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HOW TO VALUE A SEASONAL COMPANY BY DISCOUNTED CASH FLOWS

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HOW TO VALUE A SEASONAL COMPANY BY DISCOUNTED CASH FLOWS

Abstract

The correct way to value seasonal companies by discounted cash flows is to use monthly data. It is possible to use annual data, but some adjustments are required. When using annual data in the context of the adjusted present value, the calculations of the value of the unlevered equity and the value of the tax shields must be adjusted. We derive the adjustments to be made. Errors due to using annual data without making the necessary adjustments are big. Adjusting merely by using average debt and average working capital requirements does not provide a good approximation.

When inventories are a liquid commodity such as grain or seeds, it is not correct to consider all of them as working capital requirements. Excess inventories financed with debt are equivalent to a set of futures contracts. We show that not considering them as such leads us to undervalue the company.

The paper includes a valuation of a company in which the seasonality is due to purchases of raw materials: the company buys and pays for all raw materials in December. We show that the equity value calculated using annual data without making the necessary adjustments understates the true value by 45% if the valuation is done in December, and overstates the true value by 38% if the valuation is done in November. The error due to adjusting only by using average debt and average working capital requirements ranges from –17.9% to 8.5%.

JEL Classification: G12, G31, M21

Keywords: valuation of seasonal companies; seasonality; cash flow discounting

HOW TO VALUE A SEASONAL COMPANY BY DISCOUNTED CASH FLOWS

Introduction

Little attention has been paid to the impact of seasonality on the valuation of companies. Damodaran (1994), Brealey and Myers (2000), Penman (2001), and Copeland (2000) do not even include the terms "seasonal" or "seasonality" in their indexes.

We may define seasonality of cash flows as the variance of a company's monthly cash flows. We normally say that a company exhibits a seasonality pattern when the variance of the monthly cash flows is high.

Seasonality normally is due to sales (as in the case of toy factories), purchases (as in the case of edible oil producers) or production decisions. When valuing companies, seasonality affects the calculation of the Free Cash Flows through the increase in Working Capital Requirements.

When valuing seasonal companies using annual data (instead of monthly data), it is necessary to make some adjustments. The errors that result from using unadjusted annual data for valuing companies are big.

In this paper we will use the example of Russoil, a company that buys sunflower seeds to produce and sell oil. Sales of sunflower oil are stable over the year, but the company has a policy of buying all its annual needs of seeds in December. Section 1 describes the company and provides the expected monthly balance sheets, P&Ls and cash flows. Section 2 provides a valuation of the company using monthly data. Section 3 values the company using annual data without adjustments and shows that the resulting valuation understates the true value by 45% if the valuation is done at the end of December, and overstates the true value by 38% if the valuation is done at the end of November. Sections 3.1 and 3.2 show the adjustments needed to perform a correct valuation using annual data. We define a correct valuation as one that provides the same value as the valuation using monthly data. Section 4 shows that the error caused by adjusting the annual data merely by using average debt and average working capital requirements ranges from –17.9% to 8.5%. Section 5 shows how the valuation should be modified if the company holds excess inventories that are a liquid commodity. We argue that if the inventories are a very liquid commodity, then it is not correct to treat them as working capital requirements. We define excess inventories as any amount over a minimum or safety inventory. When excess inventories are financed with debt, they are equivalent to a set of futures contracts. We argue that buying futures contracts on a very liquid commodity is identical to buying the commodity with borrowed money. Therefore, the debt incurred in order to finance these futures contracts should not be considered financial debt in the valuation. That is exactly what Russoil does: it buys the seeds in December with borrowed money. We show that not taking this approach leads us to undervalue the company by between 12% and 14%. Section 6 concludes.

1. Description of Russoil, a seasonal company

Russoil is a seasonal company that buys seeds and produces sunflower oil. The seasonality is due to the fact that the seeds are purchased and paid for in December. Table 1 shows the projected balance sheets and P&Ls for the company's first fourteen months. The company does not own any fixed assets. It has a policy of holding a minimum cash of $140,000 and of canceling its debt at least one month every year.

Sales are expected to grow at a monthly rate of 1% until December 2008. From then on, sales are expected to remain constant until November 2010, when the company will be liquidated.

Cost of sales is 75% of sales. 80% of the cost of sales is the cost of seeds. The remaining 20% is mainly labor costs. General expenses are expected to be 16% of sales.

Seeds are paid for in cash and sales are collected in cash. The company does not have any accounts receivable or accounts payable.

The company pays 0.5% monthly interest on the debt. Corporate taxes are 40%.

Figure 1 shows the seasonality of the inventories and of the debt.

Table 2 contains Russoil's expected cash flows and Figure 2 highlights the seasonality of the free cash flows. The equity cash flow is equal to the dividends paid to the shareholders.

Table 1. Projected balance sheets and P&Ls of Russoil ($000's)

	11/03	**12/03**	**1/04**	**2/04**	**3/04**	**4/04**	**5/04**	**6/04**	**7/04**	**8/04**	**9/04**	**10/04**	**11/04**	**12/04**
Cash	140	140	140	140	140	140	140	140	140	140	140	140	140	140
Stocks	201	2,572	2,370	2,165	1,958	1,749	1,538	1,325	1,109	892	672	450	226	2,899
Fixed assets	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total assets	**341**	**2,712**	**2,510**	**2,305**	**2,098**	**1,889**	**1,678**	**1,465**	**1,249**	**1,032**	**812**	**590**	**366**	**3,039**
Debt	0	2,353	2,139	1,923	1,703	1,480	1,255	1,026	794	560	322	81	0	2,652
Equity	341	359	370	382	395	409	423	439	455	472	490	509	366	387
Total	**341**	**2,712**	**2,510**	**2,305**	**2,098**	**1,889**	**1,678**	**1,465**	**1,249**	**1,032**	**812**	**590**	**366**	**3,039**
Sales		334.7	338.0	341.4	344.8	348.3	351.8	355.3	358.8	362.4	366.1	369.7	373.4	377.1
Cost of sales		251.0	253.5	256.1	258.6	261.2	263.8	266.5	269.1	271.8	274.5	277.3	280.1	282.9
Gross margin		83.7	84.5	85.4	86.2	87.1	87.9	88.8	89.7	90.6	91.5	92.4	93.4	94.3
General expenses		53.6	54.1	54.6	55.2	55.7	56.3	56.8	57.4	58.0	58.6	59.2	59.7	60.3
Interest		0.0	11.8	10.7	9.6	8.5	7.4	6.3	5.1	4.0	2.8	1.6	0.4	0.0
PBT		30.1	18.7	20.0	21.4	22.8	24.3	25.7	27.2	28.6	30.1	31.7	33.2	33.9
Taxes (40%)		12.0	7.5	8.0	8.6	9.1	9.7	10.3	10.9	11.5	12.1	12.7	13.3	13.6
Net income		**18.1**	**11.2**	**12.0**	**12.9**	**13.7**	**14.6**	**15.4**	**16.3**	**17.2**	**18.1**	**19.0**	**19.9**	**20.4**
Dividends paid		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	162.8	0.0

	11/03	12/03	1/04	2/04	3/04	4/04	5/04	6/04	7/04	8/04	9/04	10/04	11/04	12/04
Initial stock		201	2,572	2,370	2,165	1,958	1,749	1,538	1,325	1,109	892	672	450	226
+ Purchases		2,572	0	0	0	0	0	0	0	0	0	0	0	2,899
+ Labor and other		**50**	**51**	**51**	**52**	**52**	**53**	**53**	**54**	**54**	**55**	**55**	**56**	**57**
–Cost of sales		251	254	256	259	261	264	266	269	272	275	277	280	283
Final stock		2,572	2,370	2,165	1,958	1,749	1,538	1,325	1,109	892	672	450	226	2,899

Figure 1. Seasonality of monthly debt and stocks

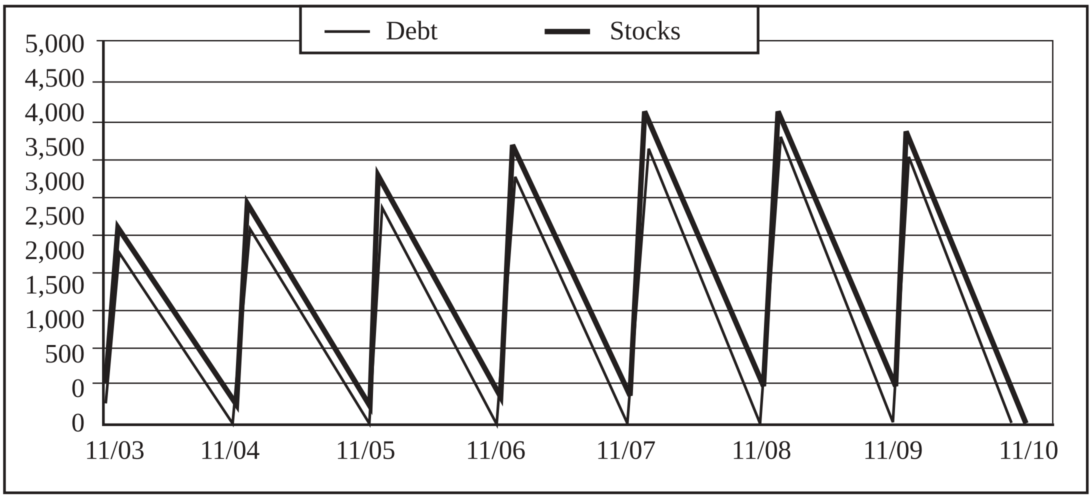
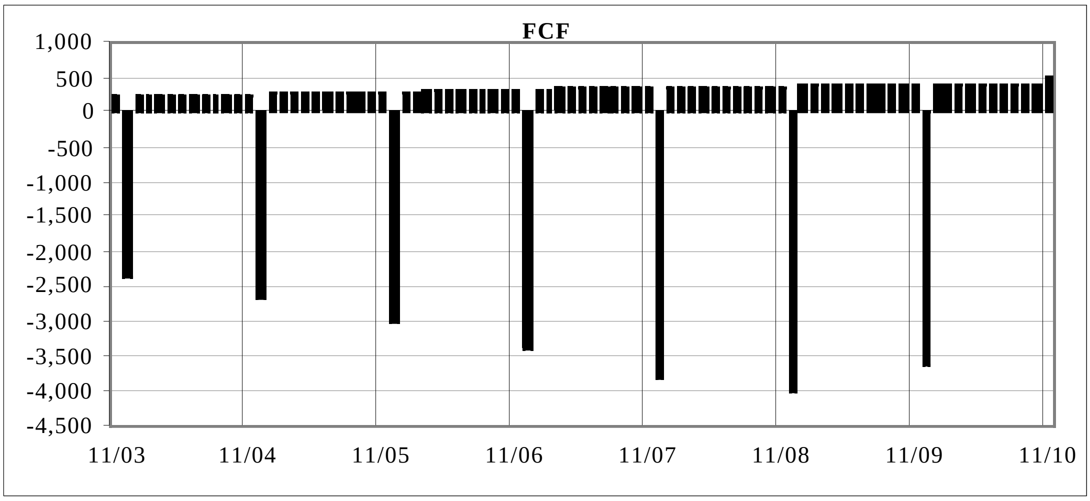


Table 2. Projected monthly cash flows of Russoil ($000's)

	12/03	1/04	2/04	3/04	4/04	5/04	6/04	7/04	8/04	9/04	10/04	11/04	12/04
Gross margin	83.7	84.5	85.4	86.2	87.1	87.9	88.8	89.7	90.6	91.5	92.4	93.4	94.3
– General expenses	–53.6	–54.1	–54.6	–55.2	–55.7	–56.3	–56.8	–57.4	–58.0	–58.6	–59.2	–59.7	–60.3
NOPBT	30.1	30.4	30.7	31.0	31.3	31.7	32.0	32.3	32.6	32.9	33.3	33.6	33.9
Taxes on NOPBT	–12.0	–12.2	–12.3	–12.4	–12.5	–12.7	–12.8	–12.9	–13.0	–13.2	–13.3	–13.4	–13.6
NOPAT	18.1	18.3	18.4	18.6	18.8	19.0	19.2	19.4	19.6	19.8	20.0	20.2	20.4
– Increase of WCR	–2,371.6	202.8	204.9	206.9	209.0	211.1	213.2	215.3	217.5	219.6	221.8	224.0	–2,672.3
FCF	–2,353.5	221.1	223.3	225.5	227.8	230.1	232.4	234.7	237.0	239.4	241.8	244.2	–2,652.0
+ ΔD	2,353.5	–214.0	–216.9	–219.8	–222.7	–225.6	–228.6	–231.6	–234.6	–237.7	–240.8	–81.1	2,652.0
– Int (1-T)	0.0	–7.1	–6.4	–5.8	–5.1	–4.4	–3.8	–3.1	–2.4	–1.7	–1.0	–0.2	0.0
ECF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	162.8	0.0
CFd	–2,353.5	225.8	227.6	229.4	231.2	233.0	234.9	236.7	238.6	240.5	242.4	81.5	–2,652.0

Figure 2. Seasonality of monthly FCF



2. Valuation of Russoil using monthly data

In November 2003, the monthly risk-free rate was 0.4% and the monthly market risk premium was assumed to be 0.45%. The unlevered beta of the company was assumed to be 1.0. Therefore, the monthly unlevered cost of equity (Ku) was 0.85%.

Using the Adjusted Present Value (APV) formula, the valuation of the company at the end of November 2003 and at the end of December 2003 are shown in Table 3. The Value of Tax Shields (VTS) is calculated according to Fernández (2003).

Table 3. Valuation of Russoil using APV with monthly data

	11/03	**12/03**
Ku	0.85%	0.85%
Vu = PV (Ku; FCF)	859.0	3,219.8
VTS = PV (Ku; D T Ku)	307.0	309.6
E + D = VTS + Vu	1,166.0	3,529.4
E = (E+D) - D	1,166.0	1,175.9

Table 4 shows the valuation using the Equity cash flow method and the WACC method. Using those methods, the WACC and the required return to equity (Ke) change every month, as can be seen in Figure 3. Note that Ke = WACC = Ku = 0.85% in the months when there is no debt. Ke is higher (WACC is lower) when the debt is higher.

The valuation results of Table 4 are equal to those of Table 3. Note that the equity values calculated for November and December satisfy the following equilibrium relation:

$$E_t = E_{t-1} \ (1+Ke_t) - ECF_t \qquad [1]$$

The values calculated for the enterprise value (EV = E+D) satisfy the following equilibrium relation:

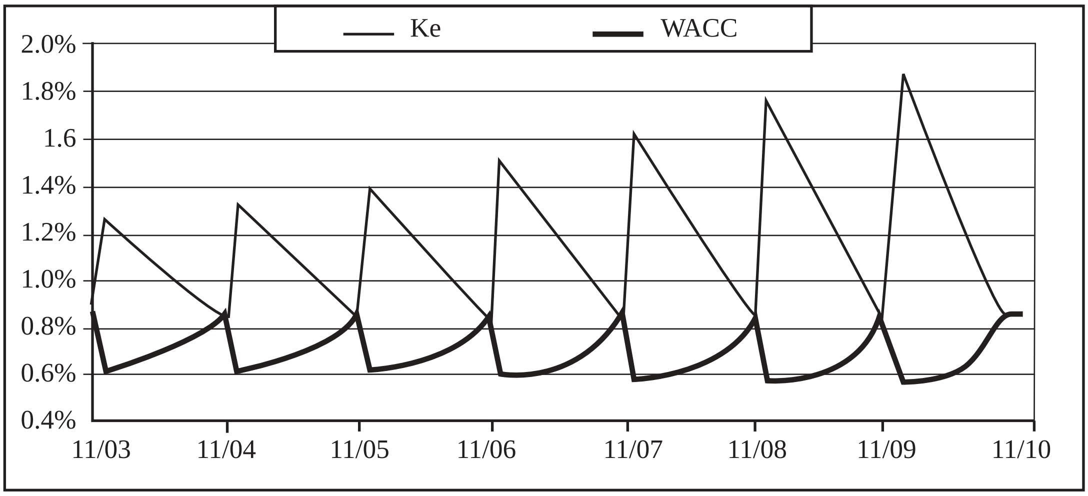
$$(D_t+E_t) = (D_{t-1} + E_{t-1})(1+WACC_t)-FCF_t \quad [2]$$

Table 4. Valuation of Russoil using the Equity cash flow method and the WACC method with monthly data

	11/03	12/03
Ke	0.85%	1.27%
E = PV(Ke; ECF)	1,166.0	1,175.9

WACC	0.850%	0.623%
E + D = PV (WACC;FCF)	1,166.0	3,529.4
E = (E+D) – D	1,166.0	1,175.9

Figure 3. Seasonality of monthly Ke and WACC



3. Valuation of Russoil using yearly data

Table 5 shows Russoil’s projected annual balance sheets and P&Ls assuming that each year finishes in December. The balance sheets correspond to the monthly balance sheets of December. The P&Ls and the cash flows for each year are the sum of the 12 monthly P&Ls and cash flows from January to December.

Analogously, Table 6 shows Russoil’s projected annual balance sheets and P&Ls assuming that each year finishes in November (instead of in December as in Table 5). The balance sheets correspond to the monthly balance sheets of November. The P&Ls and the cash flows for each year are the sum of the 12 monthly P&Ls and cash flows from December to November the following year.

Table 7 highlights the difference in the annual Free Cash Flows between Tables 5 and 6, that is, depending whether we consider that the year finishes in December or in November. This difference has important consequences for valuation purposes. The annual equity cash flows are equal in Tables 5 and 6.

Table 5. Projected annual balance sheets, P&Ls and Cash flows of Russoil ($000's) in December

	2003	2004	2005	2006	2007	2008	2009	2010
Cash	140.0	140.0	140.0	140.0	140.0	140.0	140.0	0.0
Stocks	2,572.4	2,898.6	3,266.2	3,680.5	4,147.2	4,378.0	4,013.1	0.0
Fixed assets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total assets	2,712.4	3,038.6	3,406.2	3,820.5	4,287.2	4,518.0	4,153.1	0.0
Debt	2,353.5	2,652.0	2,988.3	3,367.3	3,794.3	3,980.3	3,615.5	0.0
Equity	358.9	386.7	417.9	453.2	492.9	537.7	537.7	0.0
Total	2,712.4	3,038.6	3,406.2	3,820.5	4,287.2	4,518.0	4,153.1	0.0
Sales		4,287.3	4,831.0	5,443.7	6,134.1	6,912.1	7,296.6	6,688.5
Cost of sales		3,215.5	3,623.3	4,082.8	4,600.6	5,184.1	5,472.4	5,016.4
Gross margin		1,071.8	1,207.8	1,360.9	1,533.5	1,728.0	1,824.1	1,672.1
General expenses		686.0	773.0	871.0	981.5	1,105.9	1,167.5	1,070.2
Depreciation		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Interest		68.2	76.8	86.6	97.6	109.9	111.9	93.0
PBT		317.7	358.0	403.4	454.5	512.2	544.8	508.9
Taxes (40%)		127.1	143.2	161.3	181.8	204.9	217.9	203.6
Net income		190.6	214.8	242.0	272.7	307.3	326.9	305.4
Gross margin		1,071.8	1,207.8	1,360.9	1,533.5	1,728.0	1,824.1	1,672.1
- General expenses		–686.0	–773.0	–871.0	–981.5	–1,105.9	–1,167.5	–1,070.2
NOPBT		385.9	434.8	489.9	552.1	622.1	656.7	602.0
Taxes on NOPBT		–154.3	–173.9	–196.0	–220.8	–248.8	–262.7	–240.8
NOPAT		231.5	260.9	294.0	331.2	373.3	394.0	361.2
Increase of WCR		–326.2	–367.6	–414.2	–466.8	–230.7	364.8	4,153.1
FCF		–94.7	–106.7	–120.3	–135.5	142.5	758.8	4,514.3
+ ΔD		298.5	336.3	379.0	427.1	186.0	–364.8	–3,615.5
- Int (1-T)		–40.9	–46.1	–51.9	–58.5	–66.0	–67.1	–55.8
ECF		162.8	183.5	206.8	233.0	262.5	326.9	843.0
CFd		–230.3	–259.5	–292.4	–329.5	–76.0	476.7	3,708.5

Table 6. Projected annual balance sheets, P&Ls and Cash flows of Russoil ($000's) in November

	2003	2004	2005	2006	2007	2008	2009	2010
Cash	140.0	140.0	140.0	140.0	140.0	140.0	140.0	0.0
Stocks	200.8	226.3	255.0	287.3	323.8	364.8	364.8	0.0
Fixed assets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total assets	340.8	366.3	395.0	427.3	463.8	504.8	504.8	0.0
Accounts payable	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Debt	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Equity	340.8	366.3	395.0	427.3	463.8	504.8	504.8	0.0
Total	340.8	366.3	395.0	427.3	463.8	504.8	504.8	0.0

Sales	4,244.8	4,783.2	5,389.8	6,073.4	6,843.6	7,296.6	7,296.6
Cost of sales	3,183.6	3,587.4	4,042.4	4,555.0	5,132.7	5,472.4	5,472.4
Gross margin	1,061.2	1,195.8	1,347.5	1,518.3	1,710.9	1,824.1	1,824.1
General expenses	679.2	765.3	862.4	971.7	1,095.0	1,167.5	1,167.5
Interest	68.2	76.8	86.6	97.6	109.9	111.9	93.0
PBT	313.9	353.7	398.5	449.1	506.0	544.8	563.7
Taxes (40%)	125.5	141.5	159.4	179.6	202.4	217.9	225.5
Net income	188.3	212.2	239.1	269.4	303.6	326.9	338.2

Gross margin	1,061.2	1,195.8	1,347.5	1,518.3	1,710.9	1,824.1	1,824.1
- General expenses	–679.2	–765.3	–862.4	–971.7	–1,095.0	–1,167.5	–1,167.5
NOPBT	382.0	430.5	485.1	546.6	615.9	656.7	656.7
Taxes on NOPBT	–152.8	–172.2	–194.0	–218.6	–246.4	–262.7	–262.7
NOPAT	229.2	258.3	291.1	328.0	369.6	394.0	394.0
- Increase of WCR	–25.5	–28.7	–32.3	–36.4	–41.1	0.0	504.8
FCF	203.8	229.6	258.7	291.5	328.5	394.0	898.8

+ ΔD	0.0	0.0	0.0	0.0	0.0	0.0	0.0
- Int (1-T)	–40.9	–46.1	–51.9	–58.5	–66.0	–67.1	–55.8
ECF	162.8	183.5	206.8	233.0	262.5	326.9	843.0

Table 7. Annual Free Cash Flows of Russoil ($000's) from Tables 5 and 6, that is, depending whether we consider the year ends in December or in November

	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
FCF - November	204	230	259	292	328	394	899
FCF - December	–95	–107	–120	–136	143	759	4,514

If we value Russoil using the APV method and the annual data from Tables 5 and 6, we get very different values to those obtained in Table 3. The annual required return to the unlevered equity (Kua) should be: Kua = (1+Ku)12 –1 = (1+0.0085)12 –1 = 10.6906%. Table 8 contains the valuation of Russoil using the annual FCFs from Tables 5 and 6, without taking the seasonality into account. Column 1 contains the unlevered equity value, column 2 the value of tax shields, column 3 the enterprise value, column 4 the debt at the beginning of the year, and column 5 the equity value obtained using annual data. Column 6 has the equity value obtained using monthly data (the correct value), and column 7 the error of using annual data without adjustments. It may be seen that the Enterprise Value (EV = E+D) in November is 1,609.8 (instead of 1,166 in Table 3) and 3,003.7 in December (instead of 3,529.4 in Table 3). The equity value (E) in November is 1,609.8 (instead of 1,166 in Table 3) and 650.2 in December (instead of 1,175.9 in Table 3). The value of the unlevered equity (Vu) in November is 1,609.8 (instead of 859 in Table 3), and 2,363.9 in December (instead of 3,219.8 in Table 3).

Obviously, the right values are those of Table 3. **Columns 1, 2, 3 and 5 of Table 8 are wrong** because we did not take the seasonality into account.

Table 8. Valuation of Russoil using annual data, without taking seasonality into account
Error = (E annual data - E monthly data) / E monthly data

Column #	1	2	3	4	5	6	7
	Vu	VTS	D+E	–D	E annual data	E monthly data	Error
11/03	1,609.8	0.0	1,609.8	0.0	1,609.8	1,166.0	38.1%
12/03	2,363.9	639.7	3,003.7	2,353.5	650.2	1,175.9	–44.7%
1/04	2,297.5	579.8	2,877.3	2,139.5	737.8	1,190.8	–38.0%
2/04	2,230.0	519.2	2,749.2	1,922.6	826.6	1,205.4	–31.4%
3/04	2,161.4	458.0	2,619.4	1,702.8	916.6	1,219.7	–24.9%
4/04	2,091.6	396.2	2,487.8	1,480.1	1,007.6	1,233.7	–18.3%
5/04	2,020.7	333.7	2,354.4	1,254.5	1,099.9	1,247.3	–11.8%
6/04	1,948.7	270.6	2,219.2	1,025.9	1,193.3	1,260.5	–5.3%
7/04	1,875.4	206.8	2,082.3	794.3	1,287.9	1,273.4	1.1%
8/04	1,801.1	142.4	1,943.4	559.7	1,383.8	1,285.9	7.6%
9/04	1,725.5	77.3	1,802.8	322.0	1,480.8	1,298.0	14.1%
10/04	1,648.7	17.9	1,666.6	81.1	1,585.5	1,309.7	21.1%
11/04	1,594.3	0.0	1,594.3	0.0	1,594.3	1,158.1	37.7%

Tables 9 and 10 show the sensitivity of the error due to using annual data without taking seasonality into account, to the growth rate and to the discount rate. It can be seen that the error increases with higher growth and higher discount rates.

Table 9. Sensitivity of the error due to valuing Russoil using annual data without taking seasonality into account, to the growth rate

		g					
		0.0%	0.5%	1.0%	1.5%	2.0%	2.5%
November	E monthly data	813.2	966.9	1166.0	1425.9	1767.6	2219.7
November	E annual data	1082.5	1311.3	1609.8	2001.6	2519.3	3206.8
	error	33.1%	35.6%	38.1%	40.4%	42.5%	44.5%
December	E monthly data	820.1	975.1	1175.9	1438.0	1782.7	2238.5
December	E annual data	488.6	559.6	650.2	767.0	918.9	1118.2
	error	–40.4%	–42.6%	–44.7%	–46.7%	–48.5%	–50.0%

Table 10. Sensitivity of the error due to valuing Russoil using annual data without taking seasonality into account, to the discount rate

		ßu							
		0.25	0.50	0.75	1.00	1.50	2.00	2.50	3.00
November	E monthly data	1,631.2	1,463.0	1,308.3	1,166.0	914.1	700.3	518.3	363.2
November	E annual data	1,937.5	1,819.9	1,710.9	1,609.8	1,428.9	1,272.8	1,137.7	1,020.5
	error	18.8%	24.4%	30.8%	38.1%	56.3%	81.8%	119.5%	181.0%
December	E monthly data	1,639.5	1,472.2	1,318.0	1,175.9	924.0	709.4	526.2	369.5
December	E annual data	1,270.2	1,044.5	838.4	650.2	321.2	46.6	–182.9	–374.8
	error	–22.5%	–29.1%	–36.4%	–44.7%	–65.2%	–93.4%	–134.8%	–201.4%

There is the issue of within-year compounding of the free cash flows, but that explains only a minor part of the error, as we will see in the next section.

3.1. Adjustments needed for valuing the company using yearly data

When dealing with seasonality, it is important to isolate it. One way of doing this is to decompose the free cash flow into two parts: the free cash flow without purchases of seeds (FCF. purchases =0), and the seed purchases[1] (Purchases).

Figures 4 and 5 show the evolution of both magnitudes. The free cash flow without changes in Working Capital Requirements (FCF. purchases =0) grows at a monthly rate of 1% until December 2008, and from then until October 2010 remains constant. In November 2010, the free cash flow without changes in Working Capital Requirements (FCF. purchases =0) is 140 higher than in October, due to the recovery of the cash.

Figure 4. Russoil. Monthly free cash flow without purchases of raw materials (FCF. purchases = 0)

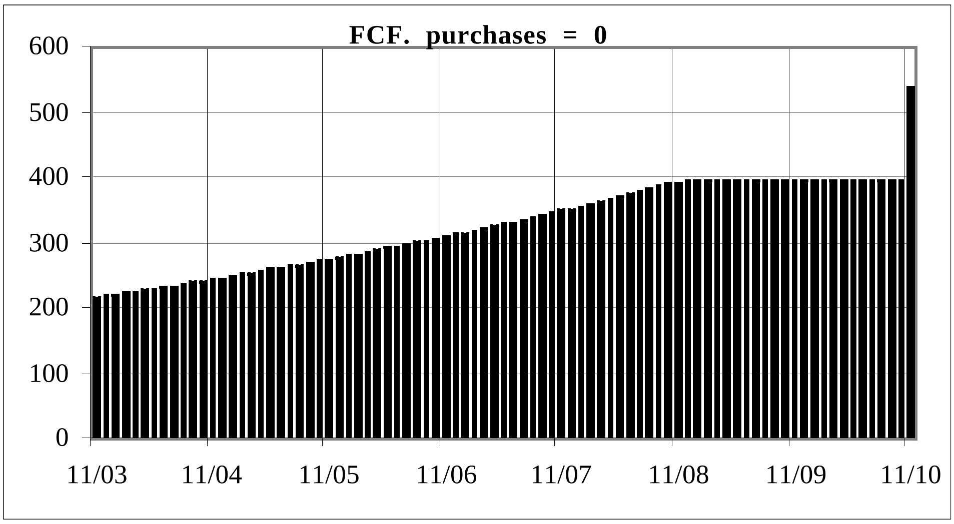
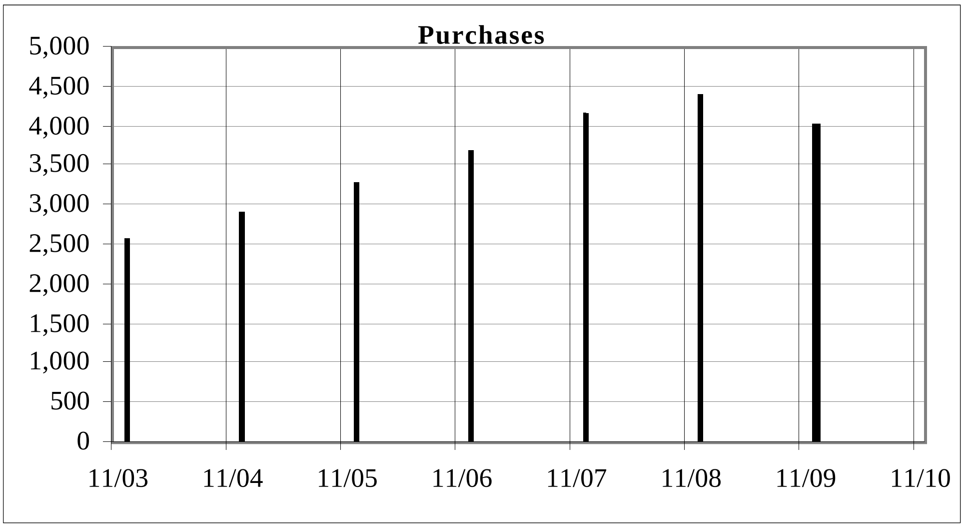


Figure 5. Russoil. Monthly purchases (and payments) of seeds



(1) What really matters is the payment of the seeds. In the case of Russoil, as payments are made in cash, the purchase and the payment of the seeds takes place at the same time.

The seasonality of Russoil is clearly due to purchases.

The value of the unlevered equity (Vu) may be decomposed as the sum of the present values of the two components of the free cash flows (PV_m means present value with monthly data):

$$Vu = PV_m\ (FCF;Ku) = PV_m\ (FCF.\ purchases = 0;Ku) - PV_m\ (Purchases;Ku) \qquad [3]$$

Table 11 contains the present value of the monthly free cash flows of the different years.

Table 11. Valuation of Russoil using monthly data

Value in November 2003			Present value of monthly free cash flows		
			FCF	FCF. purchases = 0	Purchases
December 2003	-	November 2004	75.3	2,626.0	2,550.7
December 2004	-	November 2005	76.7	2,673.3	2,596.6
December 2005	-	November 2006	78.0	2,721.4	2,643.3
December 2006	-	November 2007	79.5	2,770.3	2,690.9
December 2007	-	November 2008	80.9	2,820.2	2,739.3
December 2008	-	November 2009	106.8	2,719.2	2,612.4
December 2009	-	November 2010	361.9	2,525.3	2,163.4
		SUM	859.0	18,855.6	17,996.6

			Value in December 2003		
Value in December 2003			Present value of monthly free cash flows		
			FCF	FCF. purchases = 0	Purchases
January 2004	-	December 2004	33.6	2,652.3	2,618.7
January 2005	-	December 2005	34.2	2,700.0	2,665.8
January 2006	-	December 2006	34.8	2,748.6	2,713.8
January 2007	-	December 2007	35.4	2,798.0	2,762.6
January 2008	-	December 2008	213.8	2,848.4	2,634.6
January 2009	-	December 2009	537.4	2,719.2	2,181.8
January 2010	-	December 2010	2,330.6	2,330.6	0.0
		SUM	3,219.8	18,797.0	15,577.2

Using annual data, the value of the unlevered equity (Vu) may be decomposed as the sum of the present values of the two components of the free cash flows (PVa means present value with annual data):

$$Vu = PV_a\ (FCF.\ purchases = 0;Kuae) - PV_a\ (Purchases;Kuas) \qquad [4]$$

In a correct valuation, (3) must equal (4).

To calculate PV_a (FCF. purchases =0; Kuae) using annual data, it is worth taking a look at **Appendix 1**. In **Appendix 1** we calculate the annual discount rate (Kuae needed to discount annual free cash flows) such that the present value of the monthly free cash flows (which grow at a monthly rate g) equals the present value of the annual free cash flow.

To calculate PV_a (Purchases; Kuas) using annual data, it is worth taking a look at **Appendix 2**. In **Appendix 2** we calculate the annual discount rate (Kuas needed to discount annual purchases) that ensures that the present value of the monthly purchases (one cash flow per year) equals the present value of the annual purchases.

Table 12 contains the present value of the annual free cash flows taking the adjustments of **Appendixes 1** and **2** into account. Lines 1 to 12 contain the valuation in November 2003, and lines 13 to 24, the valuation in December 2003. Lines 1 and 7 contain the free cash flow decomposition. Line 2 contains the monthly growth of the monthly free cash flows (g). Line 3 is the calculation of the Kuae rate according to the formulas in **Appendix 1**. Line 4 contains the rate at which the cash flows of line 1 should be discounted. Line 5 is the inverse of line 4. Line 6 is the first present value of equation (4): PVa (FCF. purchases =0; Kuae). Line 8 contains the month (after the valuation date) in which the purchase and payment of the raw materials takes place (n). Line 9 is the calculation of the Kuas rate according to the formula in **Appendix 2**. Line 10 contains the rate at which the cash flows of line 7 should be discounted. Line 11 is the inverse of line 10. Line 12 is the second present value of equation (4): PV_a (Purchases; Kuas).

Table 12. Valuation of Russoil using annual data, taking seasonality into account through the discount rates

line	NOVEMBER	2004	2005	2006	2007	2008	2009	2010	Sum
1	**FCF. purchases = 0**	2,776.1	3,128.2	3,524.9	3,972.0	4,475.7	4,772.0	4,912.0	27,561.0
2	g	1.0%	1.0%	1.0%	1.0%	1.0%	0.0%	0.00%	
3	Kuae	5.72%	5.72%	5.72%	5.72%	5.72%	5.61%	5.61%	
4	$(1+Kuae)(1+Kua)^{n-1}$	1.0572	1.1702	1.2953	1.4338	1.5870	1.7549	1.9426	
5	Discount factor	0.9459	0.8546	0.7720	0.6975	0.6301	0.5698	0.5148	
6	PV(FCF. purchases = 0)	2,626.0	2,673.3	2,721.4	2,770.3	2,820.2	2,719.2	2,528.6	18,858.9
7	**Purchases**	2,572.4	2,898.6	3,266.2	3,680.5	4,147.2	4,378.0	4,013.1	24,956.0
8	**n**	1	1	1	1	1	1	1	
9	**Kuas**	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	
10	$(1+Kuas)(1+Kua)^{n-1}$	1.0085	1.1163	1.2357	1.3678	1.5140	1.6758	1.8550	
11	Discount factor	0.9916	0.8958	0.8093	0.7311	0.6605	0.5967	0.5391	
12	PV(Purchases)	2,550.7	2,596.6	2,643.3	2,690.9	2,739.3	2,612.4	2,163.4	17,996.6

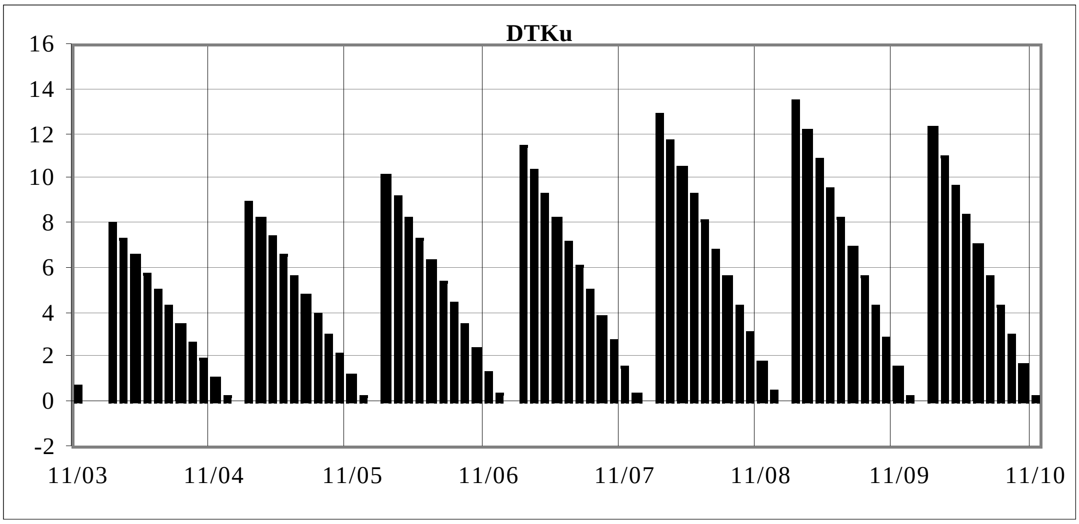
	DECEMBER	2004	2005	2006	2007	2008	2009	2010	Sum
13	FCF. purchases = 0	2,803.9	3,159.5	3,560.2	4,011.7	4,520.5	4,772.0	4,514.3	27,342.1
14	g	1.0%	1.0%	1.0%	1.0%	1.0%	0.0%	0.0%	
15	Kuae	5.72%	5.72%	5.72%	5.72%	5.72%	5.61%	5.17% *	
16	$(1+Kuae)(1+Kua)^{n-1}$	1.0572	1.1702	1.2953	1.4338	1.5870	1.7549	1.9345	
17	Discount factor	0.9459	0.8546	0.7720	0.6975	0.6301	0.5698	0.5169	
18	PV(FCF. purchases = 0)	2,652.3	2,700.0	2,748.6	2,798.0	2,848.4	2,719.2	**2,333.6**	18,800.0
* 11 months in 2010									
19	**Purchases**	2,898.6	3,266.2	3,680.5	4,147.2	4,378.0	4,013.1	0.0	22,383.6
20	n	12	12	12	12	12	12	12	
21	Kuas	10.69%	10.69%	10.69%	10.69%	10.69%	10.69%	10.69%	
22	$(1+Kuas)(1+Kua)^{n-1}$	1.1069	1.2252	1.3562	1.5012	1.6617	1.8394	2.0360	
23	Discount factor	0.9034	0.8162	0.7373	0.6661	0.6018	0.5437	0.4912	
24	PV(Purchases)	2,618.7	2,665.8	2,713.8	2,762.6	2,634.6	2,181.8	0.0	15,577.2

If we compare Tables 11 and 12, we can see that all the present values match except PV_a (FCF. purchases = 0) in year 2010 (lines 6 and 18 of Table 12). Why is that? Because, as can be seen from Figures 2 and 4, the Free Cash Flow of November 2010 is $140,000 bigger than the Free Cash Flow of October 2010 because in November 2010 the Free Cash Flow includes the Cash that the company had. If we correct for the effect of those $140,000, the results of Tables 11 and 12 match[2].

3.2. Calculating the Value of tax shields using annual data

We show in Figure 2 that Debt is very seasonal. The Value of tax shields is the present value of (D T Ku) discounted at Ku. D T Ku is also very seasonal, as can be seen in Figure 6.

Figure 6. Russoil. Seasonality of monthly D T Ku



As Debt (D) is a balance sheet measure, it is very complex to model. Table 13 has the discount factors (column 5) and the annual discount rates (column 6) that ensure that the Value of tax shields calculated using monthly data equals the Value of tax shields calculated using annual data.

An easier approach, and a good approximation, is to consider the average debt when using annual data[3]. The error of this approximation is very small, as we show in Table 14. Column 1 contains the correct value (the Value of tax shields calculated using monthly data),

(2) **November**. The PV (FCF. purchases = 0, in year 2010) is 2,525.3 in Table 11 (the correct one) and 2,528.6 in Table 12 (line 6). The present value of these $140,000 is calculated in Table 12 using a discount factor of 0.5148 (1/1.9426). But these 140,000 are a monthly cash flow in the 12th month, like the ones valued in Appendix 2. The appropriate Kuas rate (for Ku = 0.85%; n = 12) is 10.6906227%.
In this case, $(1+Kuas)(1+Kua)^{n-1} = (1+10.690623\%)(1+10.690623\%)^6 = 2.03599$
Therefore, in Table 12 we must add -3.307 = 140/ 2.03599 - 140/ 1.9426. Note that 2,528.6-3.307 = 2,525.3.
For December, the appropriate Kuas rate (for Ku = 0.85%; n = 11) 9.7577%.
In this case, $(1+Kuas)(1+Kua)^{n-1} = (1+9.7577\%)(1+10.690623\%)^6 = 2.01883$
Therefore, in Table 10 we must add 3.023 = 140 / 2.01883- 140/ 1.9345. Note that 2,333.6- 3.023 = 2,330.6.

(3) But to calculate the average debt, we need to forecast the monthly balance sheets.

column 5 contains the approximation (the Value of tax shields calculated using annual data), and column 6 contains the error of the approximation. The errors are small. Tables 15 and 16 contain sensitivity analyses of the errors and confirm that the errors of the approximation are small. The error grows with the discount rate.

Table 17 shows that the error of this approximation of the VTS of Russoil ranges between –2% and 2.2%. Therefore, using average debt when using annual data is a very good approximation for calculating the Value of Tax Shields. However, we will see in the next section that using average debt and average Working Capital Requirements when using annual data is a worse approximation for calculating the Value of the unlevered company and the equity value.

Table 13. Correct discount factor and correct annual discount rate for calculating the value of tax shields using annual data

	PV (DTKu;Ku) monthly	Da T Kua	Average annual debt (Da)	1/ discount	Discount factor	Annual discount rate
Column #	1	2	3	4	5	6
December 2003 - November 2004	44.4	48.6	1,136.3	1.0947	0.9135	9.47%
December 2004 - November 2005	45.2	54.8	1,280.5	1.2117	0.8253	10.69%
December 2005 - November 2006	46.0	61.7	1,442.8	1.3413	0.7456	10.69%
December 2006 - November 2007	46.8	69.5	1,625.8	1.4847	0.6736	10.69%
December 2007 - November 2008	47.7	78.3	1,832.0	1.6434	0.6085	10.69%
December 2008 - November 2009	43.9	79.7	1,864.7	1.8177	0.5501	10.61%
December 2009 - November 2010	33.0	66.3	1,550.7	2.0068	0.4983	10.40%

Table 14. Error due to calculating the value of tax shields using annual data and average debt

	PV (DTKu;Ku) monthly	Da (average debt)	Kua	factor	PV (DaTKua; Kua) annual	error
Column #	1	2	3	4	5	6
December 2003 - November 2004	44.4	1,136.3	10.69%	1.1069	43.9	–1.1%
December 2004 - November 2005	45.2	1,280.5	10.69%	1.2252	44.7	–1.1%
December 2005 - November 2006	46.0	1,442.8	10.69%	1.3562	45.5	–1.1%
December 2006 - November 2007	46.8	1,625.8	10.69%	1.5012	46.3	–1.1%
December 2007 - November 2008	47.7	1,832.0	10.69%	1.6617	47.1	–1.1%
December 2008 - November 2009	43.9	1,864.7	10.69%	1.8394	43.4	–1.2%
December 2009 - November 2010	33.0	1,550.7	10.69%	2.0360	32.6	–1.4%
SUM	307.0				303.5	–1.1%

	PV (DTKu;Ku) monthly	Da (average debt)	Kua	factor	PV (DaTKua; Kua) annual	error
January 2004 - December 2004	44.8	1,136.3	10.69%	1.1069	43.9	–1.9%
January 2005 - December 2005	45.6	1,280.5	10.69%	1.2252	44.7	–1.9%
January 2006 - December 2006	46.4	1,442.8	10.69%	1.3562	45.5	–1.9%
January 2007 - December 2007	47.2	1,625.8	10.69%	1.5012	46.3	–1.9%
January 2008 - December 2008	48.1	1,832.0	10.69%	1.6617	47.1	–1.9%
January 2009 - December 2009	44.2	1,864.7	10.69%	1.8394	43.4	–2.0%
January 2010 - December 2010	33.3	1,550.7	10.69%	2.0360	32.6	–2.3%
SUM	309.6				303.5	–2.0%

Table 15. Sensitivity of the error due to calculating the value of tax shields using annual data and average debt, to the monthly growth rate

	g					
	0.0%	0.5%	1.0%	1.5%	2.0%	2.5%
Error in December 2010	–2.0%	–2.0%	–2.0%	–2.0%	–1.9%	–1.9%
Error in November 2010	–1.2%	–1.2%	–1.1%	–1.1%	–1.1%	–1.1%

Table 16. Sensitivity of the error due to calculating the value of tax shields using annual data and average debt, to the discount rate

	ßu							
	0.25	0.50	0.75	1.00	1.50	2.00	2.50	3.00
Error in December 2010	–1.2%	–1.5%	–1.7%	–2.0%	–2.5%	–3.0%	–3.5%	–4.0%
Error in November 2010	–0.7%	–0.9%	–1.0%	–1.1%	–1.4%	–1.7%	–2.0%	–2.3%

Table 17. Error due to calculating the value of tax shields for Russoil using annual data and average debt, instead of monthly data

	VTS calculated with annual data and average debt	VTS calculated with monthly data	Error due to using annual data
11/03	303.5	307.0	–1.1%
12/03	303.5	309.6	–2.0%
1/04	300.8	304.2	–1.1%
2/04	300.2	299.5	0.2%
3/04	299.2	295.5	1.2%
4/04	297.9	292.3	1.9%
5/04	296.2	289.7	2.2%
6/04	294.3	287.9	2.2%
7/04	292.2	286.9	1.8%
8/04	290.0	286.6	1.2%
9/04	288.2	287.1	0.4%
10/04	287.4	288.5	–0.4%
11/04	287.3	290.7	–1.2%

4. Error due to valuing a seasonal company using annual data and average debt and average working capital requirements, instead of monthly data

Some professors argue that the value of a seasonal company may be computed using annual data, as long as we use average debt and average working capital requirements. This is a bad approximation, as can be seen in Tables 18 and 19.

Table 18 provides the valuation of Russoil in December 2003 using annual data, average debt and average working capital requirements. Line 2 contains the average working capital requirements and line 4, the average debt. Lines 5 to 11 give the calculation of the annual free cash flow using the average working capital requirements calculated in line 2. Line 12 contains the present value of the free cash flows given in line 11. Line 13 is the Value of Tax Shields using the average debt calculated in line 4. Line 15 is the Equity value using the APV equation:

$$E = Vu + VTS - Da \qquad [5]$$

Note that, using averages, only E (line 15) and VTS (line 13) are approximations of the true values. The value of Vu calculated in this way is not an approximation of the true Vu.

Table 18. Valuation of Russoil using annual data, average debt and average working capital requirements. Valuation performed in December 2003.

Line		**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
1	Stocks	2,572.4	2,898.6	3,266.2	3,680.5	4,147.2	4,378.0	4,013.1	0.0
2	Stocks average	1,418.8	1,598.7	1,801.5	2,029.9	2,287.4	2,371.4	2,006.6	0.0
3	Debt	2,353.5	2,652.0	2,988.3	3,367.3	3,794.3	3,980.3	3,615.5	0.0
4	Da (average debt)	1,136.3	1,280.5	1,442.8	1,625.8	1,832.0	1,864.7	1,550.7	
5	Gross margin		1,071.8	1,207.8	1,360.9	1,533.5	1,728.0	1,824.1	1,672.1
6	- General expenses		–686.0	–773.0	–871.0	–981.5	–1,105.9	–1,167.5	–1,070.2
7	NOPBT		385.9	434.8	489.9	552.1	622.1	656.7	602.0
8	Taxes on NOPBT		–154.3	–173.9	–196.0	–220.8	–248.8	–262.7	–240.8
9	NOPAT		231.5	260.9	294.0	331.2	373.3	394.0	361.2
10	- Increase of WCR average		–179.9	–202.8	–228.5	–257.4	–84.0	364.8	2,146.6
11	FCFav (using WCR average)		51.6	58.1	65.5	73.8	289.3	758.8	2,507.7
12	Vu = PV(FCFav; Kua)	2,009.8	2,173.1	2,347.3	2,532.7	2,729.7	2,732.3	2,265.5	
13	VTS = PV(Dav T Kua; Kua)	303.5	287.3	263.3	229.7	184.7	126.2	59.9	
14	EV = Vu + VTS	2,313.3	2,460.4	2,610.6	2,762.5	2,914.5	2,858.4	2,325.4	
15	E = EV - Da	1,179.7	1,185.0	1,175.6	1,147.9	1,097.8	1,017.9	831.9	

Table 19 is a comparison of the equity values obtained using annual data, average debt and average working capital requirements, with the true equity value (using monthly data). The error of adjusting only by using average debt and average working capital requirements ranges from –17.9% to 8.5%.

Table 19. Equity value using annual data, average debt and average working capital requirements. Comparison with the equity value using monthly data

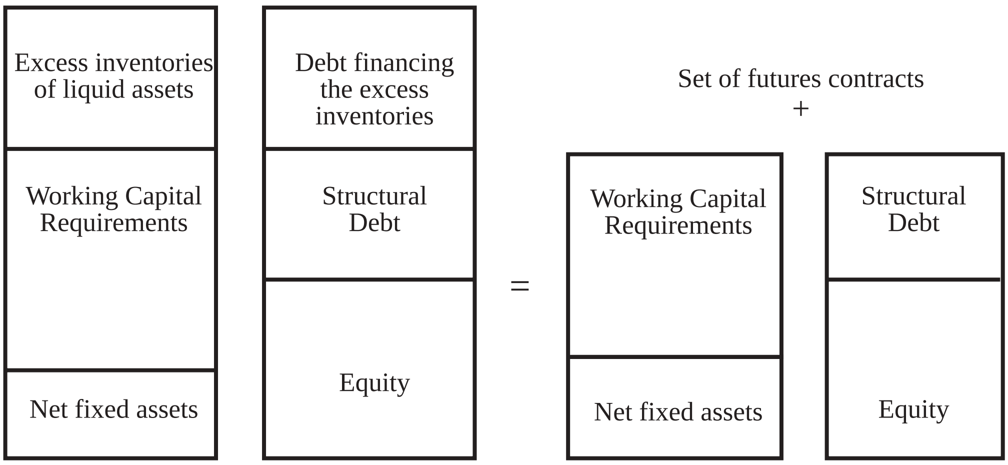
	Equity value calculated with annual data and average values E = Vu + VTS - Da	E monthly	Error
11/03	1,179.7	1,166.0	1.2%
12/03	1,176.9	1,175.9	0.1%
1/04	1,178.4	1,190.8	–1.0%
2/04	1,174.9	1,205.4	–2.5%
3/04	1,172.0	1,219.7	–3.9%
4/04	1,169.9	1,233.7	–5.2%
5/04	1,168.4	1,247.3	–6.3%
6/04	1,167.7	1,260.5	–7.4%
7/04	1,167.7	1,273.4	–8.3%
8/04	1,168.6	1,285.9	–9.1%
9/04	1,170.6	1,298.0	–9.8%
10/04	1,174.1	1,309.7	–10.4%
11/04	1,185.0	1,158.1	2.3%
12/04	1,180.0	1,168.0	1.0%
1/05	1,181.1	1,183.5	–0.2%
2/05	1,176.7	1,198.6	–1.8%
3/05	1,172.8	1,213.3	–3.3%
4/05	1,169.5	1,227.7	–4.7%
5/05	1,166.8	1,241.6	–6.0%
6/05	1,164.8	1,255.1	–7.2%
7/05	1,163.5	1,268.2	–8.3%
8/05	1,163.0	1,280.9	–9.2%
9/05	1,163.5	1,293.1	–10.0%
10/05	1,165.5	1,304.9	–10.7%
11/05	1,175.6	1,132.6	3.8%
12/05	1,167.7	1,142.3	2.2%
11/07	1,097.8	1,012.0	8.5%
12/07	1,082.4	1,020.6	6.1%
1/09	987.4	930.4	6.1%
2/09	971.8	945.8	2.7%
3/09	956.4	960.6	–0.4%
4/09	941.2	974.7	–3.4%
5/09	926.1	988.1	–6.3%
6/09	911.3	1,000.8	–8.9%
7/09	896.8	1,012.7	–11.5%
8/09	882.7	1,024.0	–13.8%
9/09	869.5	1,034.5	–16.0%
10/09	857.7	1,044.3	–17.9%
11/09	831.9	726.4	14.5%
12/09	774.8	732.6	5.8%

5. Valuation when the inventories are a liquid commodity

Let's now take a closer look at Russoil and consider the fact that the company's inventories are sunflower seeds, a very liquid commodity. If the inventories are a very liquid commodity, it is not correct to treat excess inventories as working capital requirements. We define excess inventories as any amount of inventory over a minimum or safety inventory (which may be defined as the amount needed to cover the time it takes for fresh inventories to be delivered). For example, in the case of Russoil, we define excess inventories as inventories beyond one month of sales.

A company like Russoil could maintain its minimum inventory and buy futures contracts to ensure the future supply of seeds[4]. In that case, the company would have a much lower amount of inventories and would buy the seeds in the future months at the future price (spot plus cost of carry). The cost of carry incorporates the financial interest plus the storage costs. This company will be identical to Russoil in terms of risk. The only difference is that Russoil buys all of its annual needs of seeds in December. But we also know that buying futures contracts on seeds is identical to buying the seeds with borrowed money, and that is what Russoil does: it buys the seeds in December by borrowing money. This is represented in Figure 7.

Figure 7. Equivalence of excess liquid inventories financed with debt to a set of futures contracts. If the excess inventories are a very liquid commodity, then for valuation purposes it is not correct to treat them as working capital requirements



Note that for Russoil we have also considered the cost of carry: the financial expenses are the interest on the bank debt, and the storage costs that are included in the general expenses. Therefore, a correct valuation of Russoil should consider the interest due to financing the excess seeds and their storage costs in the same way, as operating expenses, and the debt that finances the excess inventories as part of the working capital requirements.

Table 20 contains the correct balance sheets of Russoil for valuation purposes. The inventories are split into “Minimum inventory” (line 2) and “Excess inventory” (line 3). Analogously, the financial debt is split into “Debt financing excess liquid inventories” (line 6, equal to “Excess inventory”) and “Structural debt” (line 7). Note that the “Excess inventory”

(4) Or enter into an agreement with a seed supplier to cover its future needs.

financed with the "Debt financing excess liquid inventories" is equal to a group of future contracts on seeds. In that case the structural debt is negative, which means that if the minimum inventory is one month of sales, Russoil is an unlevered company.

Table 21 shows the calculation of Russoil's free cash flows if the excess inventories are liquid assets. Note that Table 21 has two changes with respect to Table 2: the interest paid on the debt that finances the excess seeds is now deducted, and the increase in Working Capital Requirements now includes only the "Minimum inventory". Note that Equity cash flows are identical in Tables 2 and 21.

Table 22 contains the valuation results of Russoil in November and December 2003. Table 23 measures the error of not considering the seeds as liquid assets when they are liquid. The undervaluation ranges between 12% and 14%.

We have pointed out that Equity Cash Flows are equal in Table 2 (not considering the seeds as liquid assets) and Table 21 (considering the seeds as liquid assets). The undervaluation is due to the required return to equity (Ke). In Figure 3 we can see that if we consider the excess inventory as working capital requirements, then the total debt is considered as structural debt and the required return to equity (Ke) is higher than Ku in all months except November, when the total debt is zero. The average Ke in Figure 3 is 1.16%, while Ku is 0.85%. The relation between Ke and Ku is given by formula (6):

$$Ke = Ku + \frac{\mathrm{D}(1-\mathrm{T})}{\mathrm{E}}(Ku - Kd) \qquad [6]$$

If we consider the seeds as liquid assets, Russoil's structural debt is zero in all months and, therefore, the required return to equity (Ke) is equal to Ku in all months.

Table 20. Balance sheet of Russoil considering seeds as liquid assets

	line	11/03	12/03	1/04	2/04	3/04	4/04	5/04	6/04	7/04	8/04	9/04	10/04	11/04	12/04
1	Cash	140	140	140	140	140	140	140	140	140	140	140	140	140	140
2	Minimum stock	201	203	205	207	209	211	213	215	217	220	222	224	226	229
3	Excess stock	0	2,370	2,165	1,958	1,749	1,538	1,325	1,109	892	672	450	226	0	2,670
4	Fixed assets	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	Total assets	341	2,712	2,510	2,305	2,098	1,889	1,678	1,465	1,249	1,032	812	590	366	3,039
6	Debt financing excess liquid inventories	0	2,370	2,165	1,958	1,749	1,538	1,325	1,109	892	672	450	226	0	2,670
7	Structural Debt	0	–16	–25	–35	–46	–58	–70	–83	–97	–112	–128	–145	0	–18
8	Equity	341	359	370	382	395	409	423	439	455	472	490	509	366	387
9	Total	341	2,712	2,510	2,305	2,098	1,889	1,678	1,465	1,249	1,032	812	590	366	3,039

Table 21. Russoil's monthly free cash flows considering seeds as liquid assets

	12/03	1/04	2/04	3/04	4/04	5/04	6/04	7/04	8/04	9/04	10/04	11/04	12/04
Gross margin	83.7	84.5	85.4	86.2	87.1	87.9	88.8	89.7	90.6	91.5	92.4	93.4	94.3
–General expenses	–53.6	–54.1	–54.6	–55.2	–55.7	–56.3	–56.8	–57.4	–58.0	–58.6	–59.2	–59.7	–60.3
–Interest on excess seeds	0.0	–11.8	–10.7	–9.6	–8.5	–7.4	–6.3	–5.1	–4.0	–2.8	–1.6	–0.4	0.0
NOPBT	30.1	18.7	20.0	21.4	22.8	24.3	25.7	27.2	28.6	30.1	31.7	33.2	33.9
Taxes on NOPBT	–12.0	–7.5	–8.0	–8.6	–9.1	–9.7	–10.3	–10.9	–11.5	–12.1	–12.7	–13.3	–13.6
NOPAT	18.1	11.2	12.0	12.9	13.7	14.6	15.4	16.3	17.2	18.1	19.0	19.9	20.4
–Increase of WCR	–18.1	–11.2	–12.0	-12.9	–13.7	–14.6	–15.4	–16.3	–17.2	–18.1	–19.0	142.9	–20.4
FCF = ECF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	162.8	0.0

Table 22. Valuation of Russoil using APV with monthly data, considering seeds as liquid assets

	11/03	12/03
Ku	0.85%	0.85%
Vu = PV (Ku; FCF)	1,355.6	1,367.1
VTS = PV (Ku; D T Ku)	0.0	0.0
E + D = VTS + Vu	1,355.6	1,367.1
E = (E+D) - D	1,355.6	1,367.1

Table 23. Valuation of Russoil using APV with monthly data.
Error of not considering the seeds as liquid assets, when they are

	Equity value (E) considering the seeds as liquid assets	Equity value (E) not considering the seeds as liquid assets	error
11/03	1,355.6	1,166.0	–14.0%
12/03	1,367.1	1,175.9	–14.0%
1/04	1,378.7	1,190.8	–13.6%
2/04	1,390.5	1,205.4	–13.3%
3/04	1,402.3	1,219.7	–13.0%
4/04	1,414.2	1,233.7	–12.8%
5/04	1,426.2	1,247.3	–12.5%
6/04	1,438.3	1,260.5	–12.4%
7/04	1,450.6	1,273.4	–12.2%
8/04	1,462.9	1,285.9	–12.1%
9/04	1,475.3	1,298.0	–12.0%
10/04	1,487.9	1,309.7	–12.0%
11/04	1,337.7	1,158.1	–13.4%
12/04	1,349.0	1,168.0	–13.4%
1/05	1,360.5	1,183.5	–13.0%

6. Conclusion

The correct way to value seasonal companies by discounted cash flows is to use monthly data. If we use annual data, some adjustments are needed.

We have shown that when using annual data in the context of the adjusted present value (APV), the calculations of the value of the unlevered equity (Vu) and the value of the tax shields (VTS) must be adjusted. However, the debt that we have to subtract to calculate the equity value does not need to be adjusted.

Errors due to using annual data without making the adjustments are big. We have shown that the equity value calculated using annual data without making the adjustments understates the true value by 45% if the valuation is done at the end of December, and overstates the true value by 38% if the valuation is done at the end of November.

Valuing a seasonal company using annual data, average debt and average working capital requirements is not a good approximation: the error ranges from –17.9% to 8.5%.

When the inventories are a liquid commodity such as grain or seeds, it is not correct to consider all of them as working capital requirements. Excess inventories financed with debt are equivalent to a set of futures contracts. We have shown that not considering them as such leads us to undervalue the company. □

Appendix 1

HOW TO VALUE A SEASONAL COMPANY BY DISCOUNTED CASH FLOWS

Month	Free cash flow	Present value
1	FCF_1	FCF_1 / (1+Ku)
2	$FCF_1(1+g)$	$FCF_1(1+g) / (1+Ku)^2$
3	$FCF_1(1+g)^2$	$FCF_1(1+g)^2 / (1+Ku)^3$
4	$FCF_1(1+g)^3$	$FCF_1(1+g)^3 / (1+Ku)^4$
5	$FCF_1(1+g)^4$	$FCF_1(1+g)^4 / (1+Ku)^5$
6	$FCF_1(1+g)^5$	$FCF_1(1+g)^5 / (1+Ku)^6$
7	$FCF_1(1+g)^6$	$FCF_1(1+g)^6 / (1+Ku)^7$
8	$FCF_1(1+g)^7$	$FCF_1(1+g)^7 / (1+Ku)^8$
9	$FCF_1(1+g)^8$	$FCF_1(1+g)^8 / (1+Ku)^9$
10	$FCF_1(1+g)^9$	$FCF_1(1+g)^9 / (1+Ku)^{10}$
11	$FCF_1(1+g)^{10}$	$FCF_1(1+g)^{10} / (1+Ku)^{11}$
12	$FCF_1(1+g)^{11}$	$FCF_1(1+g)^{11} / (1+Ku)^{12}$
Sum	Sum of FCF	Sum of PV (FCF)

Year	Free cash flow	Present value
1	Sum of FCF	Sum of FCF/ (1+ Kuae)
Sum	Sum of FCF	Sum of FCF/ (1+ Kuae)

The sum of the 12 monthly FCFs is:
Sum of FCF = $(FCF_1 / g)\,[(1+g)^{12} – 1]$.
If g = 0, then the Sum of FCF = 12 FCF_1

The sum of the Present Values of the 12 monthly FCFs is:
Sum of PV (FCF) = $[FCF_1 / (g – Ku)]\,[[(1+g)/(1+Ku)]^{12} – 1]]$.
If g = 0, then the Sum of PV (FCF) = $(FCF_1 / Ku)\,[1 – 1/(1+Ku)^{12}]$
If g = Ku, then the Sum of PV (FCF) = 12 FCF_1 / (1+Ku)

To perform a correct valuation, the sum of the present values of the monthly Free Cash Flows should be equal to the present value of the annual Free Cash Flow. The annual Free Cash Flow is the sum of the 12 monthly Free Cash Flows:

$$[FCF_1 / (g - Ku)]\,[[(1+g)/(1+Ku)]^{12} – 1]] = (FCF_1 / g)\,[(1+g)^{12} – 1] / (1+ Kuae)$$

$$\text{Kuae} = \frac{\left[(1+g)^{12}-1\right](g-Ku)}{g\left[\left(\frac{1+g}{1+Ku}\right)^{12}-1\right]}-1$$

$$\text{If } g = 0\text{, then Kuae} = \frac{12\ Ku}{1-\frac{1}{(1+Ku)^{12}}}-1 > (1+Ku)^6 - 1$$

If g = Ku, then Kuae = $[(1+g)^{12} – 1]\,(1+g) / (12\,g)$

Table A.1 has the magnitude of Kuae for different values of g and Ku. It may be seen that Kuae > $(1+Ku)^6 – 1$ if g > –3%.

Appendix 1 (continued)

Table A.1. Kuae as a function of g and Ku

		Ku							
		0.4%	0.6%	0.8%	1.0%	1.2%	1.4%	1.6%	2.0%
g	–4.0%	2.42%	3.64%	4.87%	6.11%	7.35%	8.60%	9.86%	12.39%
	–3.0%	2.47%	3.72%	4.97%	6.24%	7.51%	8.78%	10.07%	12.66%
	–2.0%	2.52%	3.79%	5.07%	6.36%	7.66%	8.97%	10.28%	12.93%
	–1.0%	2.57%	3.87%	5.18%	6.49%	7.82%	9.15%	10.49%	13.20%
	0.0%	2.62%	3.94%	5.28%	6.62%	7.97%	9.33%	10.70%	13.47%
	1.0%	2.67%	4.02%	5.38%	6.74%	8.12%	9.51%	10.91%	13.74%
	2.0%	2.72%	4.09%	5.47%	6.87%	8.27%	9.69%	11.12%	14.00%
	$(1+Ku)^6-1$	2.42%	3.65%	4.90%	6.15%	7.42%	8.70%	9.99%	12.62%
	$(1+Ku)^{12}-1$	4.9%	7.4%	10.0%	12.7%	15.4%	18.2%	21.0%	26.8%

In the case of Russoil, as Ku = 0.85% and g = 1% until December 2008, Kuae = 5.716754752%.

Appendix 2

HOW TO VALUE A SEASONAL COMPANY BY DISCOUNTED CASH FLOWS

Month	Free cash flow	Present value
1		
2		
3		
4	Purchase	Purchase / $(1+Ku)^4$
5		
6		
7		
8		
9		
10		
11		
12		
Sum	Purchase	Purchase / $(1+Ku)^4$

Year	Free cash flow	Present value
1	Purchase	Purchase / (1+ Kuas)
Sum	Purchase	Purchase / (1+ Kuas)

The Present Value of the Purchase in month n, using monthly data is:
PV (Purchase) = Purchase / $(1+Ku)^n$

To perform a correct valuation, the Present Value of the Purchase in month n, using monthly data, should be equal to the present value of the annual Free Cash Flow (considering the purchase at the end of the year):

Purchase / $(1+Ku)^n$ = Purchase / (1+ Kuas)

Kuas = $(1+Ku)^n - 1$

Table A.2. Kuas as a function of n and Ku

		Ku								
		0.4%	0.6%	0.8%	1.0%	1.2%	1.4%	1.6%	1.8%	2.0%
n	1	0.40%	0.60%	0.80%	1.00%	1.20%	1.40%	1.60%	1.80%	2.00%
	2	0.80%	1.20%	1.61%	2.01%	2.41%	2.82%	3.23%	3.63%	4.04%
	3	1.20%	1.81%	2.42%	3.03%	3.64%	4.26%	4.88%	5.50%	6.12%
	4	1.61%	2.42%	3.24%	4.06%	4.89%	5.72%	6.56%	7.40%	8.24%
	5	2.02%	3.04%	4.06%	5.10%	6.15%	7.20%	8.26%	9.33%	10.41%
	6	2.42%	3.65%	4.90%	6.15%	7.42%	8.70%	9.99%	11.30%	12.62%
	7	2.83%	4.28%	5.74%	7.21%	8.71%	10.22%	11.75%	13.30%	14.87%
	8	3.25%	4.90%	6.58%	8.29%	10.01%	11.76%	13.54%	15.34%	17.17%
	9	3.66%	5.53%	7.43%	9.37%	11.33%	13.33%	15.36%	17.42%	19.51%
	10	4.07%	6.16%	8.29%	10.46%	12.67%	14.92%	17.20%	19.53%	21.90%
	11	4.49%	6.80%	9.16%	11.57%	14.02%	16.52%	19.08%	21.68%	24.34%
	12	4.91%	7.44%	10.03%	12.68%	15.39%	18.16%	20.98%	23.87%	26.82%

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