Supply Chain Financial Analysis

Jarrod Goentzel
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At the Graduate School of Business

NOW, I KNOW YOU ALL WANT TO MAKE MONEY... BUT TODAY WE'RE GOING TO DISCUSS MAKING THINGS. ACTUAL THINGS.

THINGS?
I TOLD YOU I WANT TO MAKE MONEY!

LISTEN, LET'S GET THE BUSINESS SCHOOL. WE COULD MAKE SOME MONEY THAT WAY...

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The first principle in a common MBA finance textbook

“A company’s finances and operations are integrally connected.”


Why is operations undervalued?

• “In our company, operations is not glamorous. Deals are.”
• Operations is a branch of engineering requiring a different skill set and mindset
• Top managers – who entered through finance, strategy, or marketing – are ignorant about operations and uninterested in learning more, relying on others to mind the details of actual work
• “Financial data dominate the discourse in the modern organization, although operational performance is the driver of financial results.”

Answer these questions for your firm

• What financial KPIs do you use to measure supply chain performance?
• What financial analysis do you use to make supply chain decisions?

The Language of Finance
The language of finance

• Financial Statements
  – Balance Sheet
  – Income Statement
• Financial Analysis
  – Ratios
  – Acronyms (ROA, ROIC, EVA,...)

Balance Sheet

• Snapshot of the firm’s value
  – Approximation: accountants measured value at the time the transaction took place
  – Book value is the lower of cost or market value
• Assets (listed in order of liquidity)
  – Current: cash, marketable securities, accounts receivable, inventories
  – Fixed: property, plant, equipment (less accumulated depreciation)
  – Intangible: patents, goodwill...“growth assets”
• Liabilities (listed in order in which they must be paid)
  – Current: accounts payable, notes payable,...
  – Long-term: notes, bonds, deferred income taxes,...
• Shareholders’ equity (a.k.a. net worth)
  – Stock: preferred, common
  – Retained earnings

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Income Statement

- Performance record between snapshots
- Explains why retained earnings has changed over time

- Sales (net of markdowns)
- Cost of goods sold
- GROSS INCOME
- Selling, general & administrative (SGA) expenses
- OPERATING INCOME
- Depreciation & amortization
- OPERATING INCOME
- Interest expense
- Other nonoperating expenses/income
- Income taxes
- Extraordinary items
- NET INCOME

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Financial statements

“Financial statements are like fine perfume; to be sniffed but not swallowed.”

— Abraham Briloff


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Financial analysis

“accountants try to measure the current standing and immediate past performance of a firm, whereas financial analysis is much more forward looking.”

− Aswath Damodaran, Stern School of Business

Source: http://pages.stern.nyu.edu/~adamodar/New_Home_Page/AccPrimer/accstate.htm

Financial analysis

• Analogy about managing a company’s financial performance – stick, throttle, rudder

• “We analyze financial statements for the purpose of
  – evaluating performance and
  – understanding the levers of management control.”

Financial analysis

- Higgins’ three levers of management control
  - Net margin: Net income / Sales
  - Asset turnover: Sales / Assets
  - Financial leverage: Assets / Shareholders’ equity

- Study the “ties between a company’s operating decisions...and its financial performance.”
  - “Operating decisions are the levers by which management controls financial performance.”
  - Examples given: how many units to make this month, how to price them


DuPont analysis

- DuPont analysis is based on a return-on-investment formula developed in 1914 by a DuPont explosives salesman named Donaldson Brown and used by the company. Mr. Brown later used it as CFO at General Motors, but it was already known as the DuPont formula.

\[ R = T \times P \]

where
- \( R \) = rate of return on capital invested,
- \( T \) = rate of turnover of invested capital, and
- \( P \) = percentage of profit on sales

- In essence, it is a simple combination of two ratios

DuPont analysis

Gross or Operating Margin is a more common metric for supply chain professionals than Net Margin.

Inventory Turnover, a narrower focus than Asset Turnover, is often a metric for supply chain professionals.

\[
\text{Net margin} = \frac{\text{Net income}}{\text{Sales}} \quad \text{Asset turnover} = \frac{\text{Sales}}{\text{Total assets}}
\]

\[
\text{ROA} = \text{Net margin} \times \text{Asset turnover}
\]

\[
\text{Financial leverage} = \frac{\text{Total assets}}{\text{Equity}}
\]

\[
\text{ROE} = \text{Net margin} \times \text{Asset turnover} \times \text{Financial leverage}
\]

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DuPont analysis

• The DuPont formula is:

\[
ROA = Net \ Margin \times Asset \ Turnover
\]

\[
Net \ Margin = \frac{\text{Net Income}}{\text{Sales}} \quad Asset \ Turnover = \frac{\text{Sales}}{\text{Total Assets}}
\]

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DuPont analysis

• The formula commonly used today focuses on ROE and incorporates financial leverage

\[
ROE = \text{Net Margin} \times \text{Asset Turnover} \times \text{Financial Leverage}
\]

\[
\text{Net Margin} = \frac{\text{Net Income}}{\text{Sales}}
\]

\[
\text{Asset Turnover} = \frac{\text{Sales}}{\text{Total Assets}}
\]

\[
\text{Financial Leverage} = \frac{\text{Total Assets}}{\text{Equity}}
\]

GMROI

• GMROI = Gross Margin Return On Inventory Investment

\[
\text{GMROI} = \text{Gross Margin} \times \text{Inventory Turnover}
\]

\[
\text{Gross Margin} = \frac{\text{Gross Profit}}{\text{Sales}}
\]

\[
\text{Inventory Turnover}^* = \frac{\text{Sales}}{\text{Inventory}}
\]

* this version of the ratio does not use COGS as the numerator

• Narrower focus than DuPont
• Useful in evaluating inventory decisions, and their impact on profitability
Finance and supply chain work together to create stockholder value

Future cash flows: revenues, expenses, etc.

Operations / supply chain: use funds to generate returns
Finance: allocate funds
Finance: acquire funds

Firm
Operational Assets

Firm invests

Investors (Debt)
Investors (Equity)

Dividend

Operational Assets

Levers of performance for 10 diverse companies, 2010

<table>
<thead>
<tr>
<th></th>
<th>Return on Equity (ROE) (%)</th>
<th>Profit Margin (P) (%)</th>
<th>Asset Turnover (A) (times)</th>
<th>Financial Leverage (T) (times)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adobe Systems</td>
<td>14.9</td>
<td>20.4</td>
<td>0.47</td>
<td>1.57</td>
</tr>
<tr>
<td>Chevron</td>
<td>18.1</td>
<td>10.0</td>
<td>1.03</td>
<td>1.76</td>
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<td>Google</td>
<td>18.4</td>
<td>29.0</td>
<td>0.51</td>
<td>1.25</td>
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<tr>
<td>Hewlett-Packard</td>
<td>21.7</td>
<td>7.0</td>
<td>1.01</td>
<td>3.08</td>
</tr>
<tr>
<td>JPMorgan Chase</td>
<td>10.3</td>
<td>15.0</td>
<td>0.054</td>
<td>12.58</td>
</tr>
<tr>
<td>Norfolk Southern</td>
<td>14.0</td>
<td>15.7</td>
<td>0.34</td>
<td>2.64</td>
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<tr>
<td>Novartis</td>
<td>15.5</td>
<td>19.3</td>
<td>0.41</td>
<td>1.95</td>
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<tr>
<td>Safeway</td>
<td>11.8</td>
<td>1.42</td>
<td>2.71</td>
<td>3.03</td>
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<tr>
<td>Sainsent Technologies</td>
<td>10.9</td>
<td>8.1</td>
<td>0.83</td>
<td>1.83</td>
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<tr>
<td>Southern Company</td>
<td>12.6</td>
<td>11.7</td>
<td>0.32</td>
<td>3.40</td>
</tr>
</tbody>
</table>

Overall measure of financial performance

• Is there a single metric that can reflect the firm’s financial performance for investors?
• for executives?

• Return on Equity
  \[ ROE = \frac{\text{Net Income}}{\text{Equity}} \]

• Return on Assets
  \[ ROA = \frac{\text{Net Income}}{\text{Total Assets}} \]

Specific measures of financial performance

• Revenue growth
  – Sales growth = (Salest / Salest-1) - 1
  – Compound Annual Growth Rate (CAGR) = (Salest / Salest-n)^{1/n} - 1

• Operating margin
  – Gross margin = Gross Income / Sales
  – Operating margin = Operating Income / Sales
  – Net margin = Net Income / Sales

• Asset productivity
  – Asset turnover = Sales / Total Assets
  – Inventory turnover = COGS / Average Inventory
  – Accounts receivable turnover = Credit Sales / Average Accounts Receivable
  – Accounts payable turnover = COGS / Average Accounts Payable
  – Days of inventory outstanding = Average Inventory / (COGS/365)
## Principal ratio definitions (Higgins)*

### Profitability Ratios

<table>
<thead>
<tr>
<th>Ratio</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return on equity</td>
<td>Net income/Shareholders’ equity</td>
</tr>
<tr>
<td>Return on assets</td>
<td>Net income/Assets</td>
</tr>
<tr>
<td>Return on invested capital</td>
<td>Earnings before interest and taxes × (1 – Tax rate)</td>
</tr>
<tr>
<td>Profit margin</td>
<td>Interest-bearing debt + Shareholders’ equity × Net income/Sales</td>
</tr>
<tr>
<td>Gross margin</td>
<td>Gross profit/Sales</td>
</tr>
<tr>
<td>Price to earnings</td>
<td>Price per share/Earnings per share</td>
</tr>
</tbody>
</table>

### Turnover-Control Ratios

<table>
<thead>
<tr>
<th>Ratio</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asset turnover</td>
<td>Sales/Assets</td>
</tr>
<tr>
<td>Fixed-asset turnover</td>
<td>Sales/Net property, plant, and equipment</td>
</tr>
<tr>
<td>Inventory turnover</td>
<td>Cost of goods sold/Ending inventory</td>
</tr>
<tr>
<td>Collection period</td>
<td>Accounts receivable/Credit sales per day</td>
</tr>
<tr>
<td>(If credit sales unavailable, use sales)</td>
<td></td>
</tr>
<tr>
<td>Days’ sales in cash</td>
<td>Cash and securities/Sales per day</td>
</tr>
<tr>
<td>Payables period</td>
<td>Accounts payable/Credit purchases per day</td>
</tr>
<tr>
<td>(If purchases unavailable, use cost of goods sold)</td>
<td></td>
</tr>
</tbody>
</table>

* Excluding the leverage and liquidity ratios


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**Option to add working capital**
Ratios depend on the industry (upper quartile, median, lower quartile)

<table>
<thead>
<tr>
<th>Lines of Business and Number of Firms Reporting</th>
<th>Current Ratio (times)</th>
<th>Total Liabilities to Net Worth (%)</th>
<th>Collection Period (days)</th>
<th>Net Sales to Inventory (times)</th>
<th>Total Assets to Net Sales (%)</th>
<th>Profit Margin (%)</th>
<th>Return on Assets (%)</th>
<th>Return on Equity (%)</th>
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<tr>
<td>Retail trade:</td>
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<td></td>
<td></td>
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<td></td>
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<td></td>
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<td>Department stores (96)</td>
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<td>30.3</td>
<td>1.5</td>
<td>6.8</td>
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<td>6.4</td>
<td>4.8</td>
<td>54.7</td>
<td>2.0</td>
<td>3.6</td>
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<td>2.1</td>
<td>110.8</td>
<td>16.0</td>
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<td>74.1</td>
<td>0.1</td>
<td>-</td>
<td>(0.1)</td>
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<td>Grocery stores (185)</td>
<td>3.0</td>
<td>33.1</td>
<td>1.1</td>
<td>34.3</td>
<td>19.9</td>
<td>2.6</td>
<td>11.9</td>
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<td>13.8</td>
<td>22.1</td>
<td>1.3</td>
<td>4.6</td>
<td>11.5</td>
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<tr>
<td></td>
<td>1.3</td>
<td>213.6</td>
<td>6.9</td>
<td>13.7</td>
<td>39.2</td>
<td>0.4</td>
<td>1.9</td>
<td>4.1</td>
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<tr>
<td>Jewelry stores (114)</td>
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<td>22.1</td>
<td>1.5</td>
<td>3.2</td>
<td>47.2</td>
<td>4.7</td>
<td>8.0</td>
<td>15.0</td>
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<tr>
<td></td>
<td>2.1</td>
<td>55.4</td>
<td>13.9</td>
<td>2.2</td>
<td>74.4</td>
<td>1.0</td>
<td>1.5</td>
<td>3.0</td>
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<tr>
<td></td>
<td>1.8</td>
<td>142.3</td>
<td>36.7</td>
<td>1.6</td>
<td>190.8</td>
<td>(1.3)</td>
<td>(1.7)</td>
<td>(1.8)</td>
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<td>Services:</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Hotels and motels (84)</td>
<td>3.1</td>
<td>26.0</td>
<td>3.3</td>
<td>169.3</td>
<td>72.0</td>
<td>7.7</td>
<td>6.6</td>
<td>17.8</td>
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<tr>
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<td>193.4</td>
<td>6.6</td>
<td>108.9</td>
<td>175.2</td>
<td>1.5</td>
<td>1.2</td>
<td>5.8</td>
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<tr>
<td>Prepackaged software (195)</td>
<td>0.6</td>
<td>231.1</td>
<td>17.9</td>
<td>34.0</td>
<td>275.6</td>
<td>0.3</td>
<td>(3.2)</td>
<td>(3.3)</td>
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<tr>
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<td>39.7</td>
<td>37.6</td>
<td>212.3</td>
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<td>1.4</td>
<td>1.2</td>
<td>3.0</td>
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<tr>
<td></td>
<td>0.8</td>
<td>126.7</td>
<td>70.7</td>
<td>13.0</td>
<td>177.3</td>
<td>(15.3)</td>
<td>(19.7)</td>
<td>(7.7)</td>
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<td>College and universities (108)</td>
<td>2.0</td>
<td>29.1</td>
<td>17.0</td>
<td>300.1</td>
<td>191.1</td>
<td>10.0</td>
<td>2.9</td>
<td>5.5</td>
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<tr>
<td></td>
<td>1.9</td>
<td>54.1</td>
<td>20.5</td>
<td>98.0</td>
<td>310.1</td>
<td>1.9</td>
<td>0.6</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td>1.3</td>
<td>89.5</td>
<td>50.6</td>
<td>44.1</td>
<td>437.9</td>
<td>(0.3)</td>
<td>(2.0)</td>
<td>(2.4)</td>
</tr>
</tbody>
</table>

Ratio analysis advice

- There are not any “correct” values for ratios
- Ratio values need to be understood in context
  - Compare with industry averages
  - Compare with specific competitors
  - Observe trends over time
- Develop a framework of several ratios to monitor
- In combination, these clues may tell an interesting story

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Using ratios effectively

- Ratio values need to be understood in context
- Usually, no “correct” values for ratios
- Rely on rule of thumb assessment techniques, comparison with industry averages and specific competitors, and looking for trends


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You are now ready to be CEO

Sunflower Nutraceutical (SNC)
Simulation

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Sunflower Nutraceutical (SNC)

• How did you like being CEO?
• What was your objective in making decisions (in rank order)?
• What approaches did you use to evaluate options?
Sunflower Nutraceutical (SNC) results

Two goals of the CEO

- Provide Shareholder Value
- ...and stay out of jail

Bernard J. "Bernie" Ebbers co-founded the telecommunications company WorldCom and was the CEO. In 2005, he was sentenced to 25 years in prison for his role in the $11 billion accounting fraud that brought down the company.
Balanced Scorecard

• “Ultimately, causal paths from all the measures on a Scorecard should be linked to financial objectives.”

• “We have found that companies use three financial themes to achieve their business strategies:
  – Revenue Growth and Mix
  – Cost Reduction / Productivity Improvement
  – Asset Utilization / Investment Strategy”


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Deloitte Enterprise Value Map

Figure 1 High-level shareholder value map (Deloitte methods)


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Goal of the CEO

• Provide Shareholder Value

• Drivers of Shareholder Value
  – Revenue Growth
  – Operating Margin
  – Asset Productivity

Supply chain professionals can affect all three!
Drivers of shareholder value

How does supply chain performance make an impact on financial results?

- Tradeoffs exist
- Where do you focus?
Sunflower Nutraceutical (SNC) analysis

Decisions Phase 1: 2013 - 2015

Acquire a New Customer
Leverage Supplier Discount
Tighten Accounts Receivable
Drop Poorly Selling Products

Opportunities Selected
No opportunities selected yet.

Submit Decisions

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SNC is considering an opportunity to add Atlantic Wellness, a large, successful health food chain as a new corporate customer for its herbal nutraceutical product line. Taking on this customer would immediately increase SNC’s sales by $4 million per year (a one-time increase of 42%) and EBIT by $260,000. The profit margins and net working capital terms would remain the same as for SNC’s existing business.

What would you like to do about this opportunity?

Accept  Decline

<table>
<thead>
<tr>
<th></th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>Post 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>$4,000</td>
<td>$4,000</td>
<td>$4,000</td>
<td>$4,000</td>
</tr>
<tr>
<td>Cost of Sales</td>
<td>$3,740</td>
<td>$3,740</td>
<td>$3,740</td>
<td>$3,740</td>
</tr>
<tr>
<td>EBIT</td>
<td>$260</td>
<td>$260</td>
<td>$260</td>
<td>$260</td>
</tr>
</tbody>
</table>

Incremental Balance Sheet ($ in thousands)

<table>
<thead>
<tr>
<th></th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>Post 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accounts Receivable</td>
<td>$1,205</td>
<td>$1,205</td>
<td>$1,205</td>
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<tr>
<td>Inventories</td>
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<td>$922</td>
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<tr>
<td>Accounts Payable</td>
<td>$450</td>
<td>$450</td>
<td>$450</td>
<td>$450</td>
</tr>
</tbody>
</table>

SNC is considering working with NutriLife on a half-size contract for its herbal nutraceutical product line, with an incremental sales benefit to the top line of $2 million (a one-time 20% increase). In addition, Ayurveda Naturals, the India-based supplier of herbs for the NutriLife contract, is offering very favorable payment terms: 2/10 net 30. In other words, SNC could lower its accounts payable liability to $153,000 by paying Ayurveda Naturals within 30 days, thereby realizing a 2% discount on raw materials.

What would you like to do about this opportunity?

Accept  Decline

<table>
<thead>
<tr>
<th></th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>Post 2015</th>
</tr>
</thead>
<tbody>
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<td>Sales</td>
<td>$2,000</td>
<td>$2,000</td>
<td>$2,000</td>
<td>$2,000</td>
</tr>
<tr>
<td>Cost of Sales</td>
<td>$1,833</td>
<td>$1,833</td>
<td>$1,833</td>
<td>$1,833</td>
</tr>
<tr>
<td>EBIT</td>
<td>$167</td>
<td>$167</td>
<td>$167</td>
<td>$167</td>
</tr>
</tbody>
</table>

Incremental Balance Sheet ($ in thousands)

<table>
<thead>
<tr>
<th></th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>Post 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accounts Receivable</td>
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<td>$603</td>
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<tr>
<td>Inventories</td>
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<td>$452</td>
<td>$452</td>
<td>$452</td>
</tr>
<tr>
<td>Accounts Payable</td>
<td>$151</td>
<td>$151</td>
<td>$151</td>
<td>$151</td>
</tr>
</tbody>
</table>

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Sunflower Nutraceutical (SNC) analysis

Decisions Phase 1: 2013 - 2015

- Acquire a New Customer
- Leverage Supplier Discount
- Tighten Accounts Receivable
- Drop Poorly Selling Products

What would you like to do about this opportunity?

Submit Decisions

Opportunities Selected
No opportunities selected yet.

Sunflower Nutraceuticals is planning to review the order frequency of individual products through stock-keeping units (SKUs) over the last 12 months. Although Sunflower carries over 150 different SKUs, certain types of products—such as vitamins for specific life stages, less popular herbs, and other products—are not everyday purchases for most consumers, so these items take up space in the physical inventory but have a low turnover. If Sunflower eliminates these slower-moving items from the inventory, the company sales will decrease by $1 million and EBIT will decrease by $55,000. Reducing the size of Sunflowers overall product offerings will lower the Days Sales of Inventory (DSI) to a more desirable 65 days. These changes are reflected in the assumptions provided below.

Submit Decisions

Opportunities Selected
No opportunities selected yet.

What would you like to do about this opportunity?

Submit Decisions

Opportunities Selected
No opportunities selected yet.

What would you like to do about this opportunity?

Submit Decisions
DuPont assesses the Operating Margin – Asset Productivity tradeoff at a high level

Revenue Growth

Operating Margin

Asset Productivity

“Profit Path”

Same Destination: ROA

“Turnover Path”

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Do you see any extreme examples of Profit Path and Turnover Path?

<table>
<thead>
<tr>
<th>Return on Equity (ROE) (%)</th>
<th>Profit Margin (P) (%)</th>
<th>Asset Turnover (A) (times)</th>
<th>Financial Leverage (T) (times)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adobe Systems</td>
<td>14.9</td>
<td>20.4</td>
<td>0.47</td>
</tr>
<tr>
<td>Chevron</td>
<td>18.1</td>
<td>10.0</td>
<td>1.03</td>
</tr>
<tr>
<td>Google</td>
<td>18.4</td>
<td>29.0</td>
<td>0.51</td>
</tr>
<tr>
<td>Hewlett-Packard</td>
<td>21.7</td>
<td>7.0</td>
<td>1.01</td>
</tr>
<tr>
<td>JPMorgan Chase</td>
<td>10.3</td>
<td>15.0</td>
<td>0.054</td>
</tr>
<tr>
<td>Norfolk Southern</td>
<td>14.6</td>
<td>15.7</td>
<td>0.34</td>
</tr>
<tr>
<td>Novartis</td>
<td>15.5</td>
<td>19.3</td>
<td>0.41</td>
</tr>
<tr>
<td>Safeway</td>
<td>11.8</td>
<td>1.42</td>
<td>2.71</td>
</tr>
<tr>
<td>Sensient Technologies</td>
<td>10.9</td>
<td>8.1</td>
<td>0.63</td>
</tr>
<tr>
<td>Southern Company</td>
<td>12.6</td>
<td>11.7</td>
<td>0.32</td>
</tr>
</tbody>
</table>

Leverage drives value + increases risk

- Revenue Growth
- Operating Margin
- Leverage
- Asset Productivity
- Risk

Overall measure of financial performance

- ROA = Net Income / Total Assets
- ROE = Net Income / Equity
- Both measures can be distorted by financial leverage, i.e. more debt

<table>
<thead>
<tr>
<th></th>
<th>Company D</th>
<th>Company E</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBIT</td>
<td>$280</td>
<td>$280</td>
</tr>
<tr>
<td>Interest Expense</td>
<td>$180</td>
<td>$0</td>
</tr>
<tr>
<td>EBT</td>
<td>$100</td>
<td>$280</td>
</tr>
<tr>
<td>Income Taxes (40%)</td>
<td>$40</td>
<td>$112</td>
</tr>
<tr>
<td>Net Income</td>
<td>$60</td>
<td>$168</td>
</tr>
<tr>
<td>Total Assets</td>
<td>$2,000</td>
<td>$2,000</td>
</tr>
<tr>
<td>Long Term Debt (10%)</td>
<td>$1,800</td>
<td>$0</td>
</tr>
<tr>
<td>Total Stockholder’s Equity</td>
<td>$200</td>
<td>$2,000</td>
</tr>
<tr>
<td>Total Liabilities &amp; Equity</td>
<td>$2,000</td>
<td>$2,000</td>
</tr>
</tbody>
</table>

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ROIC

• ROIC = Return on Invested Capital
  — Returns on all capital for investors seeking a return
  — Not only equity
• ROIC = NOPAT / Invested Capital
• Net Operating Profit After Tax (NOPAT)
  — NOPAT = EBIT (1 - Tax rate)
  — Earnings after tax as if it were all equity financed (i.e., not considering interest expense or tax books)
• Invested Capital
  — IC = Interest-bearing Debt + Equity
  — Sum of all sources of cash on which a return must be earned (i.e., not including accounts payable)
  — You may want to subtract excess cash
  — Prefer the book value of Invested Capital (i.e. the value invested) rather than the market value

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ROIC

• Return on Invested Capital
  a.k.a. RONA (Return on Net Assets)
• ROIC = EBIT(1-Tax rate) / (Interest-bearing debt + Equity)
• Numerator: earnings after tax if it were all equity financed (i.e., not considering interest expense or tax books)
• Denominator: sum of all sources of cash on which a return must be earned

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## ROIC is not affected by financing scheme

<table>
<thead>
<tr>
<th>Company</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt @ 10% interest</td>
<td>$900</td>
<td>$0</td>
</tr>
<tr>
<td>Equity</td>
<td>100</td>
<td>1,000</td>
</tr>
<tr>
<td>Total assets</td>
<td>$1,000</td>
<td>$1,000</td>
</tr>
<tr>
<td>EBIT</td>
<td>$120</td>
<td>$120</td>
</tr>
<tr>
<td>- Interest expense</td>
<td>90</td>
<td>0</td>
</tr>
<tr>
<td>Earnings before tax</td>
<td>30</td>
<td>120</td>
</tr>
<tr>
<td>- Tax @ 40%</td>
<td>12</td>
<td>48</td>
</tr>
<tr>
<td>Earnings after tax</td>
<td>$18</td>
<td>$72</td>
</tr>
<tr>
<td>ROE</td>
<td>18.0%</td>
<td>7.2%</td>
</tr>
<tr>
<td>ROA</td>
<td>1.8%</td>
<td>7.2%</td>
</tr>
<tr>
<td>ROIC</td>
<td>7.2%</td>
<td>7.2%</td>
</tr>
</tbody>
</table>


---

## ROIC is not affected by financial leverage

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</table>

- ROIC is a good measure for supply chain performance
  - It is not confounded by financing strategies
  - It shows the fundamental earning power of the firm, i.e., created by operations
EVA™

• EVA™ = economic value added
  = NOPAT – (IC * COC)
• where
  – IC = invested capital
  – COC = cost of capital [i.e. WACC]
  – NOPAT = net operating profit after taxes [i.e. EBIT*(1-TaxRate)]

• Transform accounting profit into economic profit
  – Convert accrual-based earnings into a cash-based NOPAT
  – Convert total assets to invested capital
  – Assess the quantity of capital used to generate the income
  – The complexity and effort to adjust GAAP is a weakness of EVA

Note: EVA™ is a trademarked symbol of Stern, Stewart & Co.

Simple bottom line

If economic value added is positive in a given year, the firm has earned more than the amount required to compensate debtholders and shareholders
Economic Value Added

EVA = \text{SALES} - \text{COGS} - \text{INVENTORY} + \text{OTHER CURRENT ASSETS} - \text{CURRENT ASSETS} - \text{FIXED ASSETS} - \text{OTHER} - \text{GROSS MARGIN} - \text{TOTAL EXPENSES} - \text{TAXES} - \text{NOPAT} - \text{CAPITAL CHARGE} \
\times \text{COST OF CAPITAL (\%)}

Example: supply chain tradeoff

<table>
<thead>
<tr>
<th></th>
<th>Base</th>
<th>New Proposal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Revenues</strong></td>
<td>$100,000</td>
<td>$100,000</td>
</tr>
<tr>
<td><strong>Operating Costs</strong></td>
<td>$85,000</td>
<td>$86,500</td>
</tr>
<tr>
<td>SC</td>
<td>$10,000</td>
<td>$11,500</td>
</tr>
<tr>
<td>Non-SC</td>
<td>$70,000</td>
<td>$75,000</td>
</tr>
<tr>
<td><strong>EBIT</strong></td>
<td>$15,000</td>
<td>$13,500</td>
</tr>
<tr>
<td><strong>Taxes</strong></td>
<td>$5,700</td>
<td>$5,130</td>
</tr>
<tr>
<td><strong>NOPAT</strong></td>
<td>$9,300</td>
<td>$8,370</td>
</tr>
<tr>
<td><strong>Capital</strong></td>
<td>$70,000</td>
<td>$60,000</td>
</tr>
<tr>
<td>SC</td>
<td>$54,000</td>
<td>$44,000</td>
</tr>
<tr>
<td>Non-SC</td>
<td>$16,000</td>
<td>$16,000</td>
</tr>
<tr>
<td><strong>Cost of Capital</strong></td>
<td>$7,000</td>
<td>$6,000</td>
</tr>
<tr>
<td>SC</td>
<td>$5,400</td>
<td>$4,400</td>
</tr>
<tr>
<td>Non-SC</td>
<td>$1,600</td>
<td>$1,600</td>
</tr>
<tr>
<td><strong>EVA</strong></td>
<td>$2,300</td>
<td>$2,370</td>
</tr>
</tbody>
</table>

103.0%
Example: supply chain improvement

Revenues
- SC: $100,000
- Non-SC: $85,000

Operating Costs
- SC: $10,000
- Non-SC: $75,000

EBIT = $15,000

Taxes = $5,700

 NOPAT = $9,300

Capital
- SC: $70,000
- Non-SC: $64,000

Cost of Capital Charge
- SC: $7,000
- Non-SC: $5,400

EVA
- 10%: $2,300
- 10%: $2,920

Ops better
Revenues
- SC: $100,000
- Non-SC: $84,000

Operating Costs
- SC: $10,000
- Non-SC: $75,000

EBIT = $16,000

Taxes = $6,000

 NOPAT = $9,200

Capital
- SC: $70,000
- Non-SC: $54,000

Cost of Capital Charge
- SC: $7,000
- Non-SC: $5,400

EVA
- 10%: $2,300
- 10%: $2,920

Cap better
Revenues
- SC: $100,000
- Non-SC: $84,000

Operating Costs
- SC: $10,000
- Non-SC: $75,000

EBIT = $15,000

Taxes = $5,700

 NOPAT = $9,300

Capital
- SC: $64,000
- Non-SC: $16,000

Cost of Capital Charge
- SC: $6,460
- Non-SC: $4,860

EVA
- 10%: $2,790
- 10%: $3,640

EVA is aligned with NPV

The present value of EVAs from a given project is mathematically equivalent to the NPV of the project.

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EVA is not new, so why is it popular?

- Consultants are good at repackaging old ideas
  - Basic idea used by General Motors in 1920s
  - Labeled by General Electric in 1950s as “residual income”
  - Trademarked by Stern Stewart in 1990s as EVA™ (with further new terminology such as NOPAT)
- Uniformity: it can be used for three crucial management functions
  - Investment analysis (instead of NPV, IRR, BCR)
  - Business unit performance appraisal (instead of ROE, ROA)
  - Compensation incentive (turn middle managers into “owners”)
- It is more streamlined than relying on a host of measures such as NPV, IRR, BCR, ROE, ROIC, EPS, etc.

“EVA promises to complete the transformation of value creation from a mere slogan into a powerful management tool, one that may at last move modern finance out of the classroom and into the boardroom – and perhaps even onto the shop floor.”