price at time t

$D_{t+\tau}$ is the expected dividend at time $t+\tau$

While theoretically correct this formula is of little practical use. To make it useful assumptions must be made regarding the forecast horizon and/or the evolution of dividends over time. We will assume that we invest in the firm for just one year before selling on our investment: essentially this means that the above PVED formula reduces to

$$P_o = \frac{P_1 + D_1}{1 + r}$$

We further assume that accounting is done on a clean surplus basis: that is the change in equity book value is simply retained earnings. More formally $X_t - D_t = B_t - B_{t-1}$. We can then substitute for dividends [$D_t = X_t - (B_t - B_{t-1})$ or earning minus retained earnings] in the simplified PVED equation to get

$$P_0 = \frac{X_t - (B_1 - B_0) + P_1}{1 + r}$$

This can be re-arranged to give (*hint: add and subtract* $\frac{1+r}{1+r}B_0$ *to the RHS of the equation*)

$$P_0 = B_0 + \frac{X_t - rB_0}{1 + r} + \frac{P_1 - B_1}{1 + r}$$

$P_0 = B_0 + \frac{RI_1}{1+r} + \frac{P_1 - B_1}{1+r}$

This states that the value of a business is equal to its equity book value, plus the present value of residual income to the forecast horizon (here just one year) plus the present value of the forecast premium of market value over book value at the forecast horizon. It can be shown that the latter term is equal the present value of future residual income beyond the forecast horizon. In practical terms which, we will illustrate below, some assumptions must be made regarding the evolution or growth rate of RI after the forecast horizon. Thus the value of any business is made up of two parts (i) the book value of assets in place and (ii) the present value of all future

residual income. The general formula for the valuation of the business is $V_t = B_t +$ PV (RI).

In an article in the CPA Student eBulletin February (2013) Donnelly outlines how to compute free cash flow is and how to use it to value companies. Taking the same example from that article I will show how the residual income valuation model (RIVM) outlined above can be used to give the same valuation. First, Table 6 outlines the projections for Alkimos which has a cost of capital (WACC) of 7%.

TABLE 6

Alkimos

	0	1	2	3	4	5
Sales	800.00	864.00	889.92	916.62	944.12	972.44
Operating Income	80.00	86.40	88.99	91.66	94.41	97.24
Interest	10	10.29	9.82	10.11	10.42	10.73
Net Income	70.00	76.11	79.17	81.55	84.00	86.52
Fixed Assets	388.24	399.89	411.88	424.24	436.97	450.08
Net Current Assets	172.00	172.80	177.98	183.32	188.82	194.49
Total Assets	560.24	572.69	589.87	607.56	625.79	644.56
Equity	303.00	327.25	337.07	347.18	357.59	368.32
Debt	257.24	245.44	252.80	260.38	268.20	276.24
Total Capital	560.24	572.69	589.87	607.56	625.79	644.56

The valuation of Alkimos using a discounted FCF method is then outlined. Note we assume a growth rate of 3% in FCF after year 5.

TABLE 7

Valuation of Alkimos using FCF

Operating Income	86.40	88.99	91.66	94.41	97.24
ΔNOA	12.45	17.18	17.70	18.23	18.77
FCF	73.95	71.81	73.97	76.18	78.47
Disc. Factor	1.070	1.145	1.225	1.311	1.403
Disc. FCF	69.11477	62.72284	60.37806	58.12094	55.95
Cumulative DFCF	69.11477	131.8376	192.2157	250.3366	306.28
PV of Terminal Value					1440.67

Value of Assets	1746.95
Less Value of Debt	257.24
Value of Equity	1489.71

Note: details of the calculations can be found in the article of February 2013 in the CPA eBulletin.

The equivalent RI valuation is outlined in Table 8. While the valuations are identical a noticeable difference between the FCF and RIVM valuations is that in the former much more of the overall valuation comes from projections after year 5. Approximately 82% of the valuation of Alkimos' assets and an even higher percentage of equity value is derived from projections after year 5, i.e. those projections that we have least confidence in. In the RIVM only 65% of the value of equity now comes from the projections beyond year 5. Instead the book value of equity now accounts for 20% of the valuation. As for the FCF the terminal growth rate is assumed to be 3% for the RIVM calculation. To compute the RI after the forecasts horizon the RI is usually assumed to be zero, to be a constant or, as outlined here, to grow at a constant rate.

TABLE 8

Valuation of Alkimos using Residual Income (RI)

Operating Income	86.40	88.99	91.66	94.41	97.24
Opening BV	560.24	572.69	589.87	607.56	625.79
Capital Charge	39.22	40.09	41.29	42.53	43.81
RI	47.18	48.90	50.37	51.88	53.44
Discount Factor	1.07	1.145	1.225	1.311	1.403
Discounted RI (DRI)	44.096	42.71	41.118	39.58	38.10
Cumulative DRI	44.096	86.81	127.920	167.51	205.61
PV of Terminal Value					981.10
Total PV of DRI					1186.71
Plus Book Value of Equity					303.00
					1489.711

The RIVM exploits the fact that accounting accruals reflect value creation in advance of cash flows. For example, investment in cash flow terms is a deduction from

rather than a creation of value: remember FCF = C_t - I_t (cash flows less investments). Accounting recognises investment in assets as a something of value and records it as such in the balance sheet (i.e. as an asset). Thus positive changes in asset values are likely to anticipate increases in operating income and future operating cash flows. One way of thinking about this is to consider the asset value of the business as representing normal future accounting income. Normal income is the income or earnings that the assets can earn on their book value so that the rate of return equals the cost of equity (ROE = r). Thus normal income in year t+1 is rB_t. This is the level of profitability required to give the assets a PV equal to their cost i.e. a zero NPV. Note that if a firm earned its normal rate of return in perpetuity its earnings would be rB_t for each year t to infinity. The present value of such an income stream is $\frac{rB_t}{r}$ or B_t, i.e. its book value. The extra value (or NPV) of the investments not represented by the book value or assets in the balance sheet then needs to be computed. The net present value of these investments is the present value of their abnormal or residual income as outlined above. In simple terms the value of the firm now (i.e. when t=0) is B_0 + PV(RI).

4. Reconciling Accounting Performance with NPV

It is clear from the above that if RI is not greater than 0 or alternatively ROE does not exceed the cost of capital in all periods that a project may have a negative NPV. Indeed as shown in the example below a project must achieve a level of profitability such that its ROE is greater than r in order to provide a positive NPV.

TABLE 9

A profitable project with an NPV of zero

Time	0	1	2	3	4	5
Cash Flows	-500	145	136	127	118	109
Depreciation (1000/5)		100	100	100	100	100
Profit		45	36	27	18	9
Bt_{-1}		500	400	300	200	100
ROE		0.09	0.09	0.09	0.09	0.09
Residual Income		0	0	0	0	0

In this example the company's cost of capital is equal to 9%. The project has an ROE of 9% in each year so its RI is zero for each year. Thus, the projects PV of RI and its NPV are zero.

The example outlined in Table 10 demonstrates that projects must earn a ROE that is on average higher than the cost of capital to have a positive NPV. If profits are not sufficient to cover the cost of capital the project will destroy value. If we take the previous example and reduce the future cash inflows we get the following.

TABLE 10

A profitable project with a negative NPV

Time	0	1	2	3	4	5
Cash Flows	-500.00	140.00	140.00	120.00	120.00	101.00
Depreciation (1000/5)		100.00	100.00	100.00	100.00	100.00
Profit		40.00	40.00	20.00	20.00	1.00
NPV of Cash Flows @ 9%	-10.41					
Bt-1		500.00	400.00	300.00	200.00	100.00
ROI		0.08	0.10	0.07	0.10	0.01
Residual Income		-5.00	4.00	-7.00	2.00	-8.00
NPV of RI @ 9%	-10.41					

In the above example the profits are not sufficient to cover the capital charge. Even though the project is profitable in all periods it has a negative NPV and should be rejected. This illustrates why accounting profits alone can never be used as a criterion for making an investment decision. The cost of capital is always a vital input into the decision to accept or reject a project. This cost is ignored when computing accounting profit but computing the present value of RI clearly takes the cost of capital into account.

5. Concluding Remarks

It is a basic tenet of corporate finance that firms exist to maximise shareholder wealth. It follows naturally that the NPV criterion should be followed in making investment decisions. Firms will maximise their own value and hence shareholder wealth if they accept all projects that have a positive NPV and reject all others. Finance textbooks in their defence of NPV often criticise accounting information as unreliable. However, the projected cash flows for a business are usually estimated based on accounting information. In particular, FCF are estimated from projected accounting earnings. These is turn are partly based on current accounting information. This article illustrates that the cost of capital is always a vital input in valuation and the use of RI corrects accounting earnings for this.

This article shows how RI can substitute for cash flows and yield results that are perfectly consistent with the NPV criterion. RI has an advantage over NPV as it lends itself to more easily to ex-post evaluation of the performance of a firm and its managers. In this respect RI has a well-respected pedigree in management accounting. Another advantage of the RIVM is that a smaller portion of a valuation based on RI comes from projections beyond the forecast horizon than for FCF valuation. However, RI suffers from the same allocation problems as accounting itself. How can you evaluate the performance of a firm or manager over a period as

short as a year when the firm's projects typically last for a much longer period? Thus while the PV(RI) will always equal to a project's NPV it is not advisable to place too much weight on the RI of an individual year since this can be distorted by aggressive or conservative accounting. Nonetheless RI has the distinct advantage of clearly illustrating that firms must not only generate profit to be viable: their profits must be such to cover the cost of capital. In effect on average RI must be positive (or more precisely the PV of RI must be positive) if a project is to create wealth.