Regression Diagnostics for Tata Motors



68

Application Test: Analyzing the Risk

Regression

- Using your Bloomberg risk and return print out, answer the following questions:
 - How well or badly did your stock do, relative to the market, during the period of the regression?

Intercept - (Riskfree Rate/n) (1- Beta) = Jensen' s Alpha

- where n is the number of return periods in a year (12 if monthly; 52 if weekly)
- What proportion of the risk in your stock is attributable to the market? What proportion is firm-specific?
- What is the historical estimate of beta for your stock? What is the range on this estimate with 67% probability? With 95% probability?
- Based upon this beta, what is your estimate of the required return on this stock?

Riskless Rate + Beta * Risk Premium

B Beta Page PB Page 23-26

The problem with regression betas

- They are backward looking: By definition, a regression beta is backward looking because it is computed based upon past returns. Consequently, if a company's business mix or financial leverage has changed during the regression period, the regression beta (even if well estimated) is no longer operational.
- They are subject to manipulation: Changing the market index used, the time period of the regression or even the return intervals (daily, weekly, monthly) can yield very different regression output.
- They are noisy: A regression slope (which is what we use as a beta) comes with a standard error, and if you regress a stock against a broad enough index, the regression beta should have a high standard error (it is a feature, not a bug)>

Beta: Exploring Fundamentals



Determinant 1: Product Type

- Industry Effects: The beta value for a firm depends upon the sensitivity of the demand for its products and services and of its costs to macroeconomic factors that affect the overall market.
 - Cyclical companies have higher betas than non-cyclical firms
 - Firms which sell more discretionary products will have higher betas than firms that sell less discretionary products

Determinant 2: Operating Leverage Effects

- Operating leverage refers to the proportion of the total costs of the firm that are fixed.
- Other things remaining equal, higher operating leverage results in greater earnings variability which in turn results in higher betas.

Measuring Disney's Operating Leverage: 1987-2013

Average: 96-13	Domodoro	8.16%		10.20%	10.20/8.16 =1.25
Average: 87-13		11.79%		11.91%	11.91/11.79 =1.01
2013	\$45,041	6.54%	\$9,450	6.62%	Operating Leverage
2012	\$42,278	3.39%	\$8,863	13.91%	
2011	\$40,893	7.44%	\$7,781	15.69%	
2010	\$38,063	5.29%	\$6,726	18.06%	
2009	\$36,149	-4.48%	\$5,697	-23.06%	
2008	\$37,843	6.57%	\$7,404	8.42%	
2007	\$35,510	5.22%	\$6,829	27.53%	c. no ene
2006	\$33,747	5.64%	\$5,355	30.39%	a Na affa
2005	\$31,944	3.88%	\$4,107	1.46%	b. Lower
2004	\$30,752	13.64%	\$4,048	49.21%	a. Inglici
2003	\$27,061	6.84%	\$2,713	13.80%	a Higher
2002	\$25,329	0.62%	\$2,384	-15.82%	companies?
2001	\$25,172	-0.97%	\$2,832	12.16%	• • •
2000	\$25,418	8.46%	\$2,525	-29.47%	or a lower b
1999	\$23,435	2.00%	\$3,580	-6.84%	011.23, we
1998	\$22,976	2.24%	\$3,843	-2.59%	(r 1 25) w
1997	\$22.473	19.93%	\$3.945	30.46%	Given Disn
1996	\$18,739	54 71%	\$3,024	33 69%	~
1994	\$12,000	20.46%	\$1,804	25 30%	
1993	\$10,055	17.80%	\$1,500	15.64%	Average act
1992	\$7,304	21.38%	\$1,207	14.30%	
1991	\$0,162	3.78%	\$1,124	-17.04%	
1990	\$3,844	5 780/	\$1,308	10.23%	
1989	\$4,594	33.62%	\$1,177	38.80%	
1988	\$3,438	19.50%	\$848 \$1.177	12.17%	
1987	\$2,877	10.5007	\$7.30	10.170/	
1097	\$2.977	Sales	\$756	EBIT	
Ical	Net Sales	% Change In	EDII	% Change III	

rage across entertainment companies = 1.35

en Disney's operating leverage measures (1.01 .25), would you expect Disney to have a higher lower beta than other entertainment

- Higher
- Lower
- No effect

74

Determinant 3: Financial Leverage

- As firms borrow, they create fixed costs (interest payments) that make their earnings to equity investors more volatile.
- □ This increased earnings volatility which increases the equity beta.
- The beta of equity alone can be written as a function of the unlevered beta and the debt-equity ratio
- $\square \beta_{L} = \beta_{u} (1 + ((1-t)D/E))$ where
 - **D** β_L = Levered or Equity Beta D/E = Market value Debt to equity ratio
 - $\square \beta_u = \text{Unlevered or Asset Beta} \quad t = \text{Marginal tax rate}$
- Earlier, we estimated the beta for Disney from a regression. Was that beta a levered or unlevered beta?
- a. Levered
- b. Unlevered

Effects of leverage on betas: Disney

- The regression beta for Disney is 1.25. This beta is a levered beta (because it is based on stock prices, which reflect leverage) and the leverage implicit in the beta estimate is the average market debt equity ratio during the period of the regression (2008 to 2013)
- The average debt equity ratio during this period was 19.44%.
- The unlevered beta for Disney can then be estimated (using a marginal tax rate of 36.1%)
 - = Current Beta / (1 + (1 tax rate) (Average Debt/Equity))
 - = 1.25 / (1 + (1 0.361)(0.1944)) = 1.1119

Disney : Beta and Financial Leverage

Debt to Capital	Debt/Equity Ratio	Beta	Effect of Leverage
0.00%	0.00%	1.11	0.00
10.00%	11.11%	1.1908	0.08
20.00%	25.00%	1.29	0.18
30.00%	42.86%	1.42	0.30
40.00%	66.67%	1.59	0.47
50.00%	100.00%	1.82	0.71
60.00%	150.00%	2.18	1.07
70.00%	233.33%	2.77	1.66
80.00%	400.00%	3.95	2.84
90.00%	900.00%	7.51	6.39

Betas are weighted Averages

- The beta of a portfolio is always the market-value weighted average of the betas of the individual investments in that portfolio.
- Thus,
 - the beta of a mutual fund is the weighted average of the betas of the stocks and other investment in that portfolio
 - the beta of a firm after a merger is the market-value weighted average of the betas of the companies involved in the merger.

Bottom-up versus Top-down Beta

- The top-down beta for a firm comes from a regression
- □ The bottom up beta can be estimated by doing the following:
 - Find out the businesses that a firm operates in
 - Find the unlevered betas of other firms in these businesses
 - Take a weighted (by sales or operating income) average of these unlevered betas
 - Lever up using the firm's debt/equity ratio
- The bottom up beta is a better estimate than the top down beta for the following reasons
 - The standard error of the beta estimate will be much lower
 - The betas can reflect the current (and even expected future) mix of businesses that the firm is in rather than the historical mix

Disney's businesses: The financial breakdown (from 2013 annual report)

Business	Revenues	Operating Income	D&A	EBITDA	S, G & A Costs	Cap Ex	Identifiable Assets
Media Networks	\$20,356	\$6,818	\$251	\$7,069	\$2,768	\$263	\$28,627
Parks & Resorts	\$14,087	\$2,220	\$1,370	\$3,590	\$1,960	\$2,110	\$22,056
Studio Entertainment	\$5,979	\$661	\$161	\$822	\$2,145	\$78	\$14,750
Consumer Products	\$3,555	\$1,112	\$146	\$1,258	\$731	\$45	\$7,506
Interactive	\$1,064	-\$87	\$44	-\$43	\$449	\$13	\$2,311

Unlevered Betas for businesses

Unlevered Beta

(1 - Cash/ Firm Value)

Business	Comparable firms	Sample size	Median Beta	Median D/E	Median Tax rate	Company Unlevered Beta	Median Cash/ Firm Value	✓ Business Unlevered Beta
Media Networks	US firms in broadcasting business	26	1.43	71.09%	40.00%	1.0024	2.80%	1.0313
Parks & Resorts	Global firms in amusement park business	20	0.87	46.76%	35.67%	0.6677	4.95%	0.7024
Studio Entertainment	US movie firms	10	1.24	27.06%	40.00%	1.0668	2.96%	1.0993
Consumer Products	Global firms in toys/games production & retail	44	0.74	29.53%	25.00%	0.6034	10.64%	0.6752
Interactive	Global computer gaming firms	33	1.03	3.26%	34.55%	1.0085	17.25%	1.2187

A closer look at the process... Studio Entertainment Betas

						Cash/Firm	Enterprise	Marginal tax	Gross D/E	Unlevered	Pure play	
Company Name	Levered Beta	Market Cap	Total Debt	Firm Value	Cash	Value	Value	rate	ratio	Beta	beta	EV/Sales
SFX Entertainment	1.12	738.80	\$98.89	\$837.69	\$143.60	17.14%	\$694.09	40.00%	13.39%	1.04	1.25	11.20
Mass Hysteria Entertainment	1.19	0.24	\$1.13	\$1.37	\$0.00	0.00%	\$1.37	40.00%	477.94%	0.31	0.31	12.45
vedient Studios	0.93	3.21	\$3.18	\$6.39	\$0.05	0.81%	\$6.34	40.00%	99.07%	0.58	0.59	1.21
'OW! Entertainment	0.94	3.97	\$0.34	\$4.31	\$0.43	9.85%	\$3.89	40.00%	8.65%	0.89	0.99	1.92
MGM Holdings	1.29	3631.70	\$142.16	\$3,773.86	\$140.70	3.73%	\$3,633.16	40.00%	3.91%	1.26	1.31	1.92
Lions Gate Entertainment	1.20	4719.60	\$1,283.20	\$6,002.80	\$67.20	1.12%	\$5,935.60	40.00%	27.19%	1.03	1.04	2.28
DreamWorks Animation	1.32	2730.00	\$348.30	\$3,078.30	\$156.40	5.08%	\$2,921.90	40.00%	12.76%	1.23	1.29	3.81
Twenty-First Century Fox	1.28	77743.50	\$20,943.00	\$98,686.50	\$6,681.00	6.77%	\$92,005.50	40.00%	26.94%	1.10	1.18	3.20
ndependent Film Development	1.61	1.32	\$0.96	\$2.28	\$0.05	2.20%	\$2.23	40.00%	72.35%	1.12	1.15	3.37
Odyssey Pictures Corp	2.60	0.30	\$1.64	\$1.94	\$0.00	0.10%	\$1.94	40.00%	551.12%	0.60	0.60	2.90
Average	1.35					4.68%		40.00%	129.33%	0.92	0.97	4.43
Aggregate	1.35	\$89,572.64	\$22,822.82	\$112,395.45	\$7,189.43	6.40%	\$105,206.02	40.00%	25.48%	1.17	1.25	3.09
Median	1.24					2.96%		40.00%	27.06%	1.03	1.10	3.05

Backing into a pure play beta: Studio

Entertainment

The Median Movie Company

Movie Business 97.04 Beta (movies) = 1.0093	Debt	21.30	Beta (debt) = 0							
Cash Businesss 2.96 Beta (cash) = 0.0000	Equity	78.70	Beta (equity) = 1.24							
Movie Company 100.0 Beta (company) = 1.0668										
1. Start with the median regression beta (equity beta) of 1.24										
2. Unlever the beta, using the medi	ian gross D	/E ratio o	f 27.06%							
Gross D/E ratio = 21.30/7	8.70 = 27.0	06%								
Unlevered beta = $1.24/(1+1)$	+ (14) (.2	(706)) = 1	.0668							
3. Take out the cash effect, using the	ne median o	cash/value	e of 2.96%							
(.0296)(0) + (10296) (Beta of movie business) = 1.0668										
Beta of movie business = $1.0668/(10296) = 1.0993$										
Alternatively, you could have use	ed the net	debt to eq	quity ratio							

Net D/E ratio = (21.30-2.96)/78.70 = 23.30%

Aswath Damodaran Unlevered beta for movies = 1.24/(1+(1-.4)(.233)) = 1.0879

83

83

Disney's unlevered beta: Operations & Entire Company

			Value of	Proportion of	Unlevered		
Business	Revenues	EV/Sales	Business	Disney	beta	Value	Proportion
Media Networks	\$20,356	3.27	\$66,580	49.27%	1.03	\$66,579.81	49.27%
Parks & Resorts	\$14,087	3.24	\$45,683	33.81%	0.70	\$45,682.80	33.81%
Studio Entertainment	\$5,979	3.05	\$18,234	13.49%	1.10	\$18,234.27	13.49%
Consumer Products	\$3,555	0.83	\$2,952	2.18%	0.68	\$2,951.50	2.18%
Interactive	\$1,064	1.58	\$1,684	1.25%	1.22	\$1,683.72	1.25%
Disney Operations	\$45,041		\$135,132	100.00%	0.9239	\$135,132.11	

Disney has \$3.93 billion in cash, invested in close to riskless assets (with a beta of zero). You can compute an unlevered beta for Disney as a company (inclusive of cash):

$$\beta_{\text{Disney}} = \beta_{\text{Operating Assets}} \frac{\text{Value}_{\text{Operating Assets}}}{(\text{Value}_{\text{Operating Assets}} + \text{Value}_{\text{Cash}})} + \beta_{\text{Cash}} \frac{\text{Value}_{\text{Cash}}}{(\text{Value}_{\text{Operating Assets}} + \text{Value}_{\text{Cash}})}$$
$$= 0.9239 \left(\frac{135,132}{(135,132+3,931)}\right) + 0.00 \left(\frac{3,931}{(135,132+3,931)}\right) = 0.8978$$

The levered beta: Disney and its divisions

To estimate the debt ratios for division, we allocate Disney's total debt (\$15,961 million) to its divisions based on identifiable assets.

	Business	ldentifiable assets (2013)	Proportion of debt	Value of business	Allocated debt	Estimated equity	D/E ratio
I	Media Networks	\$28,627	38.04%	\$66 <i>,</i> 580	\$6,072	\$60,508	10.03%
I	Parks & Resorts	\$22,056	29.31%	\$45 <i>,</i> 683	\$4,678	\$41,005	11.41%
I	Studio Entertainment	\$14,750	19.60%	\$18,234	\$3,129	\$15,106	20.71%
I	Consumer Products	\$7,506	9.97%	\$2,952	\$1,592	\$1,359	117.11%
ſ	Interactive	\$2,311	3.07%	\$1,684	\$490	\$1,194	41.07%
I	Disney	\$75,250	100.00%		\$15,961	\$121,878	13.10%

We use the allocated debt to compute D/E ratios and levered betas.

Business	Unlevered beta	Value of business	D/E ratio	Levered beta	Cost of Equity
Media Networks	1.0313	\$66,580	10.03%	1.0975	9.07%
Parks & Resorts	0.7024	\$45,683	11.41%	0.7537	7.09%
Studio Entertainment	1.0993	\$18,234	20.71%	1.2448	9.92%
Consumer Products	0.6752	\$2,952	117.11%	1.1805	9.55%
Interactive	1.2187	\$1,684	41.07%	1.5385	11.61%
Disney Operations	0.9239	\$135,132	13.10%	1.0012	8.52%

Discussion Issue

- Assume now that you are the CFO of Disney. The head of the movie business has come to you with a new big budget movie that he would like you to fund. He claims that his analysis of the movie indicates that it will generate a return on equity of 9.5%. Would you fund it?
 - a. Yes. It is higher than the cost of equity for Disney as a company
 - b. No. It is lower than the cost of equity for the movie business.
- What are the broader implications of your choice?

Estimating Bottom Up Betas & Costs of Equity: Vale

Business	Sample	Sample size	Unlevered beta of business	Revenues	Peer Group EV/Sales	Value of Business	Proportion of Vale
	Global firms in metals &						
Metals & Mining	billion	48	0.86	\$9,013	1.97	\$17,739	16.65%
Iron Ore	Global firms in iron ore	78	0.83	\$32,717	2.48	\$81,188	76.20%
Fertilizers	Global specialty chemical firms	693	0.99	\$3,777	1.52	\$5,741	5.39%
Logistics	Global transportation firms	223	0.75	\$1,644	1.14	\$1,874	1.76%
Vale Operations			0.8440	\$47,151		\$106,543	100.00%

Business	Unlevered beta	D/E ratio	Levered beta	Risk free rate	ERP	Cost of Equity
Metals & Mining	0.86	54.99%	1.1657	2.75%	7.38%	11.35%
Iron Ore	0.83	54.99%	1.1358	2.75%	7.38%	11.13%
Fertilizers	0.99	54.99%	1.3493	2.75%	7.38%	12.70%
Logistics	0.75	54.99%	1.0222	2.75%	7.38%	10.29%
Vale Operations	0.84	54.99%	1.1503	2.75%	7.38%	11.23%

 To convert a discount rate in one currency to another, all you need are expected inflation rates in the two currencies.

 $(1 + \text{S Cost of Equity}) \frac{(1 + \text{Inflation Rate}_{\text{Brazil}})}{(1 + \text{Inflation Rate}_{\text{US}})} - 1$

From US \$ to R\$: If we use 2% as the inflation rate in US dollars and 9% as the inflation ratio in Brazil, we can convert Vale's US dollar cost of equity of 11.23% to a \$R cost of equity:

Cost of Equity_{Nominal R\$} = (1+ Cost of Equity_{US \$})
$$\frac{(1 + \text{Expected Inflation}_{R$})}{(1 + \text{Expected Inflation}_{US $})} - 1$$

$$= (1.1123) \frac{(1.09)}{(1.02)} - 1 = 18.87\%$$

 Alternatively, you can compute a cost of equity, starting with the \$R riskfree rate of 10.18%.

Cost of Equity in \$R = = 10.18% + 1.15 (7.38%) = 18.67%

Bottom up betas & Costs of Equity: Tata Motors & Baidu

- Tata Motors: We estimated an unlevered beta of 0.8601 across 76 publicly traded automotive companies (globally) and estimated a levered beta based on Tata Motor's D/E ratio of 41.41% and a marginal tax rate of 32.45% for India: Levered Beta for Tata Motors = 0.8601 (1 + (1-.3245) (.4141)) = 1.1007 Cost of equity (Rs) = 6.57% + 1.1007 (7.19%) = 14.49%
- Baidu: To estimate its beta, we looked at 42 global companies that derive all or most of their revenues from online advertising and estimated an unlevered beta of 1.30 for the business. Incorporating Baidu's current market debt to equity ratio of 5.23% and the marginal tax rate for China of 25%, we estimate Baidu's current levered beta to be 1.3560. Levered Beta for Baidu = 1.30 (1 + (1-.25) (.0523)) = 1.356

Cost of Equity for Baidu (Renmimbi) = 3.50% + 1.356 (6.94%) = 12.91%

Bottom up Betas and Costs of Equity: Deutsche Bank

 We break Deutsche Bank down into two businesses – commercial and investment banking.

	Sample	<i>a</i> , , ,	Median Levered	Deutsche Net	
Business	used	Sample size	Beta	Revenues in 2012	Proportion
	European				
	diversified				
Banking	banks	84	1.0665	19,019 mil €	54.86%
	Global				
Investment	investment				
Banking	banks	58	1.2550	15,648 mil €	45.14%
Deutsche Bank			1.1516	34,667 mil €	

 We do not unlever or relever betas, because estimating debt and equity for banks is an exercise in futility.

Business	Beta	Cost of Equity
Commercial banking	1.0665	1.75% + 1.0665(6.12%) = 8.28%
Investment Banking	1.2550	1.75% + 1.2550(6.12%) = 9.44%
Deutsche Bank	1.1516	1.75% + 1.1516(6.12%) = 8.80%

Estimating Betas for Non-Traded Assets

- The conventional approaches of estimating betas from regressions do not work for assets that are not traded. There are no stock prices or historical returns that can be used to compute regression betas.
- There are two ways in which betas can be estimated for non-traded assets
 - Using comparable firms
 - Using accounting earnings