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Aligning Internal and External Metrics: The Cost of Capital for Financial Institutions

University Finance Seminar, Cambridge

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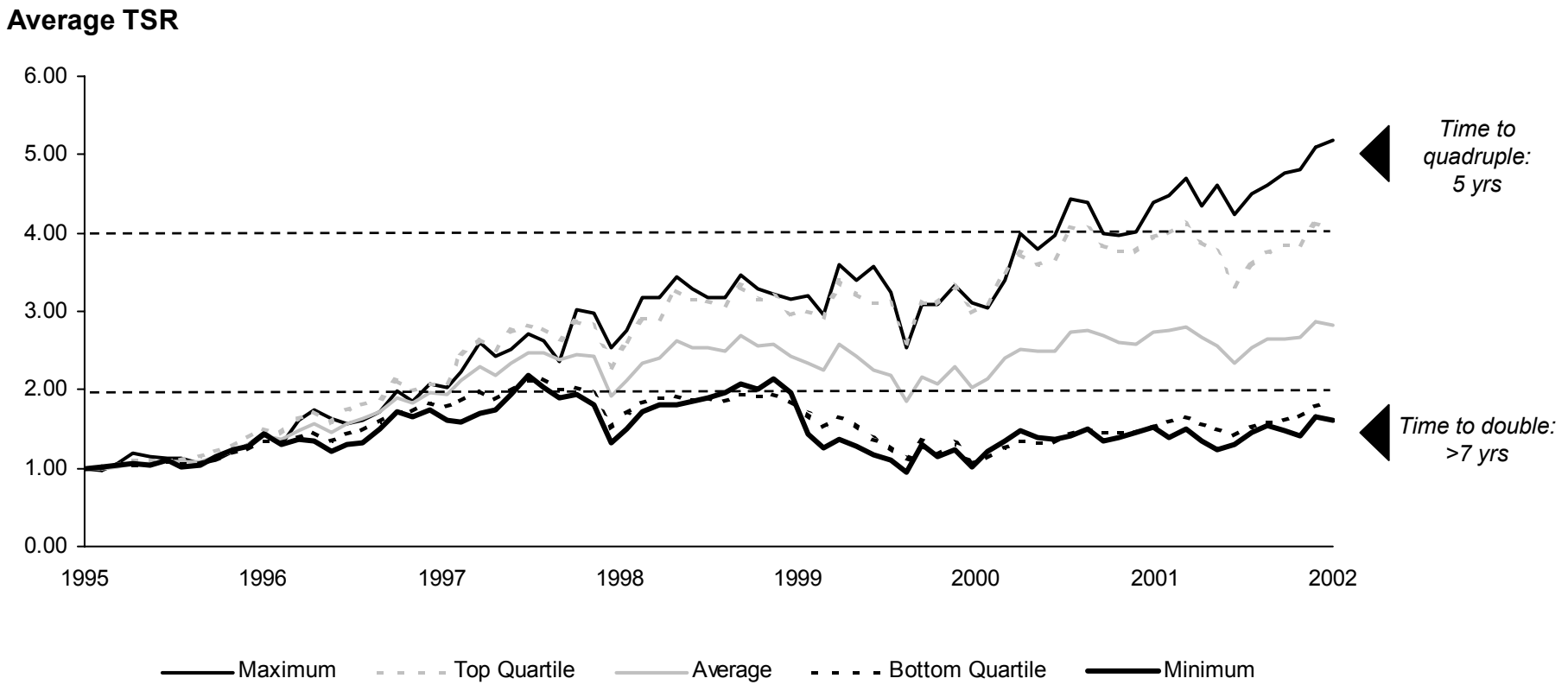
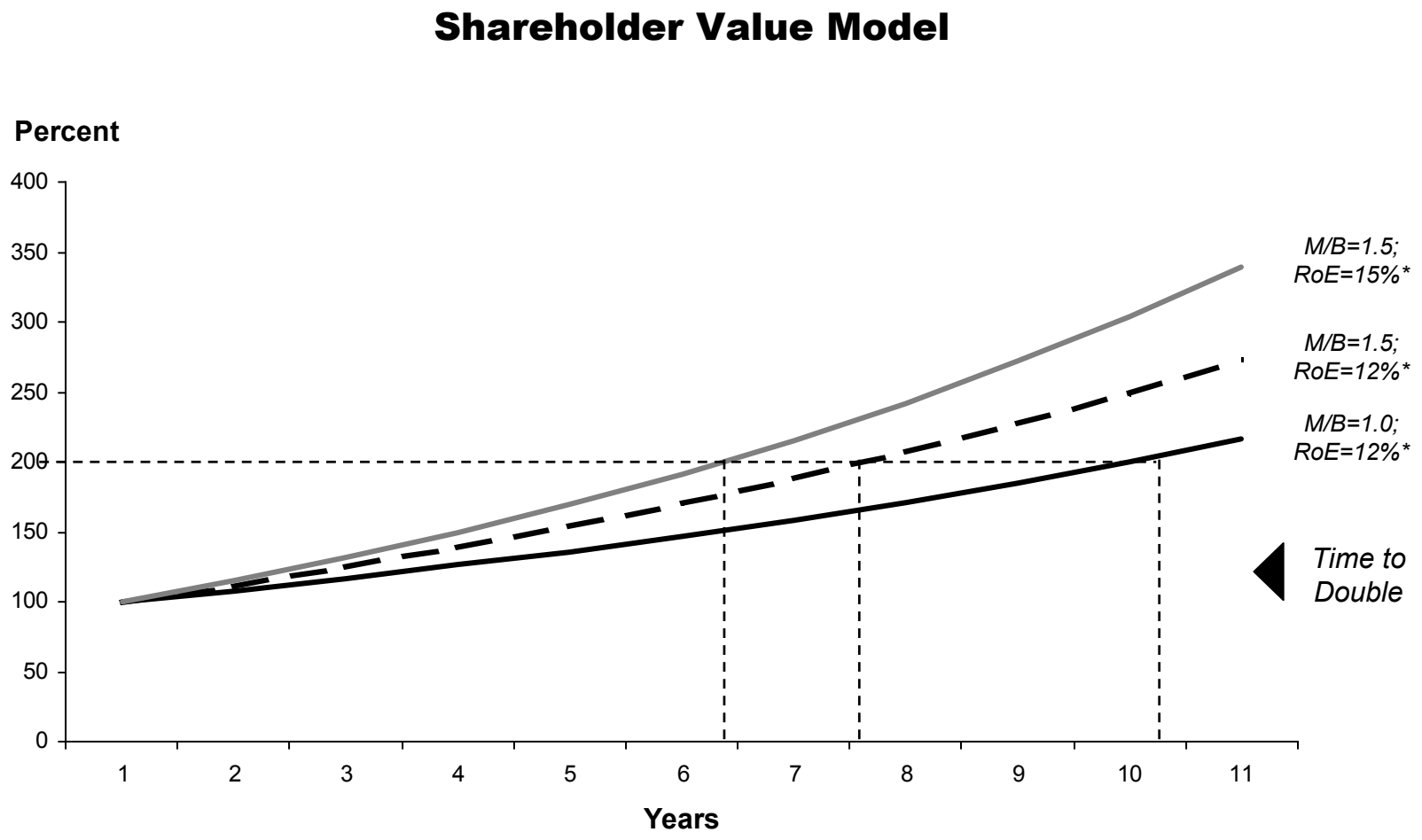
Different Performance

Total Shareholder Return S&P US Bank Index 1995-2002



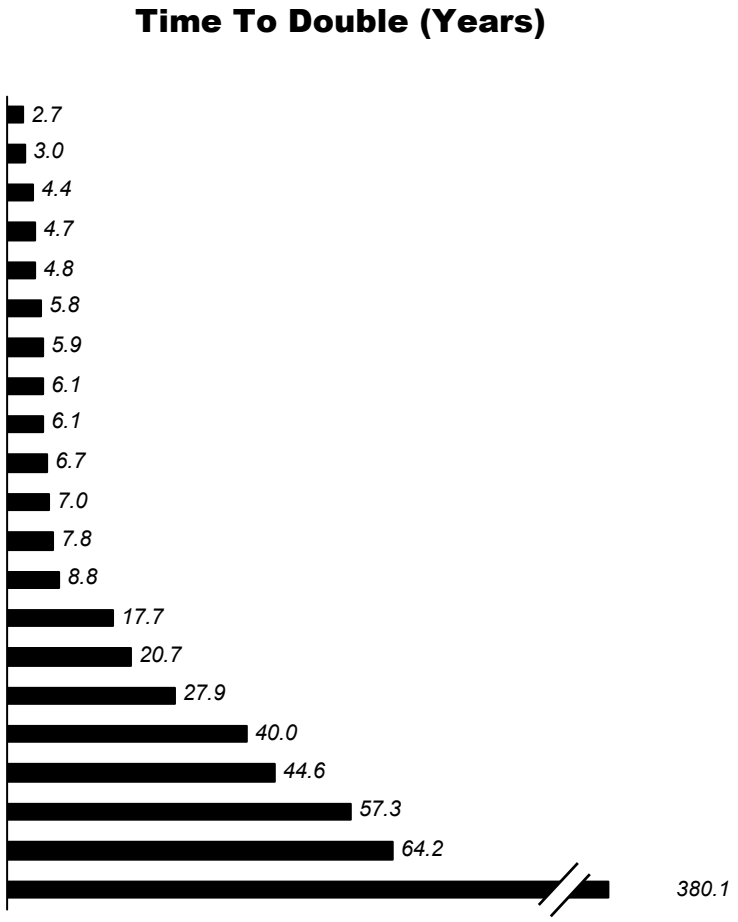
Value Driven at a High Level by M/B Multiple, RoE



* Assumes 33% dividend rate

Widely Different Implied Performance

	P/E*	M/B*	RoE*
Lloyds TSB Group PLC	17.0	4.0	24.0
ABN Amro Holding NV	11.1	3.0	28.1
Citigroup Inc	15.9	2.9	19.4
ING Groep NV-CVA	12.0	2.6	19.5
Barclays PLC	16.6	2.8	17.8
Fortis	12.7	2.2	17.9
Aegon NV	14.0	2.3	17.1
Wells Fargo & Company	24.2	3.2	12.8
Bank of America Corp	14.7	2.4	14.1
American International Group	25.9	3.4	10.8
Lehman Brothers Holdings Inc	15.5	2.0	15.7
Goldman Sachs Group Inc	20.7	2.1	13.3
UBS AG-Registered	21.1	2.3	11.3
Credit Suisse Group	43.6	2.4	5.4
Allianz AG-Reg	39.0	2.2	4.8
JP Morgan Chase & Co	24.6	1.9	4.0
Merrill Lynch & Co	19.2	1.8	2.9
Metlife Inc	15.8	1.5	2.9
AXA	75.3	1.6	2.2
Chubb Corp	98.1	2.0	1.7
Deutsche Bank AG-Reg	147.5	1.2	0.4



* Previous 12 months

Understanding M/B Multiple

Intrinsic Value Theory

$$\frac{M}{B} = \left(1 + \frac{Raroc - CoC}{CoC - g}\right) + Perception\ Gap$$

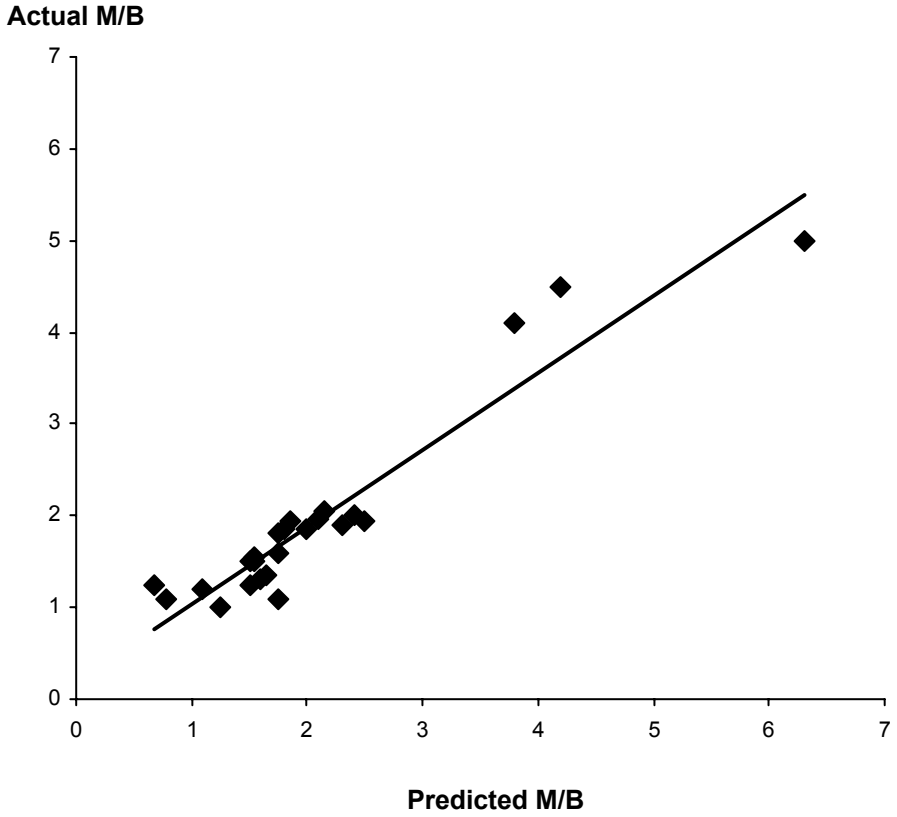
Excess Returns

Cost of Capital

Growth

Empirical Evidence

Actual Vs. Predicted M/B
Selected Financial Institutions



* Steady state residual income model

Reconciling Internal and External Metrics

General form:

$$\frac{M}{AdjBook} = \frac{ExcessCap}{TotalCap} + \frac{OpCap}{TotalCap}\sum_{i}^{N}\omega_i\left[1 + \frac{AdjRoC_i - CoC_i}{CoC_i - g_i}\right]$$

- Differentiated cost of capital by line of business
- Cost of capital reflects leverage/rating
- Economic adjustment
  - Capital
  - Earnings
- Capital attribution and excess capital
- Growth

Contents

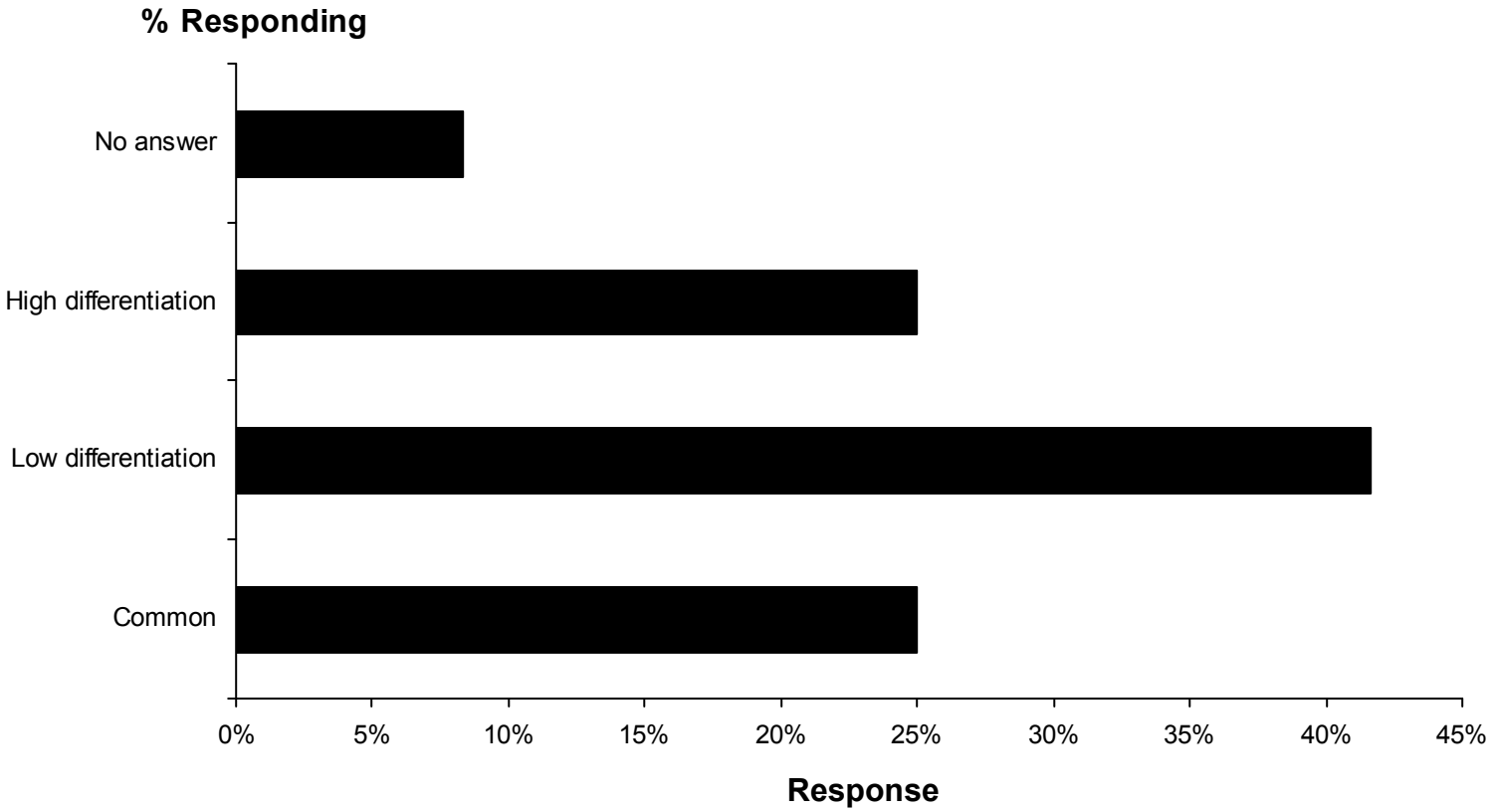
Many Institutions Implicitly Subsidize Higher Risk Businesses . . .

- Many institutions implicitly subsidize higher risk businesses at the expense of lower risk businesses

- This subsidization is implicitly done by the choice of a common cost of capital across different business activities, typically rationalized by one of two arguments
  - By differentiating risk capital such that each business is capitalized to a common probability of default, no further risk adjustment is needed.
  - Even if a differentiated cost of capital were theoretically correct, it would not be practical to implement because
    - It would be too difficult to empirically estimate
    - The strategic impact would be low
    - Management buy-in would be low

Cost of Capital Survey Results

- Do you use a common cost of capital for performance measurement?



* OWC/KFI Global CFO/CRO Survey, Winter 2002

Article Makes and Empirically Verifies Following Claims

- **Differentiated cost of capital effect**: All else being equal, shareholders expect different returns from different businesses, even if they are capitalized to a common rating standard

- **Leverage Effect**: All else being equal, including business mix, shareholders expect a higher return from firms with a higher probability of default and therefore more leverage

- **Idiosyncratic Risk Effect**: All else being equal, shareholders will put a premium on firms which have lower idiosyncratic risk (due to their higher ability to leverage equity)

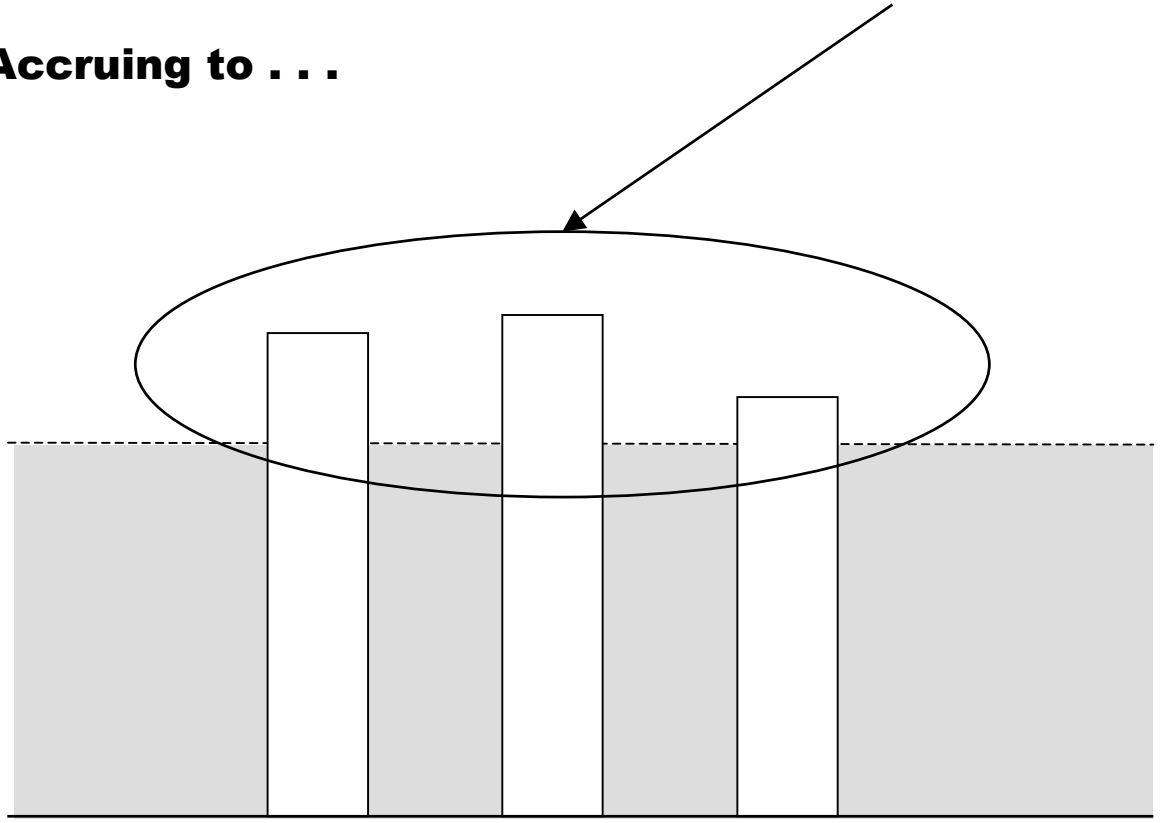
- **Country of Domicile Effect**: All else being equal, shareholders of European financial institutions expect a lower overall return for systematic risk

Intuition

Shareholders value portfolio of cash flows in excess of leverage/debt service levels

Cash Flows Accruing to . . .
Equity

. . . Debt



Intuition – Corporate Finance Approach

$$R_E = R_f + \beta_E (R_m - R_f)$$

$$\beta_E = \left[\frac{E + D}{E} \left(p^* \right) \right] \beta_A = \left[\frac{E + D}{E} \left(p^* \right) \right] \sum_{i=1}^{N} \omega_i \beta_i$$

- Cost of capital depends on:
- Actual leverage
- Business portfolio mix

Differentiated Cost of Capital – Armchair Empiricism

Comparison Of Average Betas, 1990-1995

Insurance Vs Investment Banking

	AA to A+ Firms	Beta range (avg)
Insurance**	AEG, CGNU, AXA, AS	0.81-1.29 (1.03)
Investment Banking**	ML, MS, GS, LB	2.34-3.78 (2.90)

* Average domestic betas and blended public rating (Moody's, Standard & Poor's) when available, 1990-2001

** MR=Munich Re, SR = Swiss Re, AL = Allianz, PRU = Prudential UK, AEG = Aegon, ML = Merrill Lynch, AS = Allstate, MS = Morgan Stanley, GS = Goldman Sachs, LB = Lehman Brothers, DB = Deutsche Bank, DRB = Dresdner, NBA = National Bank of Australia, COM = Commonwealth Bank of Australia, BHV = Bayerishe Hypo-Vereinsbank, BSCH = Banco Santander Central Hispanoamerica, FB = FleetBoston, BNP = Banque National de Paris, JPM = J. P. Morgan, RBS = Royal Bank of Scotland, BA = Bank of America

Leverage Effect – Armchair Empiricism

Comparison Of Average Betas, 1990-2000

Universal Banks

Rating	AA+*	AA*	AA-*	A+*
Universal Banks**	DB – 0.94	DRB – 1.01 NBA – 0.92 COM – 0.72	BHV – 0.93 SG – 1.23 BBVA – 1.22 BSCH – 1.25 FB – 1.19	BNP – 1.56 JPM – 1.95 RBS – 1.70 BA – 1.76
Avg	0.94	0.88	1.16	1.74

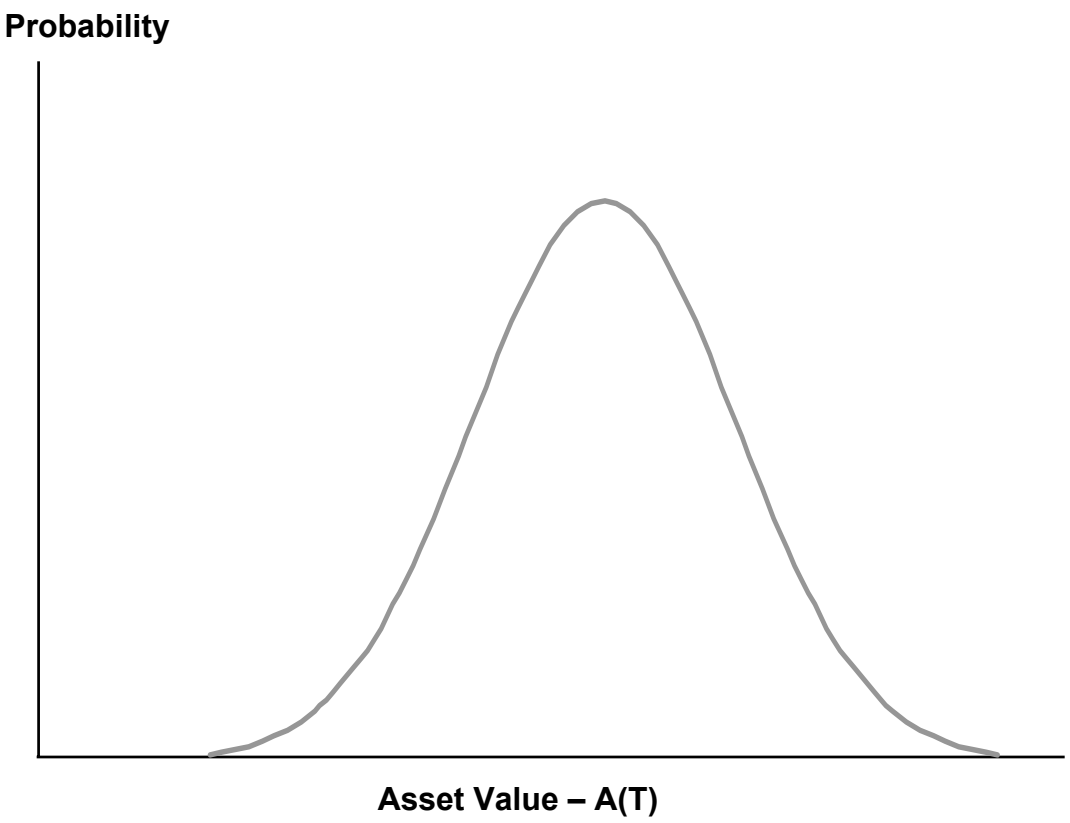
* Average domestic betas and blended public rating (Moody's, Standard & Poor's) when available, 1990-2001

**MR=Munich Re, SR = Swiss Re, AL = Allianz, PRU = Prudential UK, AEG = Aegon, ML = Merrill Lynch, AS = Allstate, MS = Morgan Stanley, GS = Goldman Sachs, LB = Lehman Brothers, DB = Deutsche Bank, DRB = Dresdner, NBA = National Bank of Australia, COM = Commonwealth Bank of Australia, BHV = Bayerishe Hypo-Vereinsbank, BSCH = Banco Santander Central Hispanoamerica, FB = FleetBoston, BNP = Banque National de Paris, JPM = J. P. Morgan, RBS = Royal Bank of Scotland, BA = Bank of America

Contents

The Asset Value Of The Firm

- N-asset value returns follow Brownian Motion
- Firm assets well approximated by Brownian Motion; match moments
- Take approximation and substitute in CAPM

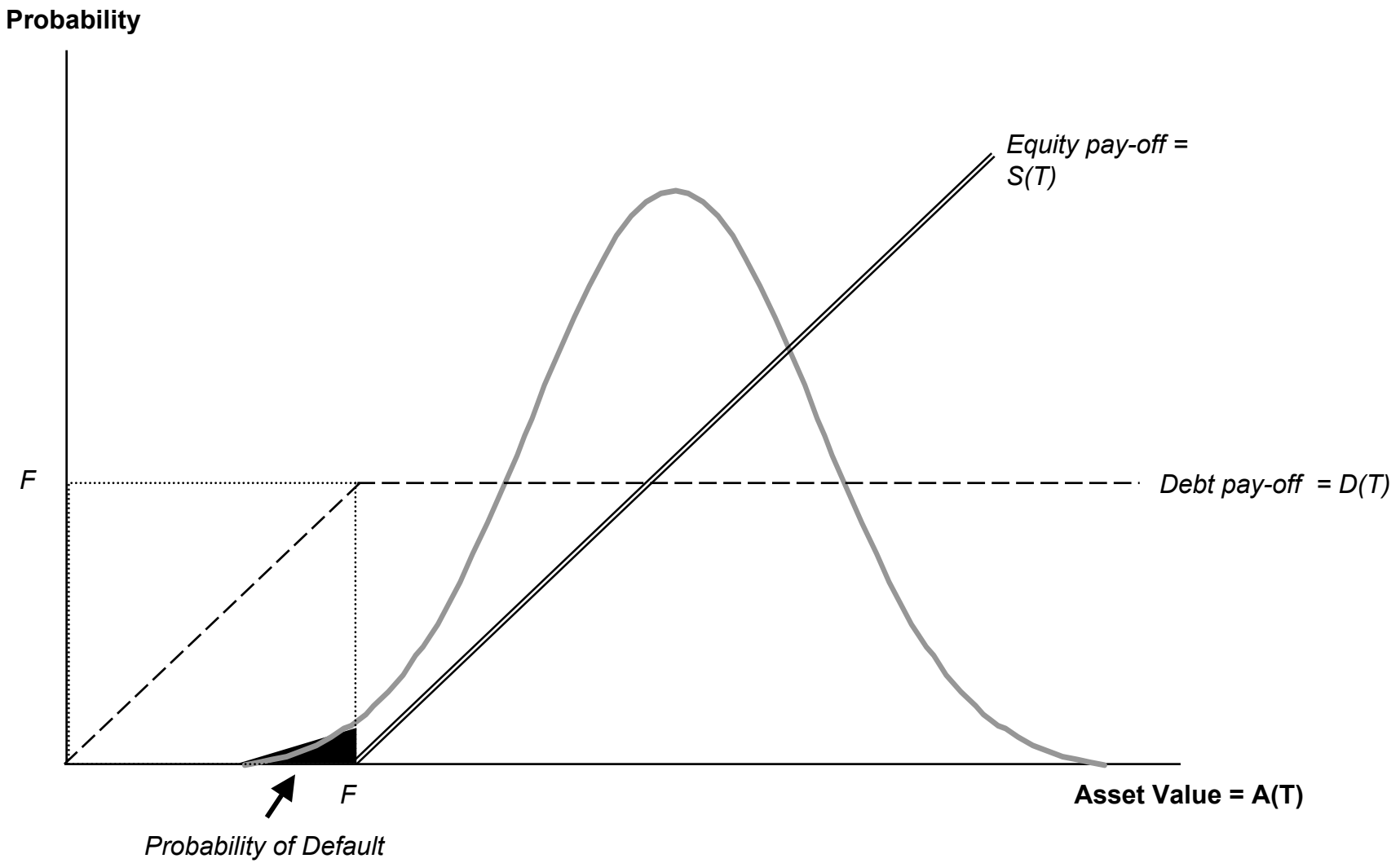


$$A(t) = A(0)\exp[(\mu_A - \frac{\sigma_A^2}{2})t + \sigma_A W_A(t)]$$

$$\mu_A \cong R_f + \sum_{i=1}^{N} \omega_i \beta_i Rp$$

$$\sigma_A^2 \cong \left(\sum_{j=1}^{N} \omega_i \beta_i \right)^2 \sigma_m^2 + \sigma_I^2$$

Capital Structure of the Firm



Cost of Capital of the Firm – Differentiated Cost of Capital

$$\mu_E = \ln\left[\frac{E[S(T)]}{S(0)}\right] = G\left(R_A, \sigma_A^2, p^*\right) = G\left(\beta_A, \sigma_I^2, p^*\right)$$

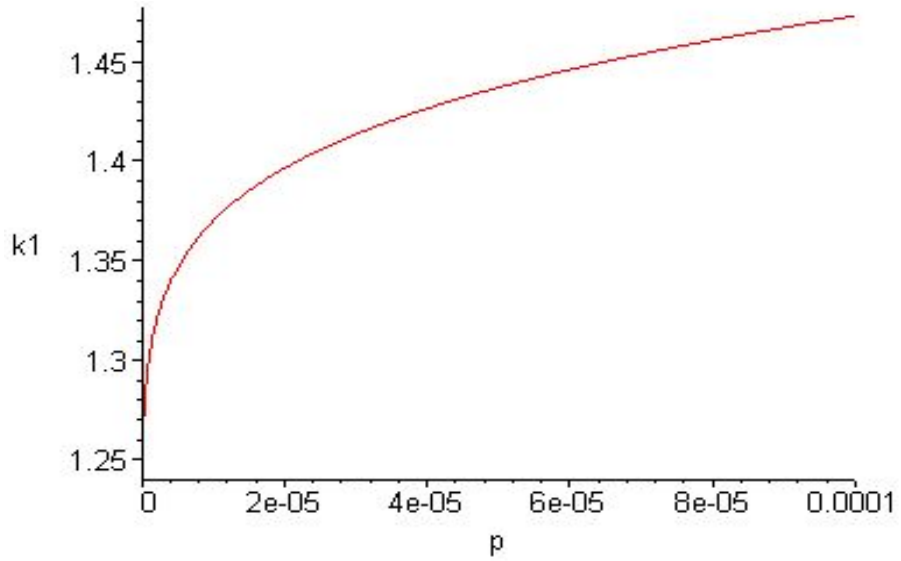
$$G\left(\beta_A, \sigma_I^2 \middle| p^*\right) \cong G\left(\beta, \sigma_i^2 \middle| p^*\right) + \frac{\partial G}{\partial \beta_A}\left(\beta_A - \beta\right) + \frac{\partial G}{\partial \sigma_I^2}\left(\sigma_I^2 - \sigma_i^2\right)$$

$$\beta_E \cong \kappa_1(p^*)\sum_{i=1}^{N}\omega_i\beta_i + \kappa_2(p^*)\sigma_I^2$$

$$\beta_E = \left[\frac{E+D}{E}\left(p^*\right)\right]\sum_{i=1}^{N}\omega_i\beta_i$$

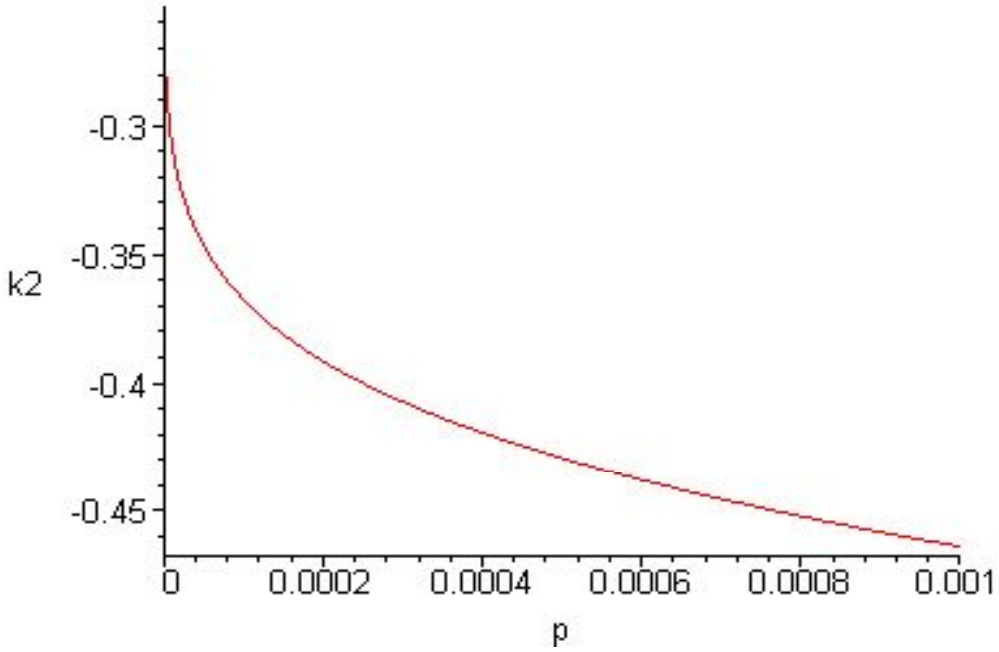
Cost of Capital of the Firm – Leverage Effect

$$\beta_E \cong \kappa_1(p^*)\sum_{i=1}^{N}\omega_i\beta_i + \kappa_2(p^*)\sigma_I^2\infty$$



Cost of Capital of the Firm – Idiosyncratic Risk Premium

$$\beta_E \cong \kappa_1(p^*)\sum_{i=1}^{N}\omega_i\beta_i + \kappa_2(p^*)\sigma_I^2$$



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The Sample

Company	Avg Beta*	Avg 3-yr Cum Pd**	Company	Avg Beta	Avg 3-yr Cum Pd**	Rating	3-yr Cum Pd***
Citigroup	2.19	0.0018	CGNU	1.12	0.0014	AAA	0.0005
AIG	0.98	0.0005	Abbey National	1.01	0.0009	AA+	0.0006
Bank of America	1.76	0.0027	Prudential	1.02	0.0006	AA	0.0009
JPMorgan	1.95	0.0030	Barclays	1.56	0.0009	AA-	0.0014
Wells Fargo	1.05	0.0019	Allianz	0.96	0.0007	A+	0.0023
Morgan Stanley	2.34	0.0027	Munich Re	0.86	0.0005	A	0.0036
American Express	1.67	0.0022	Deutsche Bank	0.94	0.0006	A-	0.0051
Merrill Lynch	2.48	0.0015	Bayer Hypo	0.93	0.0012	BBB+	0.0073
US Bancorp	0.79	0.0048	Dresdner	1.01	0.0009	BBB	0.0108
Fleet Boston	1.19	0.0044	BNP	1.56	0.0019		
Bank One	1.29	0.0041	Societe Generale	1.23	0.0013		
Bank of New York	1.45	0.0029	SCOR	0.93	0.0018		
Fifth Third	1.10	0.0014	AXA	1.29	0.0023		
Washington Mutual	1.99	0.0085	Credit Suisse	1.42	0.0015		
Allstate	0.81	0.0029	UBS	1.39	0.0006		
Household	1.59	0.0036	Swiss Re	1.01	0.0005		
Marsh	1.42	0.0014	Zurich Financial	1.36	0.0009		
Mellon	1.37	0.0032	ING	1.25	0.0014		
State Street Corp	1.70	0.0014	Aegon	0.91	0.0011		
Charles Schwab	2.20	0.0057	ABN Amro	1.40	0.0011		
Lehman Brothers	2.99	0.0036	Generali	0.80	0.0014		
Goldman Sachs	3.78	0.0023	Fortis	1.17	0.0023		
HSBC	2.03	0.0029	BBVA	1.22	0.0014		
Royal Bank of Scotland	1.70	0.0018	BSCH	1.25	0.0017		
			National Bank of Australia	0.92	0.0009		
			Commonwealth Bank	0.72	0.0011		

* Average estimate of monthly beta, 1992-2000 as data available
** Average cumulative default probability based on rating, 1992-2000 as data available
*** Cumulative probability of default based on rating

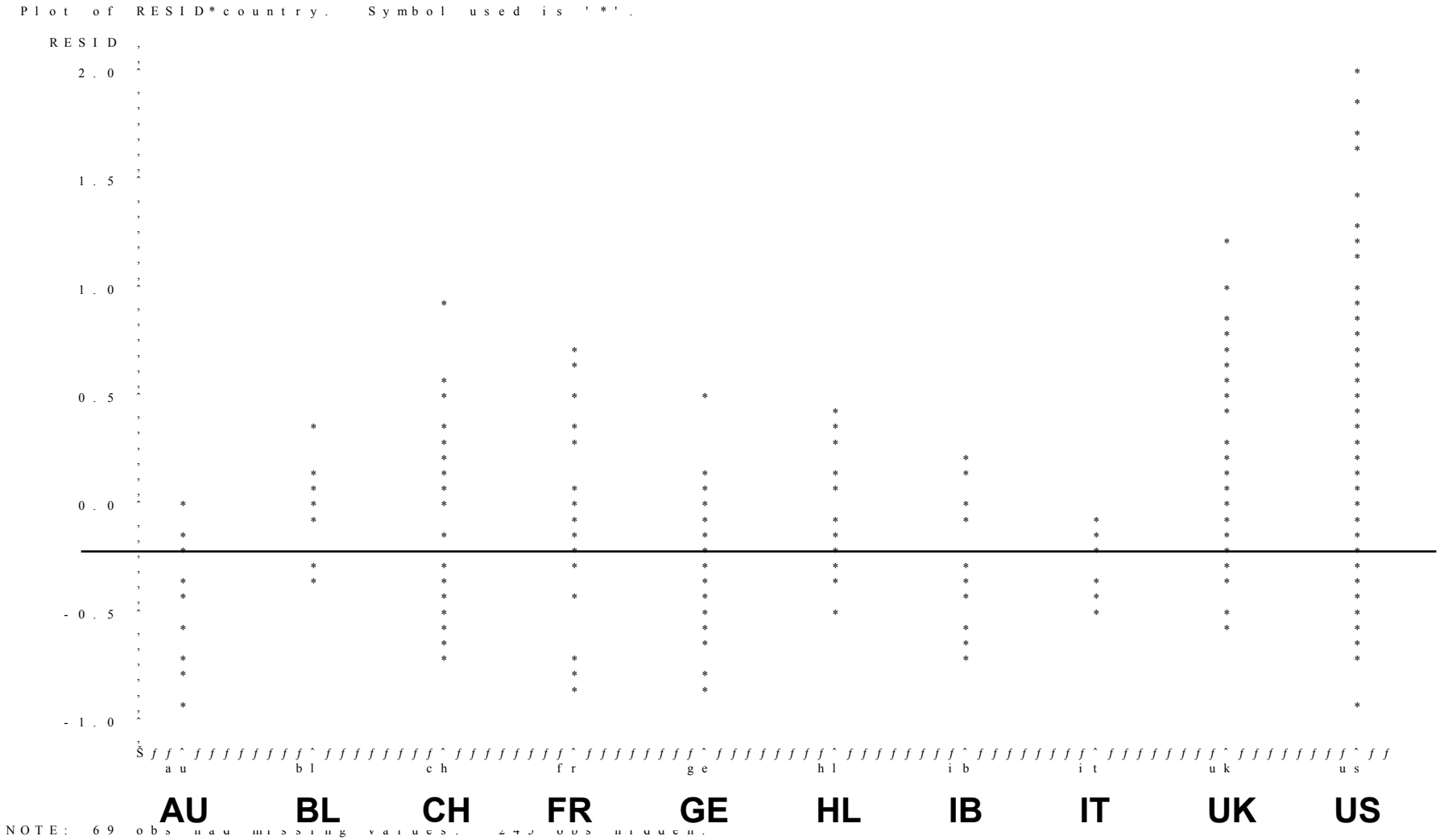
Cost of Capital – Standard Corporate Finance Approach

Model	Equation
1. Standard Approach	$\beta_t^l = \sum_{i=1}^{N} \omega_{i,t}^l \hat{\beta}_i + \varepsilon_t^l$

Parameter estimate (standard error)	Adj-R^2 F-stat	β_1 Comm Bank	β_2 Retail Bank	β_3 Asset Mgmt	β_4 Life Ins	β_5 P&C Ins	β_6 Equity I-Bank	β_6 FI I-Bank
Model 1:	87.9%	1.21**	1.23**	1.67**	0.94**	1.05**	4.34**	1.50*
Standard Approach	466***	(0.14)	(0.09)	(0.11)	(0.09)	(0.12)	(0.85)	(0.70)

* Significant at a > 10% confidence level
** Significant at a > 5% confidence level
*** Significant at a > 1% confidence level

Cost of Capital – Country of Domicile Effect



Cost of Capital – With Country of Domicile Effect

Model	Equation
1. Standard Approach	$\beta_t^l = \sum_{i=1}^{N} \omega_{i,t}^l \hat{\beta}_i + \varepsilon_t^l$
2. Country-of-domicile	$\beta_t^l = \sum_{i=1}^{N} \omega_{i,t}^l \hat{\beta}_i^{(1+k_0 d)} + \varepsilon_t^l$

Parameter estimate (standard error)	Adj-R^2 F-stat	k_0 Eur. Dummy	β_1 Comm Bank	β_2 Retail Bank	β_3 Asset Mgmt	β_4 Life Ins	β_5 P&C Ins	β_6 Equity I-Bank	β_6 FI I-Bank
Model 1: Standard Approach	87.9% 466***		1.21** (0.14)	1.23** (0.09)	1.67** (0.11)	0.94** (0.09)	1.05** (0.12)	4.34** (0.85)	1.50* (0.70)
Model 2: Country of Domicile	88.8% 461***	-0.55*** (0.09)	1.49** (0.16)	1.28** (0.09)	1.79** (0.11)	0.89** (0.12)	1.09** (0.18)	4.56** (0.85)	1.54* (0.68)

* Significant at a > 10% confidence level
** Significant at a > 5% confidence level
*** Significant at a > 1% confidence level

Cost of Capital – With Leverage Effect

Model	Equation
1. Standard Approach	$\beta_t^l = \sum_{i=1}^{N} \omega_{i,t}^l \hat{\beta}_i + \varepsilon_t^l$
2. Country-of-domicile	$\beta_t^l = \sum_{i=1}^{N} \omega_{i,t}^l \hat{\beta}_i^{(1+k_0 d)} + \varepsilon_t^l$
3. Leverage effect	$\beta_t^l = (1 + k_1 p^*) \sum_{i=1}^{N} \omega_{i,t}^l \hat{\beta}_i^{(1+k_0 d)} + \varepsilon_t^l$

Parameter estimate (standard error)	Adj-R^2 F-stat	k_0 Eur. Dummy	k_1 Leverage Effect	β_1 Comm Bank	β_2 Retail Bank	β_3 Asset Mgmt	β_4 Life Ins	β_5 P&C Ins	β_6 Equity I-Bank	β_6 FI I-Bank
Model 1: Standard Approach	87.9% 466***			1.21** (0.14)	1.23** (0.09)	1.67** (0.11)	0.94** (0.09)	1.05** (0.12)	4.34** (0.85)	1.50* (0.70)
Model 2: Country of Domicile	88.8% 461***	-0.55*** (0.09)		1.49** (0.16)	1.28** (0.09)	1.79** (0.11)	0.89** (0.12)	1.09** (0.18)	4.56** (0.85)	1.54* (0.68)
Model 3: Leverage Effect	89.1% 441***	-0.56*** (0.13)	70.2*** (16.4)	1.36** (0.13)	1.02** (0.09)	1.44** (0.11)	0.87** (0.11)	0.93** (0.16)	3.85** (0.93)	1.41* (0.57)

* Significant at a > 10% confidence level
** Significant at a > 5% confidence level
*** Significant at a > 1% confidence level

Cost of Capital – Estimating Idiosyncratic Risk

$$R^2 = \frac{SSR}{SSR + SSE} = \frac{\beta_E^2 \sigma_m^2}{\beta_E^2 \sigma_m^2 + \sigma_I^2} \propto \frac{\left(\sum \omega_i \beta_i\right)^2}{\left(\sum \omega_i \beta_i\right)^2 + \sigma_I^2}$$

$$\beta_t^l = \hat{\kappa}_0 + (1 + \hat{\kappa}_1 p_t^l)\left(\sum_{i=1}^{N} \omega_{i,t}^l \hat{\beta}_i\right) + \hat{\kappa}_2 p_t^l \left(\sum_{j=1}^{N} \omega_i \hat{\beta}_i\right)^2 \left(\frac{1}{\hat{R}_l^2} - 1\right) + \varepsilon_t^l$$

Cost of Capital – The Evidence

Parameter estimate (standard error)	Adj-R^2 F-stat	k_0 Eur. Dummy	k_1 Leverage Effect	k_2 Divers .Effect	β_1 Comm Bank	β_2 Retail Bank	β_3 Asset Mgmt	β_4 Life Ins	β_5 P&C Ins	β_6 Equity I-Bank	β_6 FI I-Bank
Model 1: Standard Approach	87.9% 466***				1.21** (0.14)	1.23** (0.09)	1.67** (0.11)	0.94** (0.09)	1.05** (0.12)	4.34** (0.85)	1.50* (0.70)
Model 2: Country of Domicile	88.8% 461***	-0.55*** (0.09)			1.49** (0.16)	1.28** (0.09)	1.79** (0.11)	0.89** (0.12)	1.09** (0.18)	4.56** (0.85)	1.54* (0.68)
Model 3: Leverage Effect	89.1% 441***	-0.56*** (0.13)	70.2*** (16.4)		1.36** (0.13)	1.02** (0.09)	1.44** (0.11)	0.87** (0.11)	0.93** (0.16)	3.85** (0.93)	1.41* (0.57)
Model 4: Leverage & Diversification	89.1% 409***	-0.63*** (0.12)	89.0*** (17.6)	-4.38** (1.29)	1.46** (0.14)	0.99** (0.09)	1.43** (0.11)	0.84** (0.11)	0.92** (0.17)	3.58** (0.79)	1.62* (0.62)

* Significant at a > 10% confidence level
** Significant at a > 5% confidence level
*** Significant at a > 1% confidence level

Contents

Cost of Capital & P/E Impact – Differentiated Cost of Capital US/UK AA Firm

$$\frac{P}{E} = \frac{(1+g)}{Coc - g}$$

Representative firm	Share	Levered Beta	Cost of Capital	P/E Multiple
Regional bank				
Retail banking	60%	1.05	9.3%	24.60
Commercial banking	40%	1.58	12.2%	14.62
Average	**100%**	**1.26**	**10.4%**	**19.32**
Multiline insurance				
Life insurance	40%	0.90	8.4%	30.56
P&C insurance	40%	0.99	9.0%	26.44
Asset management	20%	1.55	12.0%	14.99
Average	**100%**	**1.07**	**9.4%**	**24.06**
Investment bank				
Asset management	20%	1.55	12.0%	14.99
Equity investment banking	40%	3.90	25.0%	5.26
Fixed income investment banking	40%	1.77	13.3%	12.72
Average	**100%**	**2.58**	**17.7%**	**8.27**
Universal bank				
Retail banking	40%	1.05	9.3%	24.60
Commercial banking	30%	1.58	12.2%	14.62
Asset management	10%	1.55	12.0%	14.99
Equity investment banking	5%	3.90	25.0%	5.26
Fixed income investment banking	15%	1.77	13.3%	12.72
Average	**100%**	**1.51**	**11.8%**	**15.44**
Diversified financial services firm				
Retail banking	25%	1.05	9.3%	24.60
Commercial banking	20%	1.58	12.2%	14.62
Asset management	15%	1.55	12.0%	14.99
Life insurance	15%	0.90	8.4%	30.56
P&C insurance	5%	0.99	9.0%	26.44
Equity investment banking	10%	3.90	25.0%	5.26
Fixed income investment banking	10%	1.77	13.3%	12.72
Average	100%	1.56	12.1%	14.81

* risk free = 3.5%, risk premium = 5.5%, growth = 5%

Cost Of Capital & P/E Impact – Leverage & Country Effect

European

	Beta			P/E Multiple		
Business	**AAA**	**AA-**	**A**	**AAA**	**AA-**	**A**
Retail	1.03	1.11	1.31	25.1	22.7	18.4
Commercial	1.20	1.30	1.52	20.5	18.7	15.2
Asset Mgmt	1.19	1.29	1.51	20.7	18.8	15.4
Life Insurance	0.98	10.5	1.24	27.2	24.5	19.8
P&C Insurance	1.01	1.09	1.29	25.8	23.3	18.9
Equity I-Banking	1.68	1.81	2.13	13.6	12.4	10.3
Fixed Income I-Banking	1.26	1.35	1.59	19.4	17.7	14.5

US/UK

	Beta			P/E Multiple		
Business	**AAA**	**AA-**	**A**	**AAA**	**AA-**	**A**
Retail	1.01	1.09	1.29	25.8	23.3	18.8
Commercial	1.53	1.64	1.94	15.2	13.9	11.5
Asset Mgmt	1.49	1.61	1.90	15.6	14.3	11.8
Life Insurance	0.87	0.94	1.10	32.1	28.8	23.1
P&C Insurance	0.96	1.04	1.22	27.7	25.0	20.2
Equity I-Banking	3.77	4.07	4.78	5.5	5.0	4.2
Fixed Income I-Banking	1.71	1.85	2.17	13.2	12.1	10.0

* Risk Free = 3.5%, risk premium = 5.5%, growth - 4%

Cost Of Capital & P/E Impact – Idiosyncratic Risk

Representative Firm	Levered Beta	Cost of Capital	P/E Multiple	Levered Beta	Cost Capital	P/E Multiple	P/E Diff
Regional Bank	1.26	10.4%	19.32	1.24	10.3%	19.73	2.1%
Multiline Insurance	1.07	9.4%	24.06	1.05	9.3%	24.51	1.9%
Investment Bank	2.58	17.7%	8.27	2.49	17.2%	8.59	3.8%
Universal Bank	1.51	11.8%	15.44	1.48	11.6%	15.81	2.4%
Diversified Fin. Services	1.56	12.1%	14.81	1.53	11.9%	15.17	2.5%

* Risk Free = 3.5%, risk premium = 5.5%, growth - 4%