

# BRN 481

## Market Model Regressions

- Market model regression:

- $R(it) = \alpha(i) + \beta(i) R(mt) + e(it), \quad t = 1, \dots, T$

- where  $R(it)$  is the return to asset  $i$  and  $R(mt)$  is the return to the "market" portfolio of assets in period  $t$

is a time series regression model

- the slope coefficient  $\beta(i)$  ("beta") is a measure of the relative nondiversifiable risk of the asset which is the dependent variable in the regression [ $R(it)$ ] as part of the portfolio which is the independent variable [ $R(mt)$ ]

# Market Model Regressions

- Weighted average beta  $\sum w(i) \beta(i)$  equals 1 by construction for the set of assets  $i$  which make up the regressor portfolio  $[R(mt)]$ 
  - $w(i)$  is the proportion that asset  $i$  represents in portfolio  $m$ ,  $\sum w(i) = 1$
- Weighted average intercept  $\sum w(i) \alpha(i)$  in the market model regression must equal 0 by construction

# Market Model Regressions

- If the Capital Asset Pricing Model (CAPM) is true, then the intercept

$$\alpha(i) = [1-\beta(i)] R(f)$$

where  $R(f)$  is the risk-free rate of return

- so betas  $\beta(i) > 1$  would typically be associated with  $\alpha(i) < 0$

# Market Model Regressions

- Below we will show Excel output for the market model regression using the CRSP value-weighted portfolio as the regressor,

- $R(it) = \alpha(i) + \beta(i) R(vt) + e(it)$

where  $R(it)$  is the monthly rate of return to the various assets or portfolios and  $R(vt)$  is the rate of return to the value-weighted portfolio in period  $t$

# Market Model Regressions: Apple Daily Stock Returns for 2017

2017	AAPL	
SUMMARY OUTPUT		
Regression Statistics		
Multiple R		0.486
R Square		0.237
Adjusted R Square		0.234
Standard Error		0.0097
Observations		251

23.7% R<sup>2</sup>

Standard deviation of residuals is .0097

Beta coefficient estimate is 1.244, with a standard error of .142

So the t-test for whether Apple is an above risky stock (Beta>1) is

$$t = (1.244 - 1) / .142 = 1.72$$

(so we would not reject average risk at the 5% level)

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	7E-04	6E-04	1.114	0.266	-5E-04	0.002	-5E-04	0.002
X Variable 1	1.244	0.142	8.786	3E-16	0.965	1.522	0.965	1.522

# Market Model Regressions:

Beta Estimates from Daily Stock Returns for a Year, 2000-2018

Year	AAPL	XRX	GS	Lo 20	Qnt 2	Qnt 3	Qnt 4	Hi 20
2000	1.67	0.81	1.46	1.10	0.72	0.58	0.51	0.59
2001	1.66	1.08	1.59	1.13	0.77	0.69	0.66	0.72
2002	1.15	1.22	1.21	1.06	1.07	0.90	0.97	1.00
2003	1.29	1.24	1.32	1.05	1.08	0.93	1.02	1.15
2004	1.39	1.20	1.26	0.99	1.01	1.05	1.04	1.12
2005	1.77	0.98	1.16	0.96	1.08	1.08	1.02	1.07
2006	1.49	0.92	1.60	0.99	0.99	1.04	0.96	1.00
2007	1.22	1.01	1.70	0.92	0.97	1.11	1.03	1.06
2008	0.99	1.01	1.45	0.93	0.94	1.02	1.22	1.22
2009	0.86	1.47	1.70	0.79	0.93	1.07	1.36	1.58
2010	1.03	1.36	0.90	0.85	1.01	1.05	1.14	1.41
2011	0.75	1.25	1.25	0.95	0.95	1.07	1.00	1.35
2012	1.20	1.34	1.62	1.01	0.96	1.00	0.92	1.34
2013	0.63	1.34	1.42	0.98	0.97	1.00	1.05	1.27
2014	0.81	1.36	1.11	1.08	1.01	1.03	1.00	1.08
2015	1.16	1.30	1.26	1.03	1.01	1.04	1.00	1.17
2016	0.94	1.33	1.47	0.95	0.96	1.03	0.96	1.47
2017	1.24	1.32	1.74	0.99	0.97	1.05	1.07	1.42
2018	1.11	1.27	1.22	1.02	1.07	1.02	1.04	1.11

# Apple betas were high during the end of the “Dot-Com Bubble”

Year	AAPL	XRX	GS	Lo 20	Qnt 2	Qnt 3	Qnt 4	Hi 20
2000	<b>1.67</b>	0.81	1.46	1.10	0.72	0.58	0.51	0.59
2001	<b>1.66</b>	1.08	1.59	1.13	0.77	0.69	0.66	0.72
2002	1.15	1.22	1.21	1.06	1.07	0.90	0.97	1.00
2003	1.29	1.24	1.32	1.05	1.08	0.93	1.02	1.15
2004	1.39	1.20	1.26	0.99	1.01	1.05	1.04	1.12
2005	1.77	0.98	1.16	0.96	1.08	1.08	1.02	1.07
2006	1.49	0.92	1.60	0.99	0.99	1.04	0.96	1.00
2007	1.22	1.01	1.70	0.92	0.97	1.11	1.03	1.06
2008	0.99	1.01	1.45	0.93	0.94	1.02	1.22	1.22
2009	0.86	1.47	1.70	0.79	0.93	1.07	1.36	1.58
2010	1.03	1.36	0.90	0.85	1.01	1.05	1.14	1.41
2011	0.75	1.25	1.25	0.95	0.95	1.07	1.00	1.35
2012	1.20	1.34	1.62	1.01	0.96	1.00	0.92	1.34
2013	0.63	1.34	1.42	0.98	0.97	1.00	1.05	1.27
2014	0.81	1.36	1.11	1.08	1.01	1.03	1.00	1.08
2015	1.16	1.30	1.26	1.03	1.01	1.04	1.00	1.17
2016	0.94	1.33	1.47	0.95	0.96	1.03	0.96	1.47
2017	1.24	1.32	1.74	0.99	0.97	1.05	1.07	1.42
2018	1.11	1.27	1.22	1.02	1.07	1.02	1.01	1.11

# Goldman betas were high during the “Financial Crisis”

Year	AAPL	XRX	GS	Lo 20	Qnt 2	Qnt 3	Qnt 4	Hi 20
2000	1.67	0.81	1.46	1.10	0.72	0.58	0.51	0.59
2001	1.66	1.08	1.59	1.13	0.77	0.69	0.66	0.72
2002	1.15	1.22	1.21	1.06	1.07	0.90	0.97	1.00
2003	1.29	1.24	1.32	1.05	1.08	0.93	1.02	1.15
2004	1.39	1.20	1.26	0.99	1.01	1.05	1.04	1.12
2005	1.77	0.98	1.16	0.96	1.08	1.08	1.02	1.07
2006	1.49	0.92	<b>1.60</b>	0.99	0.99	1.04	0.96	1.00
2007	1.22	1.01	<b>1.70</b>	0.92	0.97	1.11	1.03	1.06
2008	0.99	1.01	<b>1.45</b>	0.93	0.94	1.02	1.22	1.22
2009	0.86	1.47	<b>1.70</b>	0.79	0.93	1.07	1.36	1.58
2010	1.03	1.36	0.90	0.85	1.01	1.05	1.14	1.41
2011	0.75	1.25	1.25	0.95	0.95	1.07	1.00	1.35
2012	1.20	1.34	1.62	1.01	0.96	1.00	0.92	1.34
2013	0.63	1.34	1.42	0.98	0.97	1.00	1.05	1.27
2014	0.81	1.36	1.11	1.08	1.01	1.03	1.00	1.08
2015	1.16	1.30	1.26	1.03	1.01	1.04	1.00	1.17
2016	0.94	1.33	1.47	0.95	0.96	1.03	0.96	1.47
2017	1.24	1.32	1.74	0.99	0.97	1.05	1.07	1.42
2018	1.11	1.27	1.22	1.02	1.07	1.02	1.01	1.11



# Value firm (high B/M) betas were low during the “Dot-Com Bubble”

Year	AAPL	XRX	GS	Lo 20	Qnt 2	Qnt 3	Qnt 4	Hi 20
2000	1.67	0.81	1.46	1.10	0.72	0.58	<b>0.51</b>	<b>0.59</b>
2001	1.66	1.08	1.59	1.13	0.77	0.69	<b>0.66</b>	<b>0.72</b>
2002	1.15	1.22	1.21	1.06	1.07	0.90	0.97	1.00
2003	1.29	1.24	1.32	1.05	1.08	0.93	1.02	1.15
2004	1.39	1.20	1.26	0.99	1.01	1.05	1.04	1.12
2005	1.77	0.98	1.16	0.96	1.08	1.08	1.02	1.07
2006	1.49	0.92	1.60	0.99	0.99	1.04	0.96	1.00
2007	1.22	1.01	1.70	0.92	0.97	1.11	1.03	1.06
2008	0.99	1.01	1.45	0.93	0.94	1.02	1.22	1.22
2009	0.86	1.47	1.70	0.79	0.93	1.07	1.36	1.58
2010	1.03	1.36	0.90	0.85	1.01	1.05	1.14	1.41
2011	0.75	1.25	1.25	0.95	0.95	1.07	1.00	1.35
2012	1.20	1.34	1.62	1.01	0.96	1.00	0.92	1.34
2013	0.63	1.34	1.42	0.98	0.97	1.00	1.05	1.27
2014	0.81	1.36	1.11	1.08	1.01	1.03	1.00	1.08
2015	1.16	1.30	1.26	1.03	1.01	1.04	1.00	1.17
2016	0.94	1.33	1.47	0.95	0.96	1.03	0.96	1.47
2017	1.24	1.32	1.74	0.99	0.97	1.05	1.07	1.42
2018	1.11	1.27	1.22	1.02	1.07	1.02	1.01	1.11

# Value firm (high B/M) betas were high during the “Financial Crisis”

Year	AAPL	XRX	GS	Lo 20	Qnt 2	Qnt 3	Qnt 4	Hi 20
2000	1.67	0.81	1.46	1.10	0.72	0.58	0.51	0.59
2001	1.66	1.08	1.59	1.13	0.77	0.69	0.66	0.72
2002	1.15	1.22	1.21	1.06	1.07	0.90	0.97	1.00
2003	1.29	1.24	1.32	1.05	1.08	0.93	1.02	1.15
2004	1.39	1.20	1.26	0.99	1.01	1.05	1.04	1.12
2005	1.77	0.98	1.16	0.96	1.08	1.08	1.02	1.07
2006	1.49	0.92	1.60	0.99	0.99	1.04	0.96	1.00
2007	1.22	1.01	1.70	0.92	0.97	1.11	1.03	1.06
2008	0.99	1.01	1.45	0.93	0.94	1.02	1.22	<b>1.22</b>
2009	0.86	1.47	1.70	0.79	0.93	1.07	1.36	<b>1.58</b>
2010	1.03	1.36	0.90	0.85	1.01	1.05	1.14	<b>1.41</b>
2011	0.75	1.25	1.25	0.95	0.95	1.07	1.00	<b>1.35</b>
2012	1.20	1.34	1.62	1.01	0.96	1.00	0.92	1.34
2013	0.63	1.34	1.42	0.98	0.97	1.00	1.05	1.27
2014	0.81	1.36	1.11	1.08	1.01	1.03	1.00	1.08
2015	1.16	1.30	1.26	1.03	1.01	1.04	1.00	1.17
2016	0.94	1.33	1.47	0.95	0.96	1.03	0.96	1.47
2017	1.24	1.32	1.74	0.99	0.97	1.05	1.07	1.42
2018	1.11	1.27	1.22	1.02	1.07	1.02	1.01	1.11

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