Risk Premium Results

RISK PREMIUM ANALYSIS: ALPHAS -- FOR AGL AND COMPARABLE COMPANIES REGRESSED AGAINST S&P 500

ALPHA FOR 60 MONTH PERIOD ENDING	ATLANTA GAS LIGHT (ATG)	BAY ST GAS CO	BROOKLYN UN GAS CO	INDIANA ENERGY INC	LACLEDE GAS CO	NORTHWEST NAT GAS CO	PEOPLES ENERGY CORP	WASHINGTON GAS LT CO	PIEDMONT NATURAL GAS CO	AVERAGE FOR GROUP
May-95	-0.003	0.000	0.001	0.007	0.004	0.000	-0.003	0.002	0.004	0.001
Jun-95	-0.003	0.002	0.002	0.009	0.003	0.003	-0.002	0.003	0.005	0.002
Jul-95	-0.003	0.001	0.000	0.005	0.003	0.002	-0.003	0.005	0.002	0.001
Aug-95	-0.002	0.001	0.002	0.006	0.004	0.002	-0.002	0.005	0.002	0.002
Sep-95	-0.003	-0.001	-0.001	0.004	0.003	0.001	-0.003	0.003	0.002	0.001
Oct-95	-0.002	-0.001	-0.001	0.004	0.002	0.001	-0.003	0.003	0.002	0.001
Nov-95	-0.003	-0.001	-0.002	0.001	0.002	0.002	-0.004	0.003	0.001	0.000
Dec-95	-0.002	-0.001	-0.003	0.000	0.002	0.001	-0.005	0.001	0.001	-0.001
Jan-96	-0.001	-0.002	-0.001	-0.001	0.000	0.000	-0.006	0.002	0.000	-0.001
Feb-96	-0.001	-0.002	-0.002	0.000	-0.001	-0.001	-0.006	0.001	0.000	-0.001
Mar-96	-0.003	-0.002	-0.001	0.000	-0.002	0.000	-0.005	0.002	0.002	-0.001
Apr-96	-0.002	-0.001	-0.001	0.000	-0.001	0.002	-0.005	0.002	0.002	-0.001
AV: RECENT 12 MTHS	-0.002	-0.001	-0.001	0.003	0.002	0.001	-0.004	0.003	0.002	0.000

Risk Premium Results

RISK PREMIUM ANALYSIS: T-STATISTICS OF ALPHAS – FOR AGL AND COMPARABLE COMPANIES REGRESSED AGAINST S&P 500

T-STATISTIC OF ALPHA FOR 60 MONTH PERIOD ENDING	ATLANTA GAS LIGHT (ATG)	BAY ST GAS CO	BROOKLYN UN GAS CO	INDIANA ENERGY INC	LACLEDE GAS CO	NORTHWEST NAT GAS CO	PEOPLES ENERGY CORP	WASHINGTON GAS LT CO	PIEDMONT NATURAL GAS CO	AVERAGE FOR GROUP
May-96	-0.452	-0.034	0.131	0.905	0.697	0.083	-0.447	0.337	0.577	0.200
Jun-96	-0.408	0.308	0.289	1.180	0.615	0.488	-0.324	0.508	0.705	0.373
Jul-96	-0.410	0.156	0.032	0.645	0.632	0.324	-0.486	0.822	0.335	0.228
Aug-96	-0.323	0.154	0.258	0.702	0.785	0.322	-0.287	0.902	0.302	0.313
Sep-96	-0.453	-0.118	-0.100	0.447	0.620	0.172	-0.381	0.466	0.346	0.111
Oct-96	-0.355	-0.111	-0.206	0.531	0.428	0.189	-0.437	0.473	0.360	0.097
Nov-96	-0.399	-0.098	-0.360	0.068	0.407	0.398	-0.497	0.439	0.215	0.019
Dec-96	-0.358	-0.216	-0.500	0.063	0.421	0.181	-0.717	0.152	0.082	-0.099
Jan-97	-0.191	-0.333	-0.207	-0.141	-0.050	-0.074	-0.822	0.270	0.067	-0.164
Feb-97	-0.189	-0.368	-0.310	0.036	-0.098	-0.165	-0.738	0.171	0.014	-0.183
Mar-97	-0.378	-0.290	-0.208	-0.040	-0.293	0.076	-0.659	0.309	0.313	-0.130
Apr-97	-0.344	-0.189	-0.229	-0.059	-0.269	0.278	-0.685	0.267	0.333	-0.100
AV: RECENT 12 MTHS	-0.355	-0.095	-0.117	0.361	0.325	0.189	-0.540	0.426	0.304	0.055

Risk Premium Suggested Rate Of Return

COMPANY	Debt Yield (a)	Beta (b)	Market Risk Premium = 10.7% - 3.7% (c)	Company Risk Premium (d)=(b)X(c)	Company Equity Cost (e)=(a)+(d)
AGL RESOURCES INC (HLDG CO)	7.95%	0.520	6.97%	3.62%	11.57%
BAY ST GAS CO	7.95%	0.420	6.97%	2.93%	10.88%
BROOKLYN UN GAS CO	7.95%	0.677	6.97%	4.72%	12.67%
INDIANA ENERGY INC	7.95%	0.333	6.97%	2.32%	10.27%
LACLEDE GAS CO	7.95%	0.283	6.97%	1.98%	9.92%
NORTHWEST NAT GAS CO	7.95%	0.241	6.97%	1.68%	9.63%
PEOPLES ENERGY CORP	7.95%	0.848	6.97%	5.91%	13.86%
WASHINGTON GAS LT CO	7.95%	0.368	6.97%	2.57%	10.51%
PIEDMONT NATURAL GAS CO	7.95%	0.434	6.97%	3.02%	10.97%
** Av of Comparable Cos.	7.95%	0.458	6.97%	0.032	11.14%

**Average Includes All Betas for All Companies Because the Average T-Statistics Are Greater Than 1. T-Statistics Are Shown In The Prior Schedule

Risk Premium Suggested Rate Of Return	11.14%

Any Model Relying on Ibbotson's Data Uses Monthly Compounding

Ibbotson's Annual Returns Are Based on Monthly Compounding

ROW	Month	Monthly Return	Monthly Return Relative to the Value "1"	Cumulative Return in the Year Relative to the Value "1"	Cumulative Return in the Year
	(1)	(2)*	(3)	(4)	(5)
				col (3) x prior entry in col (3)	
-	-	-	100.00%		
1	1/1/96	3.44%	103.44%	103.44%	3.44%
2	2/1/96	0.96%	100.96%	104.43%	4.43%
3	3/1/96	0.96%	100.96%	105.44%	5.44%
4	4/1/96	1.47%	101.47%	106.99%	6.99%
5	5/1/96	2.58%	102.58%	109.75%	9.75%
6	6/1/96	0.41%	100.41%	110.20%	10.20%
7	7/1/96	-4.45%	95.55%	105.29%	5.29%
8	8/1/96	2.12%	102.12%	107.52%	7.52%
9	9/1/96	5.62%	105.62%	113.57%	13.57%
10	10/1/96	2.74%	102.74%	116.68%	16.68%
11	11/1/96	7.59%	107.59%	125.53%	25.53%
12	12/1/96	-1.96%	98.04%	123.07%	23.07%

*Source: Ibbotson Associates 1997 Yearbook: Page 181, Table A-1 for 1996

CHATTANOOGA GAS COMPANY

Office of the Consumer Advocate Interrogatory/Data Request - June 4, 1997

Item 42

42. Q. With regard to Exhibit 5 Schedule 9 of the company's filing, show the calculations and provide the data used to develop the figures shown under the column headings "Amount", "Ratio" and "Cost".

A. See attached documentation.

AGL Resources
Projected Capitalization Ratios

	1997	1998	Average	Ratio
Short Term Debt	69,620	81,537	75,579	5.28%
Long Term Debt	659,500	659,500	659,500	46.07%
Preferred Stock	58,469	70,090	64,280	4.49%
Common Stock Equity	619,302	644,902	632,102	44.16%
	1,406,891	1,456,029	1,431,461	100.00%

Chattanooga Gas Company
Test Year Projected Capitalization

	Ratio	Amount
Short Term Debt	5.28%	5,060,518
Long Term Debt	46.07%	44,154,936
Preferred Stock	4.49%	4,303,357
Common Stock Equity	44.16%	42,324,333
	100.00%	95,843,144

AGL Resources
Projected Cost of Capital Components

Long Term Debt	
Projected Balance	659,500,000
Less: Unamortized Loss on Repurchase	1,585,136
Less: Unamortized Debt Discount & Expense	3,702,500
Net Projected Balance	654,212,364
Projected Interest Cost	50,730,000
Projected Cost Rate	7.75%
Short Term Debt	
Projected Average Monthly Balance	49,900,000
Projected Interest Cost	2,892,000
Projected Cost Rate	5.80%
Preferred Stock	
Projected Balance	64,280,000
Projected Dividend Accrual	4,525,000
Projected Cost Rate	7.04%
Common Stock Equity	
Projected Cost Rate	
See Cost of Equity Testimony & Exhibits	12.25%

Recommended Over All Return

		Ratio	Cost	Weighted Cost
1	Short-Term Debt	5.28%	5.80%	0.31%
2	Long-Term Debt	46.07%	7.75%	3.57%
3	Preferred Stock	4.49%	7.04%	0.32%
4	Common Equity	44.16%	10.55%	4.66%
5	Total	100.00%		8.85%

Data on Mutual Funds Specializing in Small Company Stocks; 5-31-97

Company name	Objective	Ticker	Minimum Initial Purchase	Return on Assets %	96 Rtrn %
Standish Small Cap Equity	Small Company	SDSCX	$Closed	9.51	17.36
T. Rowe Price Small-Cap Val	Small Company	PRSVX	$Closed	10.36	24.61
MAS Small Cap Value	Small Company	MPSCX	$Closed	9.47	35.15
Montgomery Small Cap R	Small Company	MNSCX	$Closed	12.11	18.69
MFS Aggr Small Cap Eq A	Small Company	MASCX	$Closed	14.24	15.45
Artisan Small Cap	Small Company	ARTSX	$Closed	10.68	11.86
Pioneer Small Company A	Small Company	PSCFX	$Closed	5.07	24.15
Pioneer Small Company B	Small Company	PBSCX	$Closed	5.07	23.21
Pioneer Small Company C	Small Company	PCSCX	$Closed	5.07	n/a
PIMCo Small Cap Growth Instl	Small Company	PSCIX	$Closed	11.07	16.83
GMO Small Cap Value III	Growth	GMSVX	$35,000,000	0	20.16
UAM ICM Small Company	Small Company	ICSCX	$5,000,000	8.89	23.01
Benchmark Small Co Index A	Small Company	BSCAX	$5,000,000	9.37	15.97
Bear Stearns Small Cap Val Y	Small Company	BSVYX	$2,500,000	7.57	15.87
DFA United Kingdom Small Co	Europe Stock	DFUKX	$2,000,000	19.98	29.81
DFA U.S. Small Cap Value	Small Company	DFSVX	$2,000,000	7.01	22.33
DFA Japanese Small Company	Pacific Stock	DFJSX	$2,000,000	4.35	-22.78
DFA Pacific Rim Small Compny	Pacific Stock	DFRSX	$2,000,000	25.72	14.36
DFA Continental Small Compny	Europe Stock	DFCSX	$2,000,000	14.28	14.32
DFA U.S. 6-10 Small Company	Small Company	DFSTX	$2,000,000	9.11	17.68
DFA U.S. 9-10 Small Company	Small Company	DFSCX	$2,000,000	8.75	17.65
DFA Intl Small Cap Value	Foreign Stock	DISVX	$2,000,000	10.57	0.95
Lazard Small Cap Instl	Small Company	LZSCX	$1,000,000	8.3	23.93
JPM Instl U.S. Small Company	Small Company	JUSSX	$1,000,000	9.6	20.84
Crabbe Huson Small Cap Instl	Small Company	CHISX	$1,000,000	3.97	n/a
Lazard Intl Small Cap Instl	Foreign Stock	LZISX	$1,000,000	16.2	15.65
ITT Hartford Small Company Y	Small Company	n/a	$1,000,000	0	n/a
Enterprise Small Co Value Y	Small Company	EIGYX	$1,000,000	7.81	11.83
Munder Small Company Grth Y	Small Company	MULYX	$500,000	11.25	37.17
Compass Small Cap Grth Instl	Small Company	PSGIX	$500,000	11.64	31.58
Compass Small Cap Val Instl	Small Company	PNSEX	$500,000	8.25	19.87
Nations Small Cap Gr Prim A	Small Company	PSCPX	$500,000	9.34	20.72
TCW Galileo Small Cap Growth	Small Company	n/a	$250,000	10.8	17.54
Emerald Small Cap Instl	Small Company	EMSCX	$250,000	10.14	10.69
Hancock Small Cap Equity	Small Company	n/a	$250,000	12.49	13.48
PIMCo Small Cap Value Instl	Small Company	PSVIX	$200,000	9.19	27.72
PIMCo Small Cap Value Admin	Small Company	n/a	$200,000	9.19	27.37
PIMCo Small Cap Growth Admin	Small Company	n/a	$200,000	11.41	16.71
JPM Pierpont U.S. Small Co	Small Company	PPCAX	$100,000	9.63	20.75
Parkstone Small Cap Instl	Small Company	PKSCX	$100,000	11.45	27.7

Data on Mutual Funds Specializing in Small Company Stocks; 5-31-97

Company name	Objective	Ticker	Minimum Initial Purchase	Return on Assets %	96 Rtrn %
Standish Small Cap Tax-Sen	Small Company	SDCEX	$100,000	11.06	21.23
Turner Small Cap Equity	Small Company	TSCEX	$100,000	11.24	28.85
Avesta Small Capitalization	Small Company	n/a	$100,000	10.78	30.95
Berger Small Cap Value Inst	Small Company	OMNIX	$100,000	8.28	25.6
Kent Small Co Growth Instl	Small Company	KNEEX	$100,000	8.95	19.61
SEI Instl Small Cap Growth A	Small Company	SSCGX	$100,000	10.96	19.14
SEI Instl Small Cap Growth A	Small Company	SSCGX	$100,000	10.96	19.14
59 Wall St Small Company	Small Company	FNSMX	$100,000	10.42	19.12
SEI Instl Small Cap Value A	Small Company	SESVX	$100,000	8	22.13
DLB Global Small Cap	World Stock	DLBSX	$100,000	15.07	9.85
Pictet Intl Small Companies	Foreign Stock	PTSCX	$100,000	14.65	n/a
Rainier Small/Mid Cap Equity	Growth	RIMSX	$25,000	9.37	22.56
Glenmede Small Cap Equity	Small Company	GTCSX	$25,000	9.33	25.1
Target Small Cap Value	Small Company	TASVX	$25,000	9.17	21.84
Target Small Cap Growth	Small Company	TASGX	$25,000	12.36	18.88
Schroder Small Cap	Small Company	WSCVX	$25,000	8.92	23.91
UAM FMA Small Company	Small Company	FMACX	$25,000	8.52	26.2
Quaker Small-Cap Value	Small Company	n/a	$25,000	0	n/a
Hotchkis & Wiley Small Cap	Small Company	HWSCX	$10,000	9.34	14.27
Longleaf Partners Small-Cap	Small Company	LLSCX	$10,000	8.12	30.64
LKCM Small Cap Equity	Small Company	LKSCX	$10,000	8.61	26.95
LKCM Small Cap Equity	Small Company	LKSCX	$10,000	8.61	26.95
CRM Small Cap Value	Small Company	CRMSX	$10,000	5.46	38.95
RCM Small Cap	Small Company	n/a	$10,000	9.71	34.41
Brazos/JMIC Small Cap Growth	Small Company	BJSCX	$10,000	0	n/a
Stratton Small-Cap Yield	Small Company	STSCX	$5,000	9.7	14.97
Compass Small Cap Grth Svc	Small Company	PCGEX	$5,000	11.64	31.39
Compass Small Cap Val Svc	Small Company	PSESX	$5,000	8.25	19.56
Prudential Small Companies C	Small Company	n/a	$5,000	9.09	22.97
Tocqueville Small Cap Val A	Small Company	TSCVX	$5,000	9.78	25.03
PBHG Strategic Small Co PBHG	Small Company	PSSCX	$5,000	0	n/a
Vanguard Index Small Cap Stk	Small Company	NAESX	$3,000	9.32	18.12
Galaxy II Small Co Index Ret	Small Company	ISCIX	$2,500	10.27	19.66
Vista Small Cap Equity A	Small Company	VSEAX	$2,500	10.4	28.8
Vista Small Cap Equity B	Small Company	VSEBX	$2,500	10.4	27.93
T. Rowe Price Small Cap Stk	Small Company	OTCFX	$2,500	10.41	21.05
Dreyfus Small Company Value	Small Company	DSCVX	$2,500	7.65	34.15
Galaxy Small Co Equity Ret A	Small Company	GASEX	$2,500	11.05	20.84
BT Investment Small Cap	Small Company	BTSCX	$2,500	11.18	6.9
Scudder Small Company Value	Small Company	SCSUX	$2,500	8.61	23.84

Data on Mutual Funds Specializing in Small Company Stocks; 5-31-97

Company name	Objective	Ticker	Minimum Initial Purchase	Return on Assets %	96 Rtrn %
Warburg Pincus Small Val Com	Small Company	WPSVX	$2,500	8.52	56.2
Galaxy Small Cap Value Ret A	Small Company	SSCEX	$2,500	9.21	26.84
Fidelity Small Cap Stock	Small Company	FDSCX	$2,500	11.18	13.63
Northern Small Cap	Small Company	NOSGX	$2,500	6.92	18.93
Strong Small Cap	Small Company	SCAPX	$2,500	10.12	22.7
Fidelity Japan Small Co	Pacific Stock	FJSCX	$2,500	7.67	-24.59
PIC Small Cap Growth	Small Company	PISCX	$2,000	11.78	18.2
Bridgeway Ultra-Small Co	Small Company	BRUSX	$2,000	10.44	29.74
Sit Small Cap Growth	Small Company	SSMGX	$2,000	12.65	14.97
AARP Small Company Stock	Small Company	ASCSX	$2,000	0	n/a
Columbia Small Cap	Small Company	CMSCX	$2,000	9	n/a
FBR Small Cap Financial	Sp.-Financial	n/a	$2,000	8	n/a
FBR Small Cap Growth/Value	Small Company	n/a	$2,000	16.61	n/a
Crabbe Huson Small Cap Prim	Small Company	CHSCX	$2,000	3.97	n/a
Rembrandt Small Cap Inv	Small Company	n/a	$2,000	13.9	19.18
Clover Capital Small Cap Val	Small Company	n/a	$2,000	5.92	n/a
Fremont Intl Small Cap	Foreign Stock	FRISX	$2,000	11.81	12.15
Berger Small Company Growth	Small Company	BESCX	$2,000	11.14	16.77
Federated Small Cap Strat B	Small Company	SMCBX	$1,500	13.04	34.16
Federated Small Cap Strat C	Small Company	SMCCX	$1,500	13.04	33.99
Federated Intl Small Co B	Foreign Stock	ISCBX	$1,500	13.73	n/a
Federated Intl Small Co C	Foreign Stock	ISCCX	$1,500	13.73	n/a
Norwest Advant Small Co Gr I	Small Company	NVSCX	$1,000	8.48	19.82
Colonial Small Cap Value A	Small Company	CSMIX	$1,000	11.02	18.35
Colonial Small Cap Value B	Small Company	CSSBX	$1,000	11.02	17.84
Heritage Small Cap Stock A	Small Company	HRSCX	$1,000	11.71	27.46
Parkstone Small Cap Inv A	Small Company	PKSAX	$1,000	11.45	27.59
Heritage Small Cap Stock C	Small Company	HSCCX	$1,000	11.71	26.45
Parkstone Small Cap Inv C	Small Company	n/a	$1,000	11.45	26.24
Parkstone Small Cap Inv B	Small Company	PKSBX	$1,000	11.45	26.62
Westcore Small-Cap Opport	Small Company	WTSCX	$1,000	8.28	25.58
Goldman Sachs Small Cap Eq A	Small Company	GSSMX	$1,000	6.13	21.84
Goldman Sachs Small Cap Eq B	Small Company	GSQBX	$1,000	6.13	n/a
Gabelli Small Cap Growth	Small Company	GABSX	$1,000	7.54	11.88
Accessor Small to Mid Cap	Small Company	ASMCX	$1,000	11.8	24.74
Munder Small Company Grth A	Small Company	MULAX	$1,000	11.25	36.83
Norwest Advant Small Cap I	Small Company	NVSOX	$1,000	0	n/a
Munder Small Company Grth C	Small Company	n/a	$1,000	11.25	36.23
Munder Small Company Grth B	Small Company	MULBX	$1,000	11.25	35.9
Kemper-Dreman Small Cap A	Small Company	KDSAX	$1,000	8.94	29.6

Data on Mutual Funds Specializing in Small Company Stocks; 5-31-97

Company name	Objective	Ticker	Minimum Initial Purchase	Return on Assets %	96 Rtrn %
ESC Strategic Small Cap A	Small Company	ESCAX	$1,000	9.67	27.43
Kemper-Dreman Small Cap C	Small Company	KDSCX	$1,000	10	29.94
Kemper-Dreman Small Cap B	Small Company	KDSBX	$1,000	8.94	28.54
ESC Strategic Small Cap D	Small Company	ESCDX	$1,000	9.67	26.83
SSgA Small Cap	Small Company	SVSCX	$1,000	11.43	28.79
Bear Stearns Small Cap Val A	Small Company	BSVAX	$1,000	7.57	15.43
Bear Stearns Small Cap Val C	Small Company	BSVCX	$1,000	7.57	14.83
BB&T Small Company Growth A	Small Company	BBBSX	$1,000	11.59	30.77
BB&T Small Company Growth B	Small Company	n/a	$1,000	11.59	30.98
Montgomery Intl Small Cap R	Foreign Stock	MNISX	$1,000	23.45	14.97
Oakmark Small Cap	Small Company	OAKSX	$1,000	8.82	39.79
Kent Small Co Growth Invmt	Small Company	KNEMX	$1,000	8.95	19.15
TCW/DW Small Cap Growth	Small Company	TCSCX	$1,000	11.33	13.71
Invesco European Small Co	Europe Stock	IVECX	$1,000	21.04	31.03
Harris Ins Small-Cap Instl	Small Company	HSCIX	$1,000	10.57	n/a
Harris Ins Small-Cap A	Small Company	n/a	$1,000	10.57	n/a
HSBC Small Cap	Small Company	MSCFX	$1,000	11.9	15.29
Prudential Small Companies A	Small Company	PGOAX	$1,000	9.09	23.92
Schwab Small Cap Index	Small Company	SWSMX	$1,000	9.72	15.49
SEI Instl Small Cap Growth D	Small Company	n/a	$1,000	10.96	18.75
PIMCo Small Cap Value A	Small Company	PCVAX	$1,000	0	n/a
PIMCo Small Cap Value B	Small Company	PCVBX	$1,000	0	n/a
PIMCo Small Cap Value C	Small Company	PCVCX	$1,000	0	n/a
Pegasus Small Cap Opport I	Growth	PSOPX	$1,000	10.56	25.63
Pegasus Small Cap Opport A	Growth	n/a	$1,000	10.56	24.59
Pegasus Small Cap Opport B	Growth	n/a	$1,000	10.56	24.42
Prudential Small Companies B	Small Company	CHNDX	$1,000	9.09	22.97
Evergreen Small Cap Eq Inc Y	Small Company	ESCEX	$1,000	11.29	22.38
Value Line Small-Cap Growth	Small Company	VLSCX	$1,000	11.24	10.35
Evergreen Small Cap Eq Inc A	Small Company	n/a	$1,000	11.29	22.01
Evergreen Small Cap Eq Inc B	Small Company	n/a	$1,000	11.29	21.1
Evergreen Small Cap Eq Inc C	Small Company	n/a	$1,000	11.29	21.1
Norwest Advant Small Co StkA	Small Company	NCSAX	$1,000	12.77	25.98
Norwest Advant Small Co Stkl	Small Company	NSCTX	$1,000	12.77	26.03
Norwest Advant Small Co StkB	Small Company	NCSBX	$1,000	12.77	24.91
Arch Small Cap Equity Inv A	Small Company	EMGRX	$1,000	9.87	10.5
Invesco Small Company Value	Small Company	IDSCX	$1,000	9.18	12.46
Preferred Small Cap	Small Company	PSMCX	$1,000	11.78	20.46
Heartland Small Cap Contrar	Small Company	HRSMX	$1,000	10	18.86
Arch Small Cap Equity Inv B	Small Company	n/a	$1,000	9.87	9.82

Data on Mutual Funds Specializing in Small Company Stocks; 5-31-97

Company name	Objective	Ticker	Minimum Initial Purchase	Return on Assets %	96 Rtrn %
North American Small/Mid A	Growth	NSMAX	$1,000	11.94	n/a
North American Small/Mid C	Growth	NSMCX	$1,000	11.94	n/a
North American Small/Mid B	Growth	NSMBX	$1,000	11.94	n/a
Aetna Small Company Sel	Small Company	AESGX	$1,000	10.1	13.62
Gateway Small Cap Index	Small Company	GSCIX	$1,000	9.13	17.04
Invesco Small Company Growth	Small Company	FIEGX	$1,000	12.21	11.62
Aetna Small Company Adv	Small Company	AESAX	$1,000	10.1	12.79
Safeco Small Co Stock NoLoad	Small Company	SFSCX	$1,000	8.08	n/a
PaineWebber Small Cap A	Small Company	PSCAX	$1,000	10.94	17.16
Eastcliff Regional Small Cap	Small Company	EARSX	$1,000	10.12	n/a
PaineWebber Small Cap B	Small Company	PSCBX	$1,000	10.94	16.2
PaineWebber Small Cap C	Small Company	PSCDX	$1,000	10.94	16.22
AAL Small Cap Stock A	Small Company	AASMX	$1,000	9.21	n/a
ITT Hartford Small Company A	Small Company	IHSAX	$1,000	11.36	n/a
ITT Hartford Small Company B	Small Company	n/a	$1,000	0	n/a
Marshall Small-Cap Growth	Small Company	MRSCX	$1,000	0	n/a
Emerald Small Cap Ret	Small Company	n/a	$1,000	10.14	10.05
Keystone Small Co Grth II A	Small Company	KSGAX	$1,000	10.34	n/a
Keystone Small Co Grth II B	Small Company	KSGBX	$1,000	10.34	n/a
Keystone Small Co Grth II C	Small Company	KSGCX	$1,000	10.34	n/a
Dean Witter Intl Small Cap	Foreign Stock	DWISX	$1,000	21.66	1.01
Keystone Small Co Grth (S-4)	Aggressive Growth	KSFOX	$1,000	12.67	0.82
Enterprise Small Co Value A	Small Company	ENSPX	$1,000	7.81	11.28
Kemper Small Cap Equity A	Small Company	KSCAX	$1,000	10.41	14.09
Enterprise Small Co Value B	Small Company	ESCBX	$1,000	7.81	10.77
Kemper Small Cap Equity B	Small Company	KSCBX	$1,000	10.41	12.84
Kemper Small Cap Equity C	Small Company	KSCCX	$1,000	10.41	12.86
Sentinel Small Company A	Small Company	SAGWX	$1,000	10.49	21.3
Sentinel Small Company B	Small Company	n/a	$1,000	10.49	n/a
SunAmerica Small Co Grth A	Small Company	SEGAX	$500	10.23	14.92
SunAmerica Small Co Grth B	Small Company	SEGBX	$500	10.23	14.12
Compass Small Cap Grth Inv A	Small Company	CSGEX	$500	11.64	31.13
Compass Small Cap Val Inv A	Small Company	PSEIX	$500	8.25	19.34
Phoenix Small Cap A	Small Company	PHSAX	$500	12.38	29.96
Federated Small Cap Strat A	Small Company	SMCAX	$500	13.04	35.04
Qualivest Small Comps Val A	Small Company	QSVAX	$500	9.89	20.07
Phoenix Small Cap B	Small Company	PHSCX	$500	12.38	28.93
Qualivest Small Comps Val C	Small Company	n/a	$500	9.89	19.35
RIMCo Monument Small Cap Eq	Small Company	RISCX	$500	10.1	21.92
Federated Intl Small Co A	Foreign Stock	ISCAX	$500	13.73	n/a

Data on Mutual Funds Specializing in Small Company Stocks; 5-31-97

Company name	Objective	Ticker	Minimum Initial Purchase	Return on Assets %	96 Rtrn %
ONE Fund Small Cap	Small Company	n/a	$500	9.34	17.01
GT Global Amer Small Cap Adv	Small Company	n/a	$500	8.85	14.22
GT Global Amer Small Cap A	Small Company	GTSAX	$500	8.85	13.81
GT Global Amer Small Cap B	Small Company	GTSBX	$500	8.85	13.14
First Omaha Small Cap Value	Small Company	n/a	$500	8.52	n/a
Alger Small Capitalization A	Small Company	n/a	$500	12.59	n/a
Alger Small Capitalization B	Small Company	ALSCX	$500	12.59	4.17
Winthrop Small Company Val A	Small Company	WFAGX	$250	9.6	14.58
Keeley Small Cap Value	Small Company	KSCVX	$250	7.83	25.99
Piper Small Company Growth A	Small Company	PJSCX	$250	9.2	11.65
Franklin Small Cap Grth I	Small Company	FRSGX	$100	10.31	27.07
Franklin Small Cap Grth II	Small Company	FRSIX	$100	10.31	26.07
Templeton Global Small Co I	World Stock	TEMGX	$100	18	22.09
Templeton Global Small Co II	World Stock	TESGX	$100	18	21.35
Munder Small Company Grth K	Small Company	MULKX	$0	11.25	36.89
Landmark Small Cap Equity A	Small Company	LSCEX	$0	9.44	37.8
Alger Small Cap Retirement	Small Company	ALSRX	$0	12.02	14.83
Galaxy Small Co Equity Tr	Small Company	GSETX	$0	11.05	21.59
BB&T Small Company Growth Tr	Small Company	BBCGX	$0	11.59	31.19
DFA U.S. Small Cap Value II	Small Company	DFAVX	$0	7.01	22.07
Warburg Pincus Adv Small Val	Small Company	n/a	$0	8.52	57
Qualivest Small Comps Val Y	Small Company	QSVYX	$0	9.89	20.36
Prudential Small Companies Z	Small Company	PSCZX	$0	9.09	n/a
Pacific Advisors Small Cap	Small Company	PASMX	$0	10.89	43.7
Galaxy Small Cap Value Tr	Small Company	SMCEX	$0	9.21	27.19
Arch Small Cap Equity Tr	Small Company	n/a	$0	9.87	10.98
Arch Small Cap Equity Instl	Small Company	n/a	$0	9.87	10.62
Rembrandt Small Cap Tr	Small Company	RSMCX	$0	13.9	19.42
SEI Instl Inv Small Cap	Small Company	n/a	$0	9.56	n/a
Kemper Small Cap Equity I	Small Company	n/a	$0	10.41	14.54
Brown Capital Small Co Instl	Small Company			10.44	

Morning Star Report on DFA 9-10 Fund

DFA U.S. 9-10 Small Company
(Data as of 05-31-97)

Investment Objective	Rating	Load	Yield	Assets ($mil)	NAV
Small Company	**	None	0.21%	1107.8	11.65

DFA U.S. 9-10 Small Company Portfolio seeks long-term capital appreciation.

The fund invests in a diverse group of small companies with readily marketable securities. These companies may be traded on the NYSE, the AMEX, or the over-the-counter market, but their market capitalizations must be comparable with those in the smallest quintile of the NYSE. The portfolio is rebalanced at least semiannually.

The fund is designed primarily for institutional investors. Prior to April 10, 1989, the fund was named DFA Investment Dimensions Small Company. Prior to 1983, the fund was named DFA Small Company.

Performance: Annual Return %

	YTD	1996	1995	1994	1993
DFA U.S. 9-10 Small Company	4.02	17.65	34.48	3.09	20.97
S&P 500 Index	15.43	22.95	37.53	1.32	10.06

These Figures Match DFA's and Dr. Andrews' Numbers in his Schedule 6, page 1, Far-left Column.

Performance: Trailing Return %

	1 Mo	3 Mo	1 Yr	3 Yr Avg	5 Yr Avg
DFA U.S. 9-10 Small Company	10.22	1.92	-1.33	18.60	18.41
S&P 500 Index	6.08	7.80	29.40	25.92	18.36

Risk Measures

Morningstar Risk: Above Avg. Beta (3 Yr): 0.78

Morning Star Report on DFA 9-10 Fund

Morningstar Return: Average Std. Deviation (3 Yr): 16.59
R-Squared: 32

Top Ten Portfolio Holdings
(Data as of 02-28-97)

Ticker	Amount 000	Security	Value $000	% Net Assets
KUH	186	Kuhlman	4380	0.38
GLE	117	Gleason	4187	0.36
INVX	179	Innovex	3844	0.33
FRC	157	First Republic Bancorp	3654	0.32
ROG	128	Rogers	3459	0.30
HEI	133	HEICO	3430	0.30
CULP	179	Culp	3214	0.28
CDSI	105	Computer Data Systems	3193	0.28
ELMG	142	Electromagnetic Sciences	3173	0.27
APR	160	American Precision Inds	3027	0.26

Portfolio Statistics

Price/Earnings Ratio: 21.64 Income Ratio %: 0.22
Price/Book Ratio: 2.80 Turnover Ratio %: 23.68
Return on Assets %: 8.75 Expense Ratio %: 0.61
Median Market Cap ($mil): 123.29

These figures are the same as those reported in DFA's 1996 Annual Report

This figure, 8.75%, is not provided in DFA's Annual Report. See Schedule 22, page 2.

Expenses and Fees

Front-End Load: 0.00 12b-1 Fee: 0.00
Deferred Sales Charge: 0.00 Management Fee: 0.50
Redemption Fee: 0.00

Operations

Ticker Symbol: DFSCX

Morning Star Report on DFA 9-10 Fund

Fund Family: DFA Investment Dimensions Group
Address: 1299 Ocean Avenue 11th Floor
Santa Monica, CA 90401
Telephone: 310-395-8005

Fund Manager: Management Team
Manager Tenure: NA years
Min. Initial Purchase: $2000000

Docket No. 97-00982
Exhibit CA-SNB____
Direct Testimony___
Schedule 22_____
Page 1 of 2____

DFA Investment Dimensions Group Inc.
and
The DFA Investment Trust Company

ANNUAL REPORT

Year Ended November 30, 1996

DFA INVESTMENT DIMENSIONS GROUP INC.

FINANCIAL HIGHLIGHTS

for a share outstanding throughout each year

	The U.S. 9-10 Small Company Portfolio									
	Year Ended Nov. 30, 1996	Year Ended Nov. 30, 1995	Year Ended Nov. 30, 1994	Year Ended Nov. 30, 1993	Year Ended Nov. 30, 1992	Year Ended Nov. 30, 1991	Year Ended Nov. 30, 1990	Year Ended Nov. 30, 1989	Year Ended Nov. 30, 1988	Year Ended Nov. 30, 1987
Net Asset Value, Beginning of Period	$ 11.03	$ 8.49	$ 8.69	$ 7.75	$ 6.33	$ 5.34	$ 7.74	$ 7.66	$ 7.50	$ 8.94
Income From Investment Operations										
Net Investment Income	0.03	0.05	0.01	0.03	0.04	0.04	0.07	0.07	0.10	0.09
Net Gain (Losses) on Securities (Realized and Unrealized)	1.85	2.61	0.40	1.67	1.53	1.64	(1.77)	0.98	1.48	(1.53)
Total From Investment Operations	1.88	2.66	0.41	1.70	1.57	1.68	(1.70)	1.05	1.58	(1.44)
Less Distributions										
Net Investment Income	(0.01)	(0.04)	(0.03)	(0.05)	(0.05)	(0.07)	(0.08)	(0.09)	(0.11)	—
Net Realized Gains	(0.76)	(0.08)	(0.58)	(0.71)	(0.10)	(0.62)	(0.62)	(0.88)	(1.31)	—
Total Distributions	(0.77)	(0.12)	(0.61)	(0.76)	(0.15)	(0.69)	(0.70)	(0.97)	(1.42)	—
Net Asset Value, End of Period	$ 12.14	$ 11.03	$ 8.49	$ 8.69	$ 7.75	$ 6.33	$ 5.34	$ 7.74	$ 7.66	$ 7.50
Total Return	18.05%	31.37%	5.06%	23.91%	25.24%	39.08%	(24.09)%	16.09%	24.36%	(16.04)%
Net Assets, End of Period (thousands)	$1,181,804	$925,474	$659,221	$630,918	$651,313	$722,289	$561,102	$949,291	$912,518	$788,821
Ratio of Expenses to Average Net Assets	0.61%	0.62%	0.65%	0.70%	0.68%	0.64%	0.62%	0.62%	0.62%	0.61%
Ratio of Net Investment Income to Average Net Assets	0.22%	0.45%	0.16%	0.26%	0.53%	0.75%	0.99%	0.86%	1.19%	0.92%
Portfolio Turnover Rate	23.68%	24.65%	16.56%	9.87%	9.72%	10.13%	3.79%	7.86%	25.98%	23.05%
Average Commission Rate (1)	$ 0.0604	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

(1) Computed by dividing the total amount of brokerage commissions paid by the total shares of investment securities purchased and sold during the period for which commissions were charged, as required by the SEC for fiscal years beginning after September 1, 1995.

See accompanying Notes to Financial Statements

DFA INVESTMENT DIMENSIONS GR(

1299 Ocean Avenue, 11th Floor, Santa Monica, California 90401
Telephone: (310) 395-8005

STATEMENT OF ADDITIONAL INFORMATION

March 28, 1997

DFA Investment Dimensions Group Inc. (the "Fund") offers thirty series of shares. This statement of additional information relates to twenty-four of those series (collectively, the "Portfolios"):

U.S. 9-10 Small Company Portfolio
U.S. 6-10 Small Company Portfolio
Enhanced U.S. Large Company Portfolio
U.S. Small Cap Value Portfolio
U.S. Large Cap Value Portfolio
DFA Real Estate Securities Portfolio
Japanese Small Company Portfolio
Pacific Rim Small Company Portfolio
United Kingdom Small Company Portfolio
Emerging Markets Portfolio
Emerging Markets Small Cap Portfolio
DFA Intermediate Government Fixed Income Portfolio
Continental Small Company Portfolio
Large Cap International Portfolio
U.S. Large Company Portfolio
DFA International Small Cap Value Portfolio
International Small Company Portfolio
DFA One-Year Fixed Income Portfolio
DFA Two-Year Corporate Fixed Income Portfolio
DFA Two-Year Global Fixed Income Portfolio
DFA Two-Year Government Portfolio
DFA Five-Year Government Portfolio
DFA Global Fixed Income Portfolio
RWB/DFA International High Book to Market Portfolio

This statement of additional information is not a prospectus but should be read in conjunction with the Portfolios' prospectus dated March 28, 1997, as amended from time to time, which can be obtained from the Fund by writing to the Fund at the above address or by calling the above telephone number.

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from the Series to satisfy the Portfolio's redemption request. Any such redemption t the Portfolio would be in accordance with Rule 18f-1 under the Investment Cor Investors may incur brokerage charges and other transaction costs selling securities t payment of redemptions. The International Equity, DFA Two-Year Global Fixed In... Global Fixed Income Portfolios reserve the right to redeem their shares in the currencies in which their investments (and, in respect of the Feeder Portfolios and International Small Company Portfolio, the currencies in which the corresponding Series' investments) are denominated. Investors may incur charges in converting such securities to dollars and the value of the securities may be affected by currency exchange fluctuations.

Shareholders may transfer shares of any Portfolio to another person by making a written request therefore to the Advisor who will transmit the request to the Fund's Transfer Agent. The request should clearly identify the account and number of shares to be transferred, and include the signature of all registered owners and all stock certificates, if any, which are subject to the transfer. The signature on the letter of request, the stock certificate or any stock power must be guaranteed in the same manner as described in the prospectus under "REDEMPTION OF SHARES." As with redemptions, the written request must be received in good order before any transfer can be made.

CALCULATION OF PERFORMANCE DATA

Following are quotations of the annualized percentage total returns for the one-, five-, and ten-year periods ended November 30, 1996 (as applicable) using the standardized method of calculation required by the SEC, which is net of the cost of any current reimbursement fees charged to investors and paid to the Portfolios. Also included is a quotation of the annualized percentage total return for the DFA Two-Year Global Fixed Income Portfolio (for the period from February 9, 1996, the date of commencement of operations), the Enhanced U.S. Large Company Portfolio (for the period from July 3, 1996, the date of commencement of operations) and the International Small Company Portfolio (for the period from October 1, 1996, the date of commencement of operations) to November 30, 1996 using the standardized method of calculation required by the SEC. Reimbursement fees of 1%, 1.5% and 1.5% were in effect from the inception of the Japanese, United Kingdom and Continental Small Company Portfolios, respectively, until June 30, 1995. A reimbursement fee of 1% was in effect from the inception of DFA International Small Cap Value Portfolio until June 30, 1995. Effective June 30, 1995, the amount of the reimbursement fee was reduced with respect to Continental Small Company, Pacific Rim Small Company, Japanese Small Company, Emerging Markets and DFA International Small Cap Value Portfolios, and eliminated with respect to the United Kingdom Small Company Portfolio. The current reimbursement fee for each Portfolio, expressed as a percentage of the net asset value of the shares of the Portfolios, is as follows: Continental Small Company, Pacific Rim Small Company and Emerging Markets Small Cap Portfolios - 1.00%; Japanese Small Company and Emerging Markets Portfolios - .50%; DFA International Small Cap Value Portfolio - .70%; and International Small Company Portfolio - .70%.

A reimbursement fee of 1% was charged to investors in The U.S. 9-10 Small Company Portfolio from December 9, 1986 through June 17, 1988. A reimbursement fee of 0.75% was charged to investors in The Large Cap International Portfolio from the date of its inception until March 5, 1992. In addition, for those Portfolios in effect for less than one, five, or ten years, the time periods during which the Portfolios have been active have been substituted for the periods stated (which in no case extends prior to the effective dates of the Portfolios' registration statements).

	One Year	Five Years	Ten Years
U.S. 9-10 Small Company Portfolio	18.03	20.38	12.35
U.S. 6-10 Small Company Portfolio	18.73	57 Months 13.42	n/a
U.S. Large Company Portfolio	27.48	17.88	71 Months 17.97

U.S. Small Cap Value Portfolio	21.77		
U.S. Large Cap Value Portfolio	22.26	46 Months 16.04	n/a
Enhanced U.S. Large Company Portfolio	4 Months 73.24	n/a	n/a
DFA Real Estate Securities Portfolio	28.24	47 Months 9.63	n/a
Japanese Small Company Portfolio	-6.74	-1.07	8.58
Pacific Rim Small Company Portfolio	17.87	47 Months 18.01	n/a
United Kingdom Small Company Portfolio	26.74	10.30	10.73
Emerging Markets Portfolio	12.61	31 Months 5.89	n/a
Continental Small Company Portfolio	12.83	5.39	103.5 Months 8.31
Large Cap International Portfolio	12.68	64 Months 8.27	n/a
RWB/DFA International High Book to Market Portfolio	14.60	42 Months 10.62	n/a
DFA One-Year Fixed Income Portfolio	5.91	5.28	6.70
DFA Five-Year Government Portfolio	7.54	6.25	114 Months 7.79
DFA Global Fixed Income Portfolio	11.13	8.40	72 Months 8.83
DFA Intermediate Government Fixed Income Portfolio	4.98	7.89	73 Months 9.37
DFA International Small Cap Value Portfolio	7.24	23 Months 2.08	n/a
DFA Two-Year Global Fixed Income Portfolio	10 Months 7.14	n/a	n/a
International Small Company Portfolio	2 Months -0.40	n/a	n/a

As the following formula indicates, the average annual total return is determined by finding the average annual compounded rates of return over the stated time period that would equate a hypothetical initial purchase order of $1,000 to its redeemable value (including capital appreciation/depreciation and dividends and distributions paid and reinvested less any fees charged to a shareholder account) at the end

of the stated time period. The calculation assumes that all dividends and distributions are reinvested at the public offering price on the reinvestment dates during the period. The quotation assumes the account was completely redeemed at the end of each period and the deduction of all applicable charges and fees. According to the SEC formula:

$$P(1 + T)^n = ERV$$

where:

P = a hypothetical initial payment of $1,000

T = average annual total return

n = number of years

ERV = ending redeemable value of a hypothetical $1,000 payment made at the beginning of the one-, five-, and ten-year periods at the end of the one-, five-, and ten-year periods (or fractional portion thereof).

Following are quotations of the annualized total returns for the one-, five-, and ten-year periods ended November 30, 1996 (as applicable) using a non-standardized method of calculation which is used in communicating performance data in addition to the standardized method required by the SEC. Also included is a quotation of the annualized percentage total return for the DFA Two-Year Global Fixed Income Portfolio (for the period from February 9, 1996, the date of commencement of operations), the Enhanced U.S. Large Company Portfolio (for the period from July 3, 1996, the date of commencement of operations) and the International Small Company Portfolio (for the period from October 1, 1996, the date of commencement of operations) to November 30, 1996 using a non-standardized method of calculation. The non-standardized quotations differ from the standardized in that they are calculated without deduction of any reimbursement fees charged to investors and paid to the Portfolios which would otherwise reduce return quotations for the Portfolios with such fees. Additionally, the non-standardized quotations are presented over time periods which extend prior to the initial investment in the Portfolios (except for The Continental Small Company (and Large Cap International) Portfolios) by using simulated data for the investment strategies of the Portfolios for that portion of the period prior to the initial investment dates. The simulated data excludes the deduction of Portfolio expenses which would otherwise reduce the returns quotations. Non-standardized quotations are also presented for the United Kingdom and Japanese Small Company Portfolios calculated assuming the local currencies of the corresponding Series are invested and redeemed at the beginning and ending dates of the period. The local currency calculations ignore the effect of foreign exchange rates on the investment and only express the returns of the underlying securities of the Series.

	Effective Date/ Initial Investment	One Year	Five Years	Ten Years
U.S. 9-10 Small Company Portfolio	12/22/81 12/22/81	18.03	20.38	12.46
U.S. 6-10 Small Company Portfolio	03/06/92 03/20/92	18.73	17.00	11.57
U.S. Large Company Portfolio	02/26/90 12/31/90	27.48	17.88	15.02
U.S. Small Cap Value Portfolio	09/18/92 03/01/93	21.77	22.14	14.88
U.S. Large Cap Value Portfolio	09/18/92 02/18/93	22.26	20.47	15.32

...tures and forward contracts is generally governed by Section 1256 of the Code. ...positions generally include listed options on debt securities, options on broad-based ...on futures contracts, regulated futures contracts and certain foreign currency contracts and options thereon.

Absent a tax election to the contrary, each such Section 1256 position held by a Portfolio or Series will be marked-to-market (i.e., treated as if it were sold for fair market value) on the last business day of a Portfolio's or Series' fiscal year, and all gain or loss associated with fiscal year transactions and marked-to-market positions at fiscal year end (except certain currency gain or loss covered by Section 988 of the Code) will generally be treated as 60% long-term capital gain or loss and 40% short-term capital gain or loss. The effect of Section 1256 marked-to-market rules may be to accelerate income or to convert what otherwise would have been long-term capital gains into short-term capital gains or short-term capital losses into long-term capital losses within a Portfolio or Series. The acceleration of income on Section 1256 positions may require a Portfolio or Series to accrue taxable income without the corresponding receipt of cash. In order to generate cash to satisfy the distribution requirements of the Code, a Portfolio or Series may be required to dispose of portfolio securities that it otherwise would have continued to hold or to use cash flows from other sources such as the sale of a Portfolio's or Series' shares. In these ways, any or all of these rules may affect both the amount, character and timing of income distributed to shareholders by a Portfolio.

When a Portfolio (or in the case of a Feeder Portfolio, the corresponding Series) holds an option or contract which substantially diminishes a Portfolio's or Series' risk of loss with respect to another position of a Portfolio or Series (as might occur in some hedging transactions), this combination of positions could be treated as a "straddle" for tax purposes, resulting in possible deferral of losses, adjustments in the holding periods of a Portfolio's or Series' securities and conversion of short-term capital losses into long-term capital losses. Certain tax elections exist for mixed straddles (i.e., straddles comprised of at least one Section 1256 position and at least one non-Section 1256 position) which may reduce or eliminate the operation of these straddle rules.

The Portfolios and those Series taxable as regulated investment companies are also subject to the requirement that less than 30% of their annual gross income be derived from the sale or other disposition of securities and certain other investments held for less than three months ("short-short income"). This requirement may limit a Portfolio's (or in the case of a Feeder Portfolio, the corresponding Series') ability to engage in options, straddles, hedging transactions and forward or futures contracts because these transactions are often consummated in less than three months, may require the sale of portfolio securities held less than three months and may, as in the case of short sales of portfolio securities, reduce the holding periods of certain securities within a Portfolio or Series, resulting in additional short-short income for a Portfolio or Series.

A Portfolio (or in the case of a Feeder Portfolio, the corresponding Series) will monitor its transactions in such options and contracts and may make certain other tax elections in order to mitigate the effect of the above rules and to prevent disqualification of a Portfolio or Series as a regulated investment company under Subchapter M of the Code.

DIRECTORS AND OFFICERS

The names and addresses of the directors and officers of the Fund and a brief statement of their present positions and principal occupations during the past five years is set forth below.

Directors

David G. Booth*, 50, Director, President and Chairman-Chief Executive Officer, Santa Monica, CA. President, Chairman-Chief Executive Officer and Director, Dimensional Fund Advisors Inc., DFA Securities Inc., DFA Australia Ltd., Dimensional Investment Group Inc. (registered investment company) and Dimensional Emerging Markets Fund Inc. (registered investment company). Trustee, President and Chairman-Chief Executive Officer of The DFA Investment Trust Company. Chairman and Director, Dimensional Fund Advisors Ltd.

George M. Constantinides, 49, Director, Chicago, IL. L Graduate School of Business, University of Chicago. Trustee, Th Director, Dimensional Investment Group Inc. and Dimensional Eme

John P. Gould, 58, Director, Chicago, IL. Steven G. Rothmeier Distinguished Service Professor of Economics, Graduate School of Business, University of Chicago. Trustee, The DFA Investment Trust Company and First Prairie Funds (registered investment companies). Director, Dimensional Investment Group Inc., Dimensional Emerging Markets Fund Inc. and Harbor Investment Advisors. Executive Vice President, Lexecon Inc. (economics, law, strategy and finance consulting).

Roger G. Ibbotson, 53, Director, New Haven, CT. Professor in Practice of Finance, Yale School of Management. Trustee, The DFA Investment Trust Company. Director, Dimensional Investment Group Inc., Dimensional Emerging Markets Fund Inc., Hospital Fund, Inc. (investment management services) and BIRR Portfolio Analysis, Inc. (software products). Chairman and President, Ibbotson Associates, Inc., Chicago, IL (software, data, publishing and consulting).

Merton H. Miller, 73, Director, Chicago, IL. Robert R. McCormick Distinguished Service Professor Emeritus, Graduate School of Business, University of Chicago. Trustee, The DFA Investment Trust Company. Director, Dimensional Investment Group Inc. and Dimensional Emerging Markets Fund Inc. Public Director, Chicago Mercantile Exchange.

Myron S. Scholes, 55, Director, Greenwich, CT. Limited Partner, Long-Term Capital Management L.P. (money manager). Frank E. Buck Professor of Finance, Graduate School of Business and Professor of Law, Law School, Senior Research Fellow, Hoover Institution, (all) Stanford University (on leave). Trustee, The DFA Investment Trust Company. Director, Dimensional Investment Group Inc., Dimensional Emerging Markets Fund Inc., Benham Capital Management Group of Investment Companies and Smith Breedon Group of Investment Companies.

Rex A. Sinquefield*, 52, Director, Chairman and Chief Investment Officer, Santa Monica, CA. Chairman-Chief Investment Officer and Director, Dimensional Fund Advisors Inc., DFA Securities Inc., DFA Australia Ltd., Dimensional Investment Group Inc. and Dimensional Emerging Markets Fund Inc. Trustee, Chairman-Chief Investment Officer of The DFA Investment Trust Company. Chairman, Chief Executive Officer and Director, Dimensional Fund Advisors Ltd.

* Interested Director of the Fund.

Officers

Each of the officers listed below hold the same office in the following entities: Dimensional Fund Advisors Inc., DFA Securities Inc., DFA Australia Ltd., Dimensional Investment Group Inc., The DFA Investment Trust Company, Dimensional Fund Advisors Ltd., and Dimensional Emerging Markets Fund Inc.

Arthur Barlow, 41, Vice President, Santa Monica, CA.

Maureen Connors, 60, Vice President, Santa Monica, CA.

Truman Clark, 55, Vice President, Santa Monica, CA. Consultant until October 1995 and Principal and Manager of Product Development, Wells Fargo Nikko Investment Advisors, San Francisco, CA from 1990-1994.

Robert Deere, 39, Vice President, Santa Monica, CA.

Irene R. Diamant, 46, Vice President and Secretary (for all entities other than Dimensional Fund Advisors Ltd.), Santa Monica, CA.

Margaret East, 56, Secretary, Dimensional Fund Advisors Ltd.

The Fund commenced offering shares of Emerging Mark International Small Cap Value Portfolio in December, 1994; DFA Two- in February, 1996; Enhanced U.S. Large Company Portfolio in July, 199[illegible] International Small Company Portfolio in October, 1996. The DFA Two-Year Corporate Fixed Income, DFA Two-Year Government and Emerging Markets Small Cap Portfolios had not commenced operations as of November 30, 1996.

Until September, 1995, The DFA Intermediate Government Fixed Income Portfolio was named The DFA Intermediate Government Bond Portfolio, The DFA Global Fixed Income Portfolio was named The DFA Global Bond Portfolio, The Pacific Rim Small Company Portfolio was named The Asia-Australia Small Company Portfolio, The U.S. Large Cap Value Portfolio was named The U.S. Large Cap High Book to Market Portfolio, The U.S. Small Cap Value Portfolio was named The U.S. Small Cap High Book to Market Portfolio, The U.S. 9-10 Small Company Portfolio was named the Small Company Shares, The DFA One-Year Fixed Income Portfolio was named The DFA Fixed Income Shares, and The Continental Small Company Portfolio was named the Continental European Portfolio. Until February, 1996, RWB/DFA International High Book to Market Portfolio was named DFA International High Book to Market Portfolio. From September, 1995 until December, 1996, The DFA Real Estate Securities Portfolio was named DFA/AEW Real Estate Securities Portfolio.

Coopers and Lybrand L.L.P., the Fund's independent accountants, audits the Fund's financial statements.

PRINCIPAL HOLDERS OF SECURITIES

As of February 28, 1997, the following stockholders owned beneficially at least 5% of the outstanding stock of the Portfolios, as set forth below.

THE U.S. 9-10 SMALL COMPANY PORTFOLIO

Charles Schwab & Company, Inc. - REIN*
101 Montgomery Street
San Francisco, CA 94104 — 25.44%

State Farm Insurance Companies
One State Farm Plaza
Bloomington, IL 61710 — 10.76%

Pepsico Inc. Master Trust
The Northern Trust Company Trustee
P.O. Box 92956
801 South Canal
Chicago, IL 60675 — 8.87%

Charles Schwab & Company, Inc. - REIN* (see address above) — 5.97%

Owens-Illinois
Master Retirement Trust
34 Exchange Place
Jersey City, NJ 07302 — 5.48%

National Electrical Benefit Fund
1125 15th Street NW
Washington, DC 20005 — 5.26%

THE U.S. 6-10 SMALL COMPANY PORTFOLIO

McKinsey & Company Master Retirement Trust
55 E. 52nd Street
New York, NY 10055 — 26.43%

Data on Dr. Andrews' Companies

Docket No. 97-00982
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Direct Testimony___
Schedule 25 _____
Page 1 of 1_____

COMPANY NAME *	PRICE AS OF 4/30/97	STOCK OUTSTANDING (000)	NUM OF SHARE HOLDERS	SHARES PER STOCKHOLDER	VALUE OF HOLDINGS PER SHAREHOLDER 4/30/97	MARKET VALUE 4/30/97 $(Millions)
(1)	(2)	(3)	(4)	(5) [col (3) / col (4)]	(6) [col (2) X col (5)]	(7) [col (2) X col (3)]
Atmos Energy Corporation	$22.63	16135	28,624	564	$12,753	365
Berkshire Gas Company	$15.13	2177	1,881	1157	$17,505	33
Bay State Gas Company	$25.50	13439	10,820	1242	$31,671	343
Cascade Natural Gas Corporation	$16.38	10824	10840	999	$16,351	177
Colonial Gas Company	$20.00	8518	5931	1436	$28,724	170
Chesapeake Utilities Corporation	$16.75	4453	2213	2012	$33,704	75
Delta Natural Gas Company, Inc.	$16.63	2325	2,382	976	$16,227	39
Essex County Gas Company	$24.25	1667	1,336	1248	$30,258	40
Energen Corporation	$30.50	13027	7,700	1692	$51,600	397
Energy North Inc	$21.75	3244	2,300	1410	$30,677	71
Energy West Incorporated	$8.50	2357	1,600	1473	$12,522	20
Mobile Gas Service Corporation	$26.75	3228	1,624	1988	$53,171	86
North Carolina Natural Gas Corporation	$29.63	6613	5,094	1298	$38,459	196
Northwest Natural Gas Company	$24.25	22566	10,859	2078	$50,394	547
Public Service Company of North Carolina, Incorporated	$17.25	19296	11,500	1678	$28,945	333
Pennsylvania Enterprises, Inc.	$22.13	9608	6,627	1450	$32,077	213
Providence Energy Corporation	$17.75	5767	6,052	953	$16,914	102
Southeastern Michigan Gas Enterprises, Inc.	$17.58	13020	8,509	1530	$26,892	229
United Cities Gas Company	$21.50	13221	7681	1721	$37,007	284
Valley Resources, Inc.	$12.25	4266	2824	1511	$18,505	52
Yankee Energy System, Inc.	$21.13	10450	28,499	367	$7,746	221
Average	$20.39	8867	7,852	1371	$28,195	190

* Excludes Washington Gas Company
It Merged With an Electric Power Company

Gas Company Stocks Owned by the DFA 9-10 Fund

COMPANY	Did the U.S. 9-10 Small Company Mutual Fund Own Stock in Dr. Andrews' Comparable Companies? YEAR 94	95	96
Atmos Energy Corporation	NO	NO	NO
Berkshire Gas Company	YES	YES	YES
Bay State Gas Company	NO	NO	NO
Cascade Natural Gas Corporation	YES	YES	YES
Chesapeake Utilities Corporation	YES	YES	YES
Colonial Gas Company	YES	YES	YES
Delta Natural Gas Company, Inc.	YES	YES	YES
Energen Corporation	NO	NO	NO
Energy North Inc	YES	NO	YES
Energy West Incorporated	NO	NO	NO
Essex County Gas Company	NO	YES	YES
Mobile Gas Service Corporation	YES	YES	YES
North Carolina Natural Gas Corporation	NO	NO	YES
Northwest Natural Gas Company	NO	NO	NO
Pennsylvania Enterprises, Inc.	NO	NO	NO
Providence Energy Corporation	YES	YES	YES
Public Service Company of North Carolina, Incorporated	NO	NO	NO
Southeastern Michigan Gas Enterprises, Inc.	NO	NO	NO
United Cities Gas Company	NO	NO	NO
Washington Energy	NO	NO	NO
Valley Resources, Inc.	YES	YES	YES
Yankee Energy System, Inc.	NO	NO	NO
TOTAL *NOT* INCLUDED IN PORTFOLIO	13	13	11
TOTAL INCLUDED IN PORTFOLIO	9	9	11

SOURCE: 1994 & 1996 - DFA ANNUAL REPORT
SOURCE: 1995 10K REPORT

Table A-1 **Large Company Stocks: Total Returns**

(continued)

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Exhibit CA-SNB____
Direct Testimony___
Schedule 27_____
Page 1 of 1____

From January 1971 to December 1995

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	JAN-DEC*
1971	0.0419	0.0141	0.0382	0.0377	-0.0367	0.0021	-0.0399	0.0412	-0.0056	-0.0404	0.0027	0.0877	1971	0.1431
1972	0.0194	0.0299	0.0072	0.0057	0.0219	-0.0205	0.0036	0.0391	-0.0036	0.0107	0.0505	0.0131	1972	0.1898
1973	-0.0159	-0.0333	-0.0002	-0.0395	-0.0139	-0.0051	0.0394	-0.0318	0.0415	0.0003	-0.1082	0.0183	1973	-0.1466
1974	-0.0085	0.0019	-0.0217	-0.0373	-0.0272	-0.0128	-0.0759	-0.0828	-0.1170	0.1657	-0.0448	-0.0177	1974	-0.2647
1975	0.1251	0.0674	0.0237	0.0493	0.0509	0.0462	-0.0659	-0.0144	-0.0328	0.0637	0.0313	-0.0096	1975	0.3720
1976	0.1199	-0.0058	0.0326	-0.0099	-0.0073	0.0427	-0.0068	0.0014	0.0247	-0.0206	-0.0009	0.0540	1976	0.2384
1977	-0.0489	-0.0151	-0.0119	0.0014	-0.0150	0.0475	-0.0151	-0.0133	0.0000	-0.0415	0.0370	0.0048	1977	-0.0718
1978	-0.0596	-0.0161	0.0276	0.0870	0.0136	-0.0152	0.0560	0.0340	-0.0048	-0.0891	0.0260	0.0172	1978	0.0656
1979	0.0421	-0.0284	0.0575	0.0036	-0.0168	0.0410	0.0110	0.0611	0.0025	-0.0656	0.0514	0.0192	1979	0.1844
1980	0.0610	0.0031	-0.0987	0.0429	0.0562	0.0296	0.0676	0.0131	0.0281	0.0187	0.1095	-0.0315	1980	0.3242
1981	-0.0438	0.0208	0.0380	-0.0213	0.0062	-0.0080	0.0007	-0.0554	-0.0502	0.0528	0.0441	-0.0265	1981	-0.0491
1982	-0.0163	-0.0512	-0.0060	0.0414	-0.0288	-0.0174	-0.0215	0.1267	0.0110	0.1126	0.0438	0.0173	1982	0.2141
1983	0.0348	0.0260	0.0365	0.0758	-0.0052	0.0382	-0.0313	0.0170	0.0136	-0.0134	0.0233	-0.0061	1983	0.2251
1984	-0.0065	-0.0328	0.0171	0.0069	-0.0534	0.0221	-0.0143	0.1125	0.0002	0.0026	-0.0101	0.0253	1984	0.0627
1985	0.0768	0.0137	0.0018	-0.0032	0.0615	0.0159	-0.0026	-0.0061	-0.0321	0.0447	0.0716	0.0467	1985	0.3216
1986	0.0044	0.0761	0.0554	-0.0124	0.0549	0.0166	-0.0569	0.0748	-0.0822	0.0556	0.0256	-0.0264	1986	0.1847
1987	0.1343	0.0413	0.0272	-0.0088	0.0103	0.0499	0.0498	0.0385	-0.0220	-0.2152	-0.0819	0.0738	1987	0.0523
1988	0.0427	0.0470	-0.0302	0.0108	0.0078	0.0464	-0.0040	-0.0331	0.0424	0.0273	-0.0142	0.0181	1988	0.1681
1989	0.0723	-0.0249	0.0236	0.0516	0.0402	-0.0054	0.0898	0.0193	-0.0039	-0.0233	0.0208	0.0236	1989	0.3149
1990	-0.0671	0.0129	0.0263	-0.0247	0.0975	-0.0070	-0.0032	-0.0903	-0.0492	-0.0037	0.0644	0.0274	1990	-0.0317
1991	0.0442	0.0716	0.0238	0.0028	0.0428	-0.0457	0.0468	0.0235	-0.0164	0.0134	-0.0404	0.1143	1991	0.3055
1992	-0.0186	0.0128	-0.0196	0.0291	0.0054	-0.0145	0.0403	-0.0202	0.0115	0.0036	0.0337	0.0131	1992	0.0767
1993	0.0073	0.0135	0.0215	-0.0245	0.0270	0.0033	-0.0047	0.0381	-0.0074	0.0203	-0.0094	0.0123	1993	0.0999
1994	0.0335	-0.0270	-0.0435	0.0130	0.0163	-0.0247	0.0331	0.0407	-0.0241	0.0229	-0.0367	0.0146	1994	0.0131
1995	0.0260	0.0388	0.0296	0.0291	0.0395	0.0235	0.0333	0.0027	0.0419	-0.0035	0.0440	0.0185	1995	0.3743

* Compound annual return

Office of the Consumer Advocate Interrogatory/Data Request-7/8/97

Q.47. Regarding the results of Dr. Andrew's regression analysis shown in Schedule 9, produce the T-statistic for each company's alpha and the T-statistic for each company's beta.

A.47. The results of regressions performed on the data for each company listed in Schedule 9 are employed only in summary, aggregated form as average alphas and betas. The average alpha and average beta are analogous to the alpha and beta of a portfolio of common stocks, in this case a "portfolio" of 22 small gas LDC's. Tests of significance, such as T-statistics, from the regressions related to individual stocks intrinsically cannot be summed or averaged across the composite (or portfolio). Accordingly, they were not found in company with the individual regressions and, hence, cannot be supplied as requested.

Victor L. Andrews

Signature

Victor L. Andrews, President, Andrews Financial Associates, Inc.

APPENDIX A

IBBOTSON YEARBOOK'S HYPOTHETICAL DISTRIBUTION OF RETURNS

The derivation of Schedule 12 and Charts two and three is based on the same probability principles used in the example shown in SBBI-97 at pages 154-155. Those pages are attached to and are part of this appendix as Attachments 1 and 2. The hypothetical distribution in the example assumes:

10% is the size of the loss

30% is the size of the gain

50% is the probability of a loss

50% is the probability of a gain.

Starting with an investment of $1, after 1 year there are two possible values, the investment will be worth either $1.3 or 90 cents. After two years there are 4 possibilities, one at $1.69, two outcomes at $1.17 and one at $.81. This shows that the number of possibilities double each year. The example is well-grounded in mathematics and is a simple illustration of a mathematical formula that is over 500 years old. If $1.3 is treated as X and $.9 is treated as Y, the first year after the investment the possible outcomes are:

$$(X + Y)^1 = \underline{1}(\$1.3) + \underline{1}(\$.9)$$

In the second year after the investment the possible outcomes are:

$$(X + Y)^2 = \underline{1}(X^2) + \underline{2}(XY) + \underline{1}(Y^2)$$

$$(\$1.3 + \$.9)^2 = \underline{1}(\$1.69) + \underline{2}(\$1.17) + \underline{1}(\$.81)$$

The underlined values -- 1 and 1 in the first year and 1, 2 ,1 in the second year -- match the total number of possibilities - 2 in the first year and 4 in the second, and the values in the parentheses -- $1.3 and $.9 in the first year and $1.69 ,$1.17, $.81 in the second -- represent the values of the possibilities. There are two important aspects of the example especially in the second year: the geometric mean is the middle value, $1.17, which has a corresponding annual return of 8.2%, is the most likely outcome - 2 chances out of four. Three out of the four chances, 75% of the possibilities, are at or below the middle value. The odds are only 25% that the investment will reach the average of $1.21, which has a corresponding return of 10%.

The heart of the example can be restated.

This information about a distribution:

10% is the size of the loss

30% is the size of the gain

50% is the probability of a loss

50% is the probability of a gain.

Leads to these facts about the distribution:

an 8.2% return is the distribution's middle

a 10% return is the distribution's average

And

the number of possibilities doubles as the years increase: in the first year there are 2

possibilities, 4 in the second, 8 in the third and so forth.

By the time 71 years elapse from 1925 to 1996 the equation above changes to:

$$(X + Y)^{71}$$

Although this term is huge it can be calculated easily with computers, giving the total number of possibilities and the possibilities for each outcome. Attachments 3 and 4 show the possibilities each year, the symmetrical pattern each year and the distribution in percentage terms. The patterns do not depend on the values of X and Y. No matter what values X and Y are, the pattern of possibilities is the same. This is why Chart 3 in my direct testimony is also symmetrical.

ACTUAL DISTRIBUTION OF LARGE COMPANY RETURNS: 1925-1996

Ibbotson's data on large companies covers 71 years. It shows a return of 10.7% as being in the middle of the distribution and an average of return of 12.7%. This is different than the example in the sense that the order of the information is reversed from the example.

The information about the actual distribution:

a 10.7% return is the distribution's middle

a 12.7% return is the distribution's average

50% is the probability of a loss

50% is the probability of a gain.

Leads to these questions about the actual distribution:

What percentage is the size of the loss?

What percentage is the size of the gain?

I calculated the size of the loss to be 8.3% and the size of the gain to be 33.6%. These are the first and last values in column (3) of Schedule 12. I then applied these two figures to the formula

$$(X + Y)^{71}$$

This gives the total number of possible returns, the value of each return ,and the probability of each return in 1996 - given a $1 investment in 1925. This is the data shown in Schedule 12.

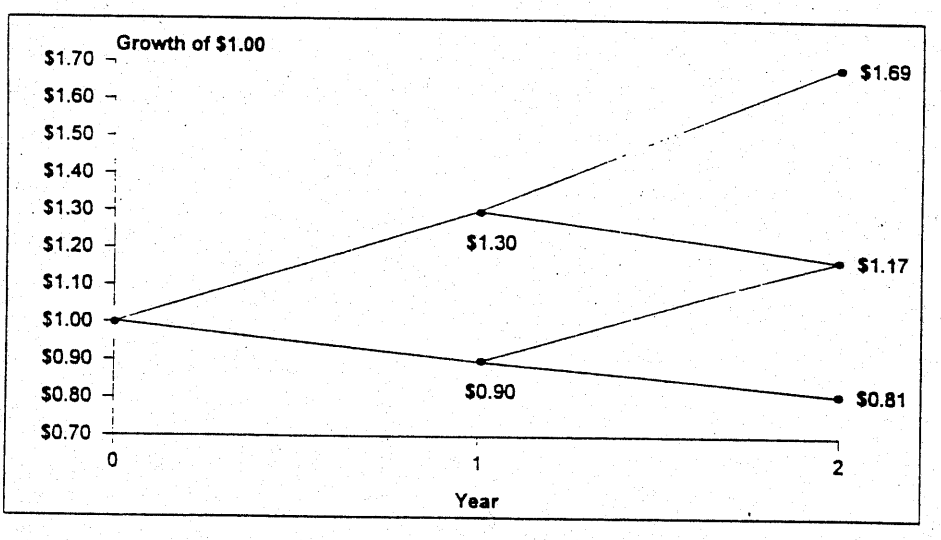
The Schedule indicates that the average return, 12.7%, has a less then 20% chance of being achieved in 1996. If the odds were looked at in 1927, the second year after the investment, the chance of achieving the average return would be no more than 25%. The point here is that as time progresses, the average return has a little less of a chance of being achieved. Its odds shrink from no more than 25% in the second year to less than 20% in the 71st year. This is not much of a change, but it highlights why the average return is not considered a useful measure by the sources I quoted. The average return is not the midpoint of the distribution, and the average return gets further and further away from the midpoint as time progresses.

where the cost of capital is the sum of its parts. Therefore, the CAPM expected equity risk premium must be derived by arithmetic, *not geometric*, subtraction.

Arithmetic Versus Geometric Means

The expected equity risk premium should always be calculated using the arithmetic mean. The arithmetic mean is the rate of return which, when compounded over multiple periods, gives the mean of the probability distribution of ending wealth values. (A simple example given below shows that this is true.) This makes the arithmetic mean return appropriate for computing the cost of capital. The discount rate that equates expected (mean) future values with the present value of an investment is that investment's cost of capital. The logic of using the discount rate as the cost of capital is reinforced by noting that investors will discount their expected (mean) ending wealth values from an investment back to the present using the arithmetic mean, for the reason given above. They will, therefore, require such an expected (mean) return prospectively (that is, in the present looking toward the future) to commit their capital to the investment.

For example, assume a stock has an expected return of +10 percent in each year and a standard deviation of 20 percent. Assume further that only two outcomes are possible each year— + 30 percent and -10 percent (that is, the mean plus or minus one standard deviation), and that these outcomes are equally likely. (The arithmetic mean of these returns is 10 percent, and the geometric mean is 8.2 percent.) Then the growth of wealth over a two-year period occurs as shown below:



Appendix A of _____
Direct Testimony
Docket No. 97-00982
Exhibit CA-SNB____
Attachment 2

Note that the median (middle outcome) and mode (most common outcome) are given by the geometric mean, 8.2 percent, which compounds up to 17 percent over a 2-year period (hence a terminal wealth of $1.17). However, the *expected value*, or probability-weighted average of all possible outcomes, is equal to:

	(.25	×	1.69)	=	0.4225
+	(.50	×	1.17)	=	0.5850
+	(.25	×	0.81)	=	0.2025
TOTAL					1.2100

Now, the rate that must be compounded up to achieve a terminal wealth of $1.21 after 2 years is 10 percent; that is, the expected value of the terminal wealth is given by compounding up the *arithmetic*, not the geometric mean. Since the arithmetic mean equates the expected future value with the present value, it is the discount rate.

Stated another way, the arithmetic mean is correct because an investment with uncertain returns will have a higher expected ending wealth value than an investment that earns, with certainty, its compound or geometric rate of return every year. In the above example, compounding at the rate of 8.2 percent for two years yields a terminal wealth of $1.17, based on $1.00 invested. But holding the uncertain investment, with a possibility of high returns (two +30 percent years in a row) as well as low returns (two -10 percent years in a row), yields a higher expected terminal wealth, $1.21. In other words, more money is gained by higher-than-expected returns than is lost by lower-than-expected returns. Therefore, in the investment markets, where returns are described by a probability distribution, the arithmetic mean is the measure that accounts for uncertainty, and is the appropriate one for estimating discount rates and the cost of capital.

Arbitrage Pricing Theory

APT is a model of the expected return on a security. It was originated by Stephen A. Ross, and elaborated by Richard Roll. APT treats the expected return on a security (*i.e.*, its cost of capital) as the sum of the payoffs for an indeterminate number of risk factors, where the amount of each risk factor inherent in a given security is estimated. Like the CAPM, APT is a model that is consistent with equilibrium and does not attempt to outguess the market. APT

Appendix A of _____
Direct Testimony
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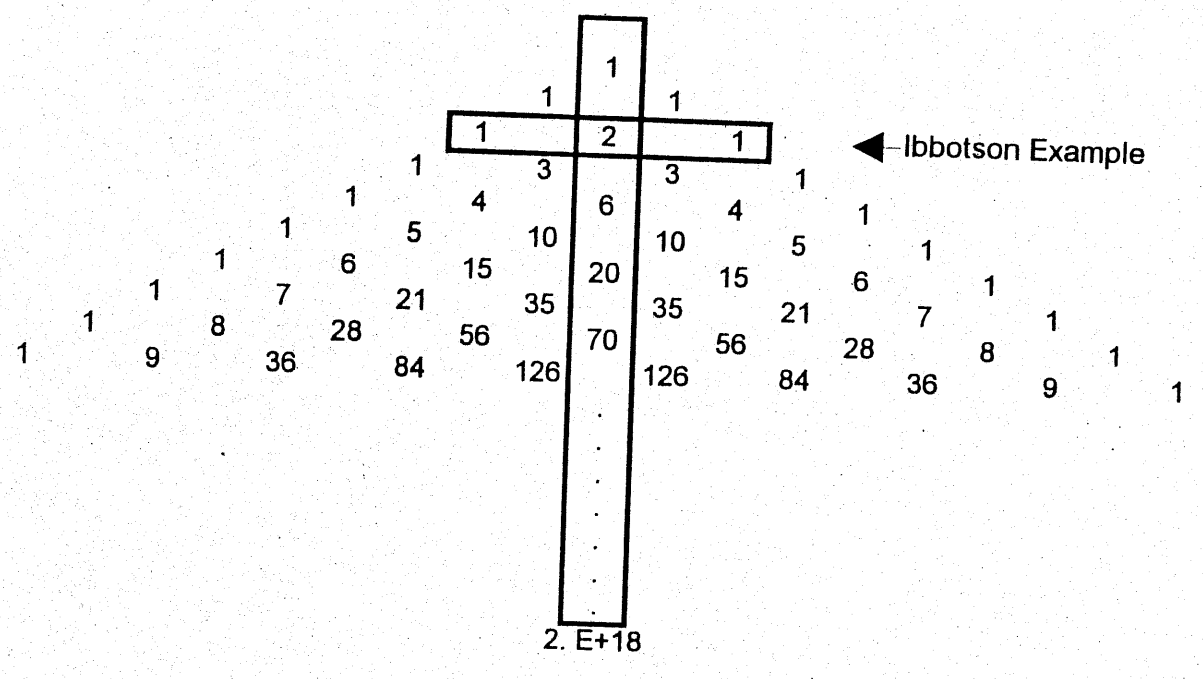
Exhibit CA-SNB____
Attachment 3

Distribution of Possibilities for (X + Y)

Center of the Distribution

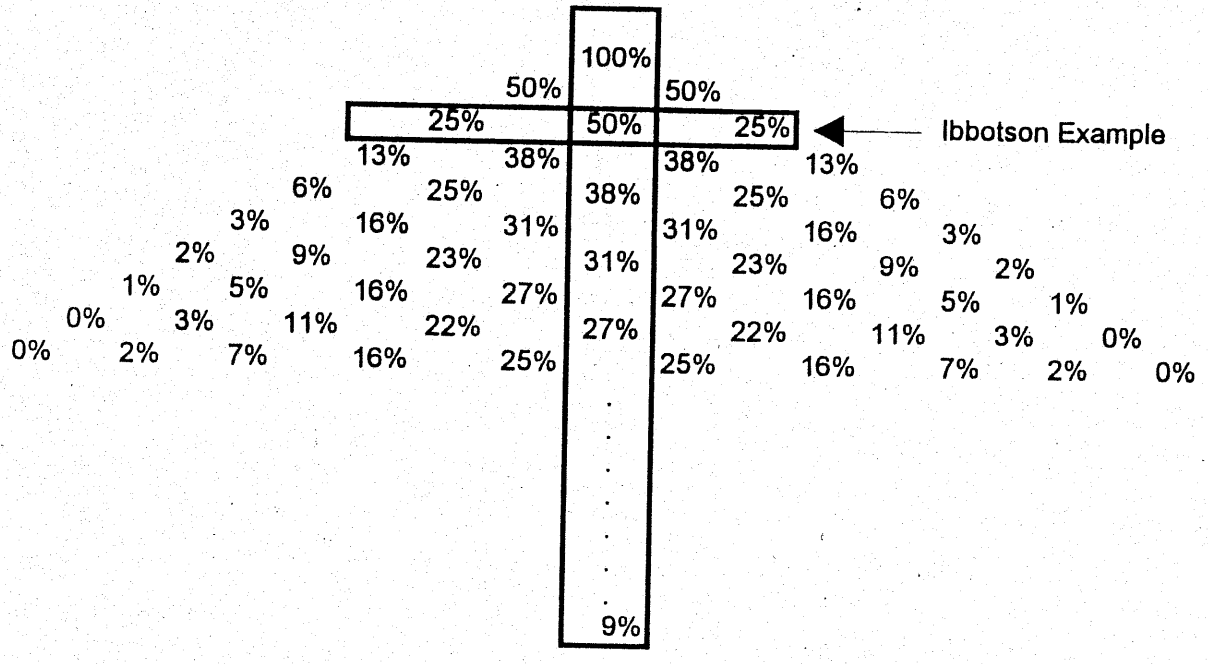


Ibbotson Example

Total Possibilities Each Year	Year
2	0
4	1
8	2
16	3
32	4
64	5
128	6
256	7
512	8
.	9
.	.
.	.
.	.
.	.
.	.
.	.
2. E+21	71

Appendix A of _____
Direct Testimony
Docket No. 97-00982
Exhibit CA-SNB____
Attachment 4

Distribution of Possibilities for (X + Y)
As a Percent of Possibilities
Center of the Distribution



← Ibbotson Example

Total Possibilities Each Year	Year
	0
1	1
4	2
8	3
16	4
32	5
64	6
128	7
256	8
512	9
.	.
.	.
.	.
.	.
.	.
.	.
2. E+21	71

19. In reference to the prefiled testimony of Consumer Advocate witness Brown set forth at page 27, lines 21 and 22, please explain, in detail, every reason or fact supporting Mr. Brown's assertion that the results of Dr. Murry's capital structure analysis and Mr. Brown's capital structure analysis are not different because of differences in the dates between values reported in Value Line and by the SEC and provide a copy of each and every document, treatise or financial accounting principle upon which Mr. Brown relied in reaching such conclusion.

Answer:

Refer to Dr. Brown's testimony, answers 38 and 39, which explain and prove that Value Line's equity ratio of 56.1 percent for Piedmont as of October 31, 2002, is identical to Piedmont's stated equity ratio of 56 percent as of October 31, 2002, which appears at page 14 of Piedmont's 10-K filed with the SEC.

Since Value Line's equity ratio and Piedmont's equity ratio are both dated October 31, 2002, and because Piedmont's U-1/A filing shows a 51.5 percent equity ratio dated October 31, 2002, the difference between Dr. Murry's and Dr. Brown's analysis stems from their different handling of short-term debt, rather than when the information is dated.

20. In reference to the prefiled testimony of Consumer Advocate witness Brown set forth at page 33, lines 22-30, please identify and produce each and every document or other evidence supporting Mr. Brown's assertion that Piedmont intentionally filed its rate case petition in April 2003 for the purpose of avoiding the inclusion of a large amount of short-term debt in its capital structure.

Answer:

Piedmont is on record as preferring to finance its construction and operating expenses with short term debt when "short term bank loans [are] more favorable than prevailing long-term debt." This is a direct quote from Piedmont's response in TRA Docket 99-00994, CAPD's DATA REQUEST #1" item 122. That data request and the company's answer are attached.

The discovery request, item 122 is as follows:

"122.
Prevailing interest rates for "A" rated debt from Nov. 1997 through in Jan. 1999, according to the Federal Reserve and other sources, ranged from a low of 6.91% to 7.26%. Explain why the company issued its new debt in Sept. 1999 instead of the time period of Nov. 1997 through Apr. 1999.

Response:

The Company forecasts construction and operating expenditures for the purpose of anticipating both short term and long term capital requirements. During the time period November 1997 through April 1999, capital requirements were met by internally generated funds and short term bank loans with rates more favorable than

prevailing long term debt rates."

Also, in Docket 99-00994 Piedmont filed a capital structure as of August 31, 1999, even though the company filed its case on December 30, 1999. In the discovery process CAPD discovered that Piedmont's capital structure included two high-cost notes which the company retired and replaced with lower cost notes in late September 1999. But those lower cost notes were not in the company's capital structure.

Consequently, in TRA Docket 99-00994, CAPD's DATA REQUEST #1" item 86, CAPD asked the company for "any written material indicating when the company informed the Tennessee Regulatory Authority of the company's intent to retire the notes, or the company's actual retirement of the notes."

The company responded: "The Company is unaware of any requirement to inform the Tennessee Regulatory Authority of its intent to retire or the actual retirement of debt securities."

That data request and the company's answer are attached.

The discovery request, item 86 is as follows:

"86.
Regarding the notes in accounts 22412, 22413 and 22414, provide copies of any written material indicating when the company informed the Tennessee Regulatory Authority of the company's intent to retire the notes, or the company's actual retirement of the notes.

Response:

The Company is unaware of any requirement to inform the Tennessee Regulatory Authority of its intent to retire or the actual retirement of debt securities. As provided in response to Item 87, the TRA approved the Company's request to issue $150 million in debt securities in Docket No. 97-01047. The instruments under which the debt was issued were approved by the TRA (or its predecessor). These instruments authorize and/or require Piedmont to call or retire debt."

Piedmont's responses to item 122 of CAPD Discovery Request #1 in Docket 99-0994 clearly demonstrate the Company's preference for short-term debt over long term debt when "short term bank loans [are] more favorable than prevailing long-term debt."

The company's response to item 86 shows that the Company's position is that it has no obligation to inform the TRA of actual or intended changes in the company's capital structure which the company files in a rate case and which the company represents as a basis for setting prices for natural gas service. Nothing the company has filed in the current docket, 03-00313, indicates the company has changed its position.

This information, in addition to Dr. Brown's direct testimony page 29 lines 17-23, page 31 lines 1-8, page 35 lines 12-24, page 36 lines 27-30, page 35, line 31 to page 36 line 13, and page 37, lines 1-23, supports Dr. Brown's conclusion.

AMOS, JEFFRIES & ROBINSON, L.L.P.
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April 14, 2000

Mr. Vance L. Broemel
Consumer Advocate Division
Office of the Attorney General
Cordell Hull Building
425 5th Avenue North
Nashville, TN 37243-0485

Re: Docket No. 99-00994

Dear Vance:

I am enclosing for filing two copies of the following responses to the Consumer Advocate's Data Requests: 119, 120, 121, and 122.

Responses to the remaining Consumer Advocate Data Requests will be provided as soon as possible.

Sincerely,

Jerry W. Amos by BRM

Jerry W. Amos

JWA:lh
Encl.

NASHVILLE GAS COMPANY
DOCKET NO. 99-00994
CONSUMER ADVOCATE DATA REQUEST # 1

122. Prevailing interest rates for "A" rated debt from Nov. 1997 through in Jan. 1999, according to the Federal Reserve and other sources, ranged from a low of 6.91% to 7.26%. Explain why the company issued its new debt in Sept. 1999 instead of the time period of Nov. 1997 through Apr. 1999.

Response:

The Company forecasts construction and operating expenditures for the purpose of anticipating both short term and long term capital requirements. During the time period November 1997 through April 1999, capital requirements were met by internally generated funds and short term bank loans with rates more favorable than prevailing long term debt rates.

NASHVILLE GAS COMPANY
DOCKET NO. 99-00994
CONSUMER ADVOCATE DATA REQUEST # 1

86. Regarding the notes in accounts 22412, 22413 and 22414, provide copies of any written material indicating when the company informed the Tennessee Regulatory Authority of the company's intent to retire the notes, or the company's actual retirement of the notes.

Response:

The Company is unaware of any requirement to inform the Tennessee Regulatory Authority of its intent to retire or the actual retirement of debt securities. As provided in response to Item 87, the TRA approved the Company's request to issue $150 million in debt securities in Docket No. 97-01047. The instruments under which the debt was issued were approved by the TRA (or its predecessor). These instruments authorize and/or require Piedmont to call or retire debt.

21. In reference to the prefiled testimony of Consumer Advocate witness Brown set forth at page 36, lines 4 through 7, please explain, in detail, every reason or fact supporting Mr. Brown's assertion that "Given this situation it would be normal for Piedmont to increase short-term debt, just as the comparable companies are doing" and provide a copy of each and every document, treatise or financial accounting principle upon which Mr. Brown relied in reaching such conclusion.

Answer:

Refer to Dr. Brown's Schedule 3 and CAPD response to Piedmont's discovery request number 20.

22. In reference to the prefiled testimony of Consumer Advocate witness Brown set forth at page 42, lines 25 through 28, please explain, in detail, every reason or fact supporting Mr. Brown's assertion that "In Docket No. 96-00977, Piedmont's capital structure was verified" and provide a copy of each and every document, treatise or financial accounting principle upon which Mr. Brown relied in reaching such conclusion.

Answer:

Refer to Dr. Brown's Schedule 9.

23. In reference to the prefiled testimony of Consumer Advocate witness Brown set forth at page 43, lines 23 through 25, please explain, in detail, every reason or fact supporting Mr. Brown's assertion that having an equity ratio of 43.8% would not make Piedmont a riskier company than the comparable companies and provide a copy of each and every document, treatise or financial accounting principle upon which Mr. Brown relied in reaching such conclusion.

Answer:

Refer to Dr. Brown's Schedule 3. Also refer to Dr. Murry's direct testimony where he establishes an equivalency of risk between Piedmont and the comparable companies he selected:

at page 5 lines 9-10, Dr. Murry discusses "alternative investments in companies of equivalent risk;"

at page 5 lines 14-5, Dr. Murry discusses "comparable investments of corresponding risks;"

at page 8 lines 1-2 Dr. Murry testifies "I included only companies....with common equity of at least 40 percent in the year 2002."

24. In reference to the prefiled testimony of Consumer Advocate witness Brown set forth at page 44, lines 2 through 4, please identify and produce a copy of each and every document reviewed, relied upon or referred to by Mr. Brown in concluding that a 43.8 percent equity ratio would not violate any covenants of which he was aware.

Answer:

Refer to Dr. Brown's Schedule 3, where statements from the comparable companies SEC forms indicate that their covenants use 30% equity, such as AGL, and 35% equity, such as NICOR and NJR and WGL, as the thresholds for covenants.

25. In reference to the prefiled testimony of Consumer Advocate witness Brown set forth at page 56, lines 7 and 8, please explain, in detail, every reason or fact supporting Mr. Brown's assertion that the equity returns shown on Schedule DAM-7 "are likely to be inflated, just as the common equity ratios are inflated" and provide a copy of each and every document, treatise or financial accounting principle upon which Mr. Brown relied in reaching such conclusion.

Answer:

Refer to Dr. Brown's testimony page 5, lines 18-34 and pages 10-49.

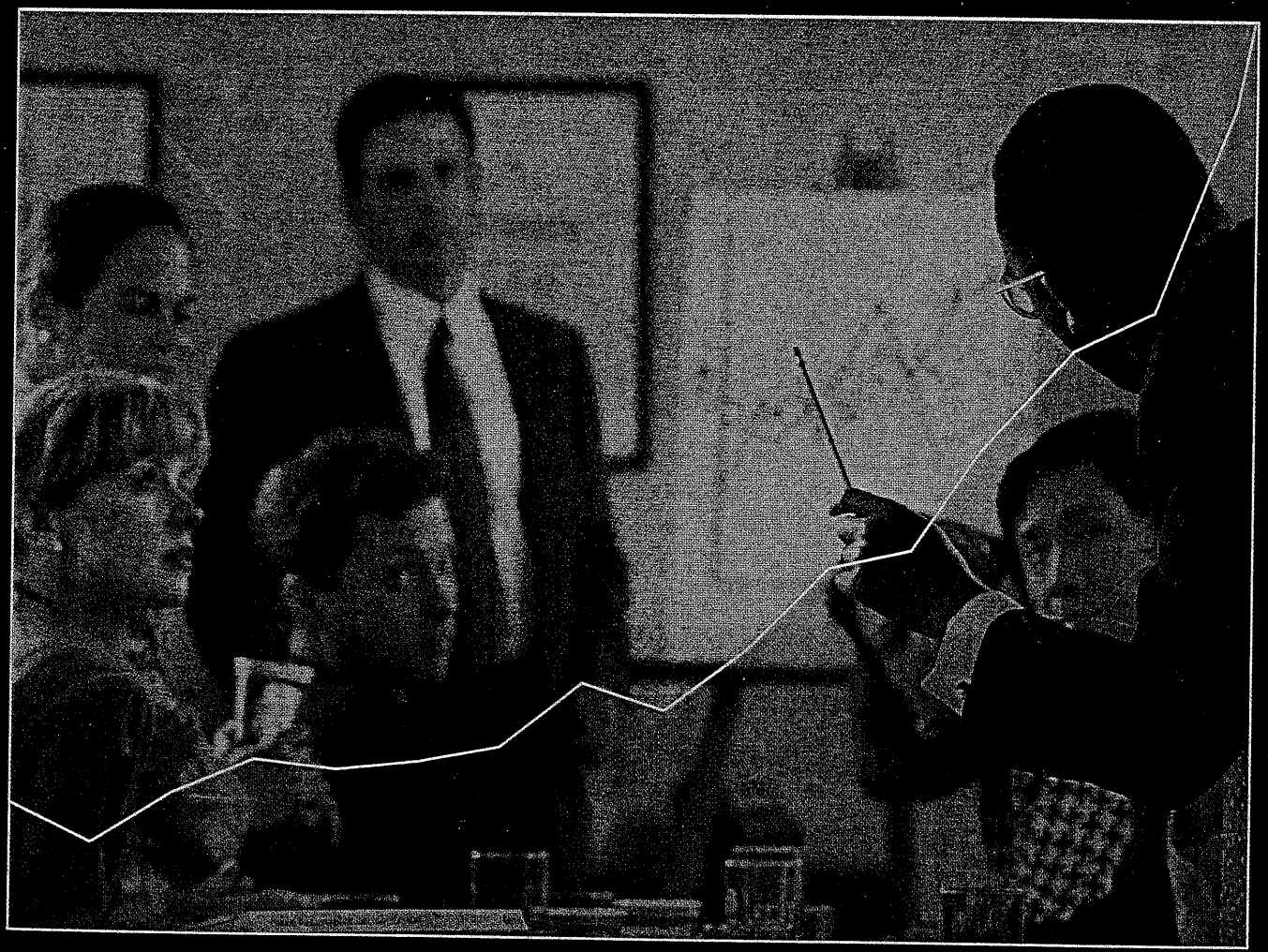
26. In reference to the prefiled testimony of Consumer Advocate witness Brown set forth at page 58, lines 13 through 16, please explain, in detail, every reason or fact supporting Mr. Brown's assertion that "Value Line's Betas . . . are not standard practice in the financial industry" and provide a copy of each and every document, treatise or financial accounting principle upon which Mr. Brown relied in reaching such conclusion.

Answer:

Refer to Dr. Brown's testimony pages 60 and 61, which discuss the authorities on betas. Copies of those authorities are provided in the CAPD workpapers.

Financial Markets and Corporate Strategy

MARK GRINBLATT ■ SHERIDAN TITMAN



Financial Markets and Corporate Strategy

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St. Louis, Missouri

To my dear brother Arnie, for his courage, perseverence, and inspiration.
M. G.

To my family, for their enduring love and support.
S. T.

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b. What is the annualized expected return required by investors in Dell Computer stock as estimated from the CAPM, using the S&P 500 as the market portfolio, 4.9 percent for the risk-free (or zero-beta) return, and the four-year average return of the S&P 500 less 4.9 percent as the market portfolio's risk premium?

Answer: *a.* Averaging the 17 quarterly returns of Dell and multiplying by 4 generates an annualized expected return of 55.18 percent.

b. The beta estimated by regressing the 17 returns of Dell on the 17 returns of the S&P 500 is 1.02. The annualized average return of the S&P over the 17 quarters is 14.9 percent. Hence, using equation (5.8), the expected return of Dell is:

$$15.1\% = 4.9\% + 1.02(14.9\% - 4.9\%)$$

Source: Dell figures are from Center for Research in Securities Prices (CRSP); the S&P 500 figures are from Ibbotson and Sinquefeld (1996).

A variety of statistical methods can improve the beta estimate. These methods usually involve taking some weighted average of 1 and the beta estimated with a software package.

Improving the Beta Estimated from Regression

Example 5.11 estimated the beta of Dell Computer with a simple regression of 17 quarterly Dell stock returns on the corresponding returns of a proxy for the market portfolio. The better beta estimates, alluded to above, account for estimation error. One source of estimation error arises simply because Dell's stock returns are volatile; therefore, estimates based on those returns are very imprecise.[27] A second source of estimation error arises because price changes for some stocks (usually the smaller capitalization stocks), seem to lag the changes of other stocks either because of nontrading or stale limit orders, that is, limit orders that were executed as a result of the investor failing to update the order as new information about the stock became available.

To understand the importance of estimation error, consider a case where last year's returns are used to estimate the betas of four very similar firms, denoted as firms A, B, C, and D. The estimated betas are $\beta_A = 1.4$, $\beta_B = .8$, $\beta_C = .6$, and $\beta_D = 1.2$. However, because these are estimated betas, they contain estimation error. As a result, the true betas are probably not as divergent as the estimated betas. Given these estimates, it is likely that stock A has the highest beta and stock C the lowest. Our best guess, however, is that the beta of stock A is overestimated and the beta of stock C is underestimated.[28]

The Bloomberg Adjustment. Bloomberg, an investment data service, adjusts estimated betas with the following formula:

$$\text{Adjusted beta} = .66 \times \text{Unadjusted beta} + .34$$

[27] Just as a coin tossed 10 times can easily have a "heads" outcome 60 percent of the time (or 6 times), even if the true probability of a "heads" outcome is 50 percent, the average historical returns of stocks are rarely equal to their true mean returns.

[28] To understand why this is true, think about your friends who scored 770 on their GMATs or SATs. While it is true that most people who score 770 are smart, scoring that high might also require some luck; thus, those with the best scores may not be quite as smart as their 770 score would indicate. Similarly, the stock with the highest estimated beta in a given group may not really be as risky as its beta would indicate. The stock with the highest estimated beta in a group is likely to have a high estimation error in addition to having a high actual beta.

Exhibit 5.10 Bloomberg Unadjusted and Adjusted Betas

	Unadjusted Beta	*Adjusted Beta*
Delta Air Lines	0.84	0.89
Procter & Gamble	1.40	1.27
Coca-Cola	0.88	0.92
Gillette	0.90	0.93
Harcourt General	0.74	0.83
Time Warner	1.52	1.35
Citicorp	1.32	1.21
Chrysler	0.77	0.85
Caterpillar	1.00	1.00
Exxon	0.64	0.76

Source: Bloomberg Financial Markets, © 1998. Bloomberg L.P. All Rights Reserved. Data from a Bloomberg machine, Dec. 10, 1996; estimation based on weekly return data from June 7, 1996, to Dec. 6, 1996.

The **Bloomberg adjustment** formula lowers betas that exceed 1 and increases betas that are under 1. Exhibit 5.10 shows adjusted and unadjusted betas for 10 well-known stocks. The Bloomberg adjustment given in Exhibit 5.10 is applied in exactly the same way to all stocks. However, beta estimates can be improved upon by adjusting some stocks more than others. For example, one would expect estimation error to be somewhat larger for small firms than for large firms, which would imply that smaller firms should have a larger adjustment factor. In addition, better beta estimates might result by shrinking the unadjusted estimates toward an industry average beta rather than toward the market average. Further adjustments take into account the firm's leverage ratio and other characteristics possibly related to beta that also improve the precision of the beta estimate.

The BARRA Adjustment. A number of data services provide beta adjustments of this type to portfolio managers. Perhaps the best known is a firm called BARRA, which was started by a former University of California, Berkeley, finance professor, Barr Rosenberg, who was one of the first to develop ways to improve beta estimates. Rosenberg et al. (1985) showed that using historical betas as predictors of future betas was much less effective than using alternative beta prediction techniques. Rosenberg first used a shrinkage factor similar to what Bloomberg is now using. Rosenberg later refined his prediction technique to incorporate fundamental variables—an industry variable and a number of company descriptors.

Adjusting for the Lagging Reaction of the Prices of Small Company Stocks to Market Portfolio Returns. It also may be necessary to make additional adjustments to the betas of small firms because the returns of the stocks of small companies tend to react to market returns with a lag. This delayed reaction creates a downward bias in the beta estimates of these smaller capitalization stocks, since only part of the effect of market movements on the returns of these stocks are captured by their contemporaneous covariances. The bias can be significant when one estimates the betas from daily stock returns. For this reason, analysts should avoid daily returns and instead estimate betas with weekly or monthly returns where the effect of delayed reaction tends to be less severe.

5.10 Estimating Betas, Risk-Free Returns, Risk Premiums, and the Market Portfolio

To implement the risk-expected return relation of the Capital Asset Pricing Model, it is necessary to estimate its parameters. These include the risk-free return, beta, the market risk premium, and the market portfolio itself.

Risk-Free or Zero-Beta Returns

Most academic studies of the CAPM have used short-term Treasury bill returns as proxies for the risk-free return. However, as Black, Jensen, and Scholes (1972), among others, have noted, this rate seems to be too low as a zero-beta return. An alternative is to use the zero-beta expected return estimate that comes from fitting the intercept in the risk-expected return equation to all stocks. Interestingly, the risk-free rate employed in derivative securities pricing models, which is the London interbank offered rate (LIBOR),[26] appears to be much closer to this fitted number.

Beta Estimation and Beta Shrinkage

Beta, as mentioned previously, is the notation for the covariance divided by the variance because this ratio is the appropriate slope coefficient in a regression. In practice, one never obtains the true beta, but it is possible to obtain an estimate. Estimation with historical data is easy after recognizing that the ratio of covariance to variance is a slope coefficient, which can be obtained from a linear regression. The left-hand variable in the regression is the return of the stock on which beta is being estimated; the right-hand side is a proxy for the market return (e.g., the return of the S&P 500). Many software packages and calculators have built-in regression routines that will use these data to estimate beta as the regression slope coefficient.

Example 5.11 provides real-world data and illustrates both a beta calculation and the estimation of expected return using beta.

Example 5.11: Estimating Beta and the Expected Return for Dell Computer

Historical quarterly returns (in %) for Dell Computer and the S&P 500 are given below:

	Dell				S&P 500			
	Q1	*Q2*	*Q3*	*Q4*	*Q1*	*Q2*	*Q3*	*Q4*
1991	—	—	—	9.04	—	—	—	11.43
1992	41.95	−25.26	57.93	67.68	−2.55	1.97	3.10	5.10
1993	−26.82	−46.62	−11.33	36.09	4.28	.51	2.56	2.31
1994	11.60	4.46	41.94	9.52	−3.81	.41	4.92	−.03
1995	6.71	37.43	41.37	−21.18	9.74	9.49	7.95	5.96

a. What is the annualized expected return required by investors in Dell Computer stock as estimated by averaging the 17 quarterly returns from the end of 1991 through 1995 and multiplying by 4?

[26] See Chapter 2.

imating Betas, Risk-Free Returns, Risk Premiums, Market Portfolio

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1991	—	—	—	9.04	—	—	—	11.43
1992	41.95	−25.26	57.93	67.68	−2.55	1.97	3.10	5.10
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a. What is the annualized expected return required by investors in Dell Computer stock as estimated by averaging the 17 quarterly returns from the end of 1991 through 1995 and multiplying by 4?

[26] See Chapter 2.

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Stanford University

Seventh Edition

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those for the market portfolio. The dots represent the monthly plots of the excess returns, 60 in all. The colored line fitted to the dots describes the historical relationship between excess returns for the stock and excess returns for the market portfolio. This line is known as the *characteristic line*, and it is used as a proxy for the expected relationship between the two sets of excess returns.

The graph reveals that the greater the expected excess return for the market, the greater the expected excess return for the stock. Three measures are important. The first is known as the *alpha*, and it is simply the intercept of the characteristic line on the vertical axis. If the excess return for the market portfolio were expected to be zero, the alpha would be the expected excess return for the stock. In theory, the alpha for an individual stock should be zero.

If it were less than zero, as a rational investor you would avoid the stock because you could do better with some combination of risk-free asset and the market portfolio. If enough people avoid it, of course, the price will decline and the expected return will increase. How long will this go on? In theory, until the alpha rises to zero. One can visualize the equilibration process by supposing the characteristic line in Fig. 3-6 were below, but parallel to, the line shown. As the security declines in price, its expected return rises and the characteristic line shifts upward to where eventually it passes through the origin. If the alpha were positive, the opposite equilibrium process would occur; people would rush to buy the security, and this would cause the price to rise and expected return to decline.[9] We assume, then, that the alpha for a particular stock is zero.

THE SYSTEMATIC RISK AS MEASURED BY BETA

The second measure with which we are concerned, and most important for our purposes, is the *beta*. The beta is simply the slope of the characteristic line. It depicts the sensitivity of the security's excess return to that of the market portfolio. If the slope is one, it means that excess returns for the stock vary proportionally with excess returns for the market portfolio. In other words, the stock has the same unavoidable or systematic risk as the market as a whole. A slope steeper than one means that the stock's excess return varies more than proportionally with the excess return of the market portfolio. Put another way, it has more systematic risk than the market as a whole. This type of stock is often called an "aggressive" investment. A slope less than one, as is the case in Fig. 3-6, means that the stock has less unavoidable or systematic risk than does the market as a whole. This type of stock is often called a "defensive" investment.

The greater the slope of the characteristic line for a stock, as depicted by its beta, the greater its systematic risk. This means that for both upward and downward movements in market excess returns, movements in excess returns for the

[9] The alpha for the market portfolio is simply a weighted average of the alphas for the individual stocks making up the portfolio. In efficient markets, rational investors seize upon any deviation from zero of the alpha of an individual stock. As the alphas of individual stocks will be driven to zero, the weighted average of alphas of stocks comprising the market portfolio also must be zero. It should be pointed out that some empirical tests have shown positive alphas for low beta stocks and negative alphas for high beta stocks. Various reasons have been advanced for this occurrence.

individual stock are greater or less, depending on its beta. If the beta for a particular stock were 1.70 and the market excess return for a specific month were −2.00 percent, this would imply an expected excess return for the stock of −3.40 percent. Thus the beta represents the systematic risk of a stock due to underlying movements in security prices. This risk cannot be diversified away by investing in more stocks because it depends on things such as changes in the economy and in the political atmosphere, which affect all stocks. In summary, the beta of a stock represents its contribution to the risk of a highly diversified portfolio of stocks.

Empirical work on the stability of historical beta information over time suggests that past betas are useful in predicting future betas; however, the ability to predict seems to vary with the size of the portfolio. The larger the number of securities in a portfolio, the greater the stability of the beta for that portfolio over time. Even for the individual stock, however, past beta information has been found to have reasonable predictive value. Put another way, measured betas show stability over time even at the individual security level. In addition to portfolio size, betas tend to show greater stability as longer time intervals are studied.

Several organizations regularly compute and publish betas for actively traded stocks. The typical analysis involves monthly returns on the stock and on the market index for 3 to 5 years in the past. In certain cases, weekly instead of monthly returns are employed. The better known services include those of Merrill Lynch, Wells Fargo Bank, and Value Line. By looking up beta as well as other information, one is saved the task of computing it. An example of betas for a sample of companies is shown in Table 3-1. The betas of most stocks range from .7 to 1.4, though some are lower and some are higher. If the past systematic risk of a stock seems likely to prevail in the future, the historical beta can be used as a proxy for the expected beta coefficient.

TABLE 3-1
Betas for selected stocks, July 1984

STOCK	BETA
American Can Company	.90
Control Data Corporation	1.50
Dow Chemical Company	1.25
Eastman Kodak	.85
General Electric	.95
Georgia-Pacific (forest products)	1.40
Hewlitt-Packard	1.25
International Business Machines	1.05
Iowa-Illinois Gas & Electric	.60
McDonnell-Douglas	1.10
Nabisco Brands	.80
Pillsbury Company	.85
Standard Oil of Indiana	1.25
U.S. Steel Corporation	1.05
Wrigley Company (chewing gum)	.65

Adjusting Historical Betas. There appears to be a tendency for the measured betas of individual securities to revert eventually toward the beta of the market portfolio, 1.0, or toward the beta of the industry of which the company is a part.[10] This tendency may be due to economic factors affecting the operations and financing of the firm and perhaps to statistical factors. To adjust for this tendency, some people—as well as one "beta provider"—calculate an *adjusted beta*. To illustrate, suppose the reversion process were toward the market beta of 1.0. If the measured beta were 1.5 and a .80 weight were attached to it and .20 to the market beta, the adjusted beta would be 1.5(.80) + 1.0(.20) = 1.40. The same could be done if the reversion process were toward an industry average beta of, say, 1.2. As one is concerned with the beta of a security in the future, it may be appropriate to adjust the measured beta if the reversion process just described is clear and consistent.

Another approach to adjusting betas involves a type of Bayesian analysis. The historical beta is calculated, as we have done, but it then is adjusted to hopefully give a better estimate of the beta that will prevail in the near future. To make the adjustment, such things as the debt ratio, the size of the stock (total market value of all of the company's shares), industry classification, dividend yield, and even the stock's price-earnings ratio are brought into play.[11] This "other" information is subjected to regression analysis or to other statistical techniques to produce a weighting of the importance of the factor involved. On the basis of the weightings, the historical beta is adjusted. To be sure, a stock's historical beta still has a positive and usually substantial effect on explaining returns, but estimates sometimes are improved with the addition of some of the factors mentioned earlier. Adjusting historical betas is difficult business, because the process is seldom clear and consistent. For a fee, several services provide beta information adjusted in the manner just described. As the techniques used are beyond the scope of this book, we will focus on betas in a generic sense.

UNSYSTEMATIC RISK

The last of the three measures with which we are concerned is the unsystematic, or avoidable, risk of a security. Unsystematic risk derives from the variability of the stock's excess return not associated with movements in the excess return of the market as a whole. This risk is described by the dispersion of the estimates involved in predicting a stock's characteristic line. In Fig. 3-6, the unsystematic risk is represented by the relative distance of the dots from the solid line. The greater the dispersion, the greater the unsystematic risk of a stock. By diversification of stocks in our portfolio, however, we can reduce unsystematic risk.

[10] Marshall E. Blume, "Betas and Their Regression Tendencies," *Journal of Finance*, 30 (June 1975), 785–96.

[11] For a general discussion of these issues, see Barr Rosenberg, "The Capital Asset Pricing Model and the Market Model," *Journal of Portfolio Management*, 7 (Winter 1981), 5–16.

July 2002

Report for the Australian Competition and Consumer Commission

Empirical Evidence on Proxy Beta Values for Regulated Gas Transmission Activities

Final Report

The Allen Consulting Group

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Table of Contents

In a recent draft decision, the Victorian Essential Services Commission (ESC) has referred to recent research that may shed some light on the size of the default premium embedded in the yields on corporate bonds, and thus provide more insight into the likely magnitude of the debt beta.[43] Elton *et al.* have provided estimates of the breakdown of the yield on US corporate bonds of different credit ratings and terms into the default premium, risk premium and tax premium (the last factor has less significance for Australia) for debt of different terms and credit ratings.[44] The ESC interpreted this research as implying that a default premium of 0.28 percentage points would apply for debt with a ten year term and BBB+ credit rating. If liquidity premia were negligible, then this would imply an expected return to debt of 0.92 per cent (using the assumptions noted above), and a debt beta of approximately 0.15. However, as we do not know the size of any potential liquidity premium, this remains an upper limit of the debt beta.

Accordingly, for the purposes of this report, a range for the debt beta of 0 to 0.15 will be used.

Should the Concern be with Asset Betas or Equity Betas?

Where asset betas are estimates for a group of comparable entities, and (for example) the average asset beta for the group is then re-levered for an assumed financing structure to be used as a proxy beta, care needs to be taken to adopt consistent assumptions between the de-levering and re-levering stages. There may be sound reasons for using a different levering methodology for the different stages in some instances – for example, to take account of differences in taxation regimes across countries. However, it is possible to misinterpret empirical data if inconsistent levering/de-levering approaches are used in the different stages without sound reasons or inadvertently (with different assumptions about the debt beta particularly important).[45]

In order to avoid the potential for misinterpretation of empirical data, this report will focus on the proxy equity beta that is consistent with the standard benchmark gearing assumption of 60 per cent debt-to-assets.

[43] Essential Services Commission (Victoria), 2002, Review of Gas Access Arrangements: Draft Decision, pp.231-233.

[44] Elton, E., M. Gruber, D. Agrawal, C. Mann, 2001, 'Explaining the Rate Spread on Corporate Bonds', *Journal of Finance*, Vol. LVI, No. 1, pp.247-277.

[45] This point was illustrated by the former Office of the Regulator-General. It showed that the proxy equity beta (for a gearing assumption of 60 per cent debt-to-assets) derived from a hypothetical but plausible set of empirical observations could vary from 1.0 to 1.6 if inconsistent assumptions about debt betas were made between the de-levering and re-levering stages. The resultant effect on the estimated cost of capital is substantial: Office of the Regulator-General, 2000, Electricity Distribution Price Determination 2001-2005, Volume 1, Statement of Purpose and Reasons, p.268.

Equity betas can only be compared for consistent assumptions about gearing, which is why it is common practice to derive asset betas (that is, to eliminate gearing as a confounding factor). However, as all Australian energy regulators have accepted an assumption of 60 per cent debt-to-assets as the standard gearing benchmark, the equity betas assumed by various energy regulators are directly comparable.[46] In contrast, however, different regulators' assumed asset betas *may not be comparable* if those betas reflect different de-levering/re-levering approaches (and, in particular, different assumptions about the magnitude of debt beta). Moreover, as the CAPM is only being used to estimate the cost of capital for the equity financed portion of regulated Australian gas transmission activities, it is the equity beta – not the asset beta – that is the relevant input into the cost of capital estimation.

3.4 Pooling of Beta Estimates

As discussed in section 2.5, even where a beta estimate is available for a particular stock, it is common practice to 'pool' that beta estimate with those of a set of comparable entities in order to improve the precision of the beta estimate. Where a beta estimate for a particular activity is not available (for example, because the entity undertaking the activity is not listed on a stock exchange), the use of comparable entities to derive a proxy beta is made necessary.

The most common method of 'pooling' various beta estimates is to focus on one of the measures of central tendency for the beta estimates for the set of comparable entities, with the simple average of the beta estimates a common measure. The standard error of the average beta across a proxy group will be lower than the average standard error of the individual betas, with the precision of the average of the proxy group rising (ie standard error falling) with the number of firms added to the proxy group.[47] The simple average of the set of proxy betas will be used in this report as the principal means of pooling betas.

One issue that arises when using an average (or even other measured of central tendency, such as the median) is whether beta estimates that are negative should be excluded from consideration. There are two potential responses to this finding.

- A negative beta could be interpreted as outside of the reasonable bounds for a beta for regulated gas transmission activities (or any other utility activity), and thus excluded to minimise the likelihood that extreme observations could bias the beta estimate.
- Alternatively, where the expected beta is low, and the standard error is high, a certain proportion of negative betas should be expected. Moreover, for every point estimate of an equity beta that is at the lower-end of a confidence interval, there may be others are the upper end. Thus, excluding only betas at the lower end of the confidence interval (ie the negative betas) may lead to bias in the beta derived from the proxy group.

[46] This gearing assumption was proposed by the utility and accepted by the regulators in the first major decisions on the cost of capital under the Gas Code (the 1998 Victorian decisions), and has been adopted in almost all energy decisions since that time.

[47] The standard error of the average beta of the proxy group will depend upon the pair-wise correlations between the various beta estimates, which is not available from commercial beta estimation services, as used in this report.

In this report, no view is taken on the relative merits of these two arguments, rather, average beta estimates with and without any observed negative betas will be reported.

One of two more sophisticated adjustments to beta estimates are made by some of the common beta estimation services, which are often referred to as the Vasicek adjustment and the Blume adjustment. Both of these adjustments may have merit when adjusting a particular beta estimate for a firm, and when projecting a future beta for a particular firm. The Vasicek adjustment is useful where the goal is to derive a beta estimate for a particular stock, for which a beta estimate can be observed individually, and the Blume adjustment may be a convenient means of responding to expected management tendencies over a future period. However, neither of these adjustments is considered appropriate where the objective to derive a proxy beta for (pure-play) regulated gas transmission activities, and this proxy beta is based upon estimates from a carefully selected set of comparable entities.[48]

The *Vasicek* adjustment[49,50] takes the weighted average of the beta estimate for an individual company, and the simple average for a 'peer group' of entities (the prior distribution), with the weighting in inverse proportion to the variances of the distributions from which the estimates are drawn.

To the extent that the 'peer group' that is used by the beta estimation service in the Vasecik adjustment is similar to the group of comparable entities used to derive the proxy beta, the application of the Vasecik adjustment is likely to have little effect on the average of the group.[51] However, to the extent that the peer group differs – and betas for entities that undertake activities that were judged not to be sufficiently comparable to regulated gas transmission activities would be taken into account – then bias to the estimate of the proxy beta may be introduced.

As noted in section 3.2, the relevant peer group employed by the Ibbotson service most relevant to gas transmission are firms classified in the two-digit industry code Electric, Gas, and Sanitary Services. While this will include a number of firms that are not considered sufficiently comparable to regulated gas transmission activities, any bias introduced may not be substantial – and, indeed, the average of the Ibbotson adjusted betas is not substantially different to the average of the raw betas. In contrast, the London Business School service uses all listed companies as the peer group, which may introduce bias in the beta estimate.

[48] The discussion in this section draws upon Lally, M., 1998, 'An Examination of Blume and Vasicek Betas,, *The Financial Review*, Vol.33, pp 183-198; and Lally, M., 2000. *The Cost of Equity Capital and Its Estimation*, McGraw-Hill Series in Advanced Finance Volume 3, Sydney: McGraw-Hill, p33-35.

[49] Vasicek, O., 1973. A note on using cross-sectional information in bayesian estimation of security betas, *Journal of Finance* 26: pp 123–129.

[50] Lally, M., 2000. *The Cost of Equity Capital and Its Estimation*, McGraw-Hill Series in Advanced Finance Volume 3, Sydney: McGraw-Hill, p 34.

[51] If the standard errors of the beta estimates for all of the firms in the peer group are identical, then the average of the Vasecik adjusted betas will be identical to the average of the raw betas. In any other case, the average of the Vasecik betas will place more weight upon the beta estimates that have a lower standard error.

The *Blume* adjustment[52,53] also involves taking a weighed average of individual betas and a prior distribution, except that the prior distribution comprises all firms (that is, an equity beta of one).[54] Further, one of the rationales for the Blume adjustment is to take account of a tendency for beta values of firms to tend to a value of one over time. That is, the adjustment is based upon two prior beliefs about betas:

- in the absence of any information, a reasonably prior belief is that a beta of a stock is one – being the market average beta; and
- empirically, betas tend to get closer to one over time.

With respect to the first of these reasons for the Blume adjustment, as with the Vasicek adjustment, the use of a prior distribution that includes all firms may introduce bias into the proxy beta that is derived. Certainly, taking account of information from all firms is somewhat at odds with carefully selecting the group of comparable entities that is used to derive the proxy beta.

Regarding the tendency of betas to regress towards one over time, it is accepted that there is empirical support for the phenomenon of beta convergence (even after the potential for the estimation method to find a spurious relationship is taken into account).[55] However, these studies attribute the regression in equity betas to conscious behavioural decisions of management – for example, by undertaking investment projects with less extreme risk characteristics, or by manipulation of financial structures (eg by equity issues, leveraged buy-outs and equity carve-outs).[56] Indeed, in a Reserve Bank of Australia working paper, Sheutrim finds a motive for the manipulation of equity betas by managers, finding a positive relationship between events that may be adverse to managers – namely, the probability of the firm being delisted.[57]

While allowing for such a management tendency may well be reasonable when projecting forward the estimated equity beta for an actual entity, it has less relevance for the estimation of the cost of capital for the regulated activities of gas transmission entity. In particular, as the objective is to derive the cost of capital associated with a pure-play gas transmission business, any prospective change to the equity beta arising from diversification into other activities would be introducing irrelevant information. Likewise, regarding changes to leverage, a better approach is to adjust betas explicitly for changes to gearing (using the theoretical relationship between equity betas and gearing, discussed above). It is noted, however, that if the 'regression' of equity betas over time and the associated change to gearing were both taken into account, the asset beta that would be derived would most likely remain unchanged.

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[52] Blume, M., 1971. On the assessment of risk, *Journal of Finance* 26, pp 1–10. Blume, M., 1975. betas and their regression tendancies, *Journal of Finance* 30, pp 785–95.

[53] Lally, M., 2000. *The Cost of Equity Capital and Its Estimation*, McGraw-Hill Series in Advanced Finance Volume 3, Sydney: McGraw-Hill, p 34.

[54] As noted in section 3.2, a Blume-adjusted beta is provided in the standard output from the Bloomberg service.

[55] The existing empirical evidence – as well as further evidence – is presented in: Sheutrim, G, 1998, Systematic Risk Characteristics of Corporate Equity, Research Discussion Paper 9802, Reserve Bank of Australia, Sydney.

[56] Brailsford, T.J., Faff, R.W. and Oliver, B.R., 2000. Research design Issues in the Estimation of Beta, McGraw-Hill Series in Advanced Finance Volume 1, Sydney: McGraw-Hill, p28; Sheutrim, G, 1998, Systematic Risk Characteristics of Corporate Equity, Research Discussion Paper 9802, Reserve Bank of Australia, Sydney, p. 8.

[57] Sheutrim, G, 1998, Systematic Risk Characteristics of Corporate Equity, Research Discussion Paper 9802, Reserve Bank of Australia, Sydney, p. 23.

Accordingly, this report uses the raw beta estimates produced by each of the beta estimation services.

Tobin, J., 1958. Liquidity preference as behavior towards risk, *Review of Economic Studies* 25, 65–85.
Tsiang, S.C., 1972. The rational of the mean-standard deviation analysis, skewness preference, and the demand for money, *American Economic Review*
Weil, Philippe, 1989. The equity premium puzzle and the risk-free rate puzzle, *Journal of Monetary Economics* 24, 401–421.

EFA Eastern Finance Association

The Financial Review

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An Examination of Blume and Vasicek Betas

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Abstract

This paper examines the Vasicek and Blume methods for correcting OLS betas. The primary conclusions are that typical applications of Vasicek's method seem to mistakenly equate the prior distribution with the cross-sectional distribution of estimated rather than true betas, that Blume's implicit forecast of any tendency for true betas to regress towards one may not be desirable, that preliminary partitioning of firms into industry type groups (as is typical for Vasicek) is desirable, and that conversion of OLS equity betas to asset betas before applying the correction process is also desirable.

Keywords: Betas, Blume, Vasicek
JEL classifications: G11/G12

1. Introduction

Market model betas are traditionally estimated by an OLS regression of asset returns on market returns. Two major problems with this process have been recognized in the literature. Firstly, true betas appear to be time varying, as indicated by, for example, Fabozzi and Francis (1978), Bos and Newbold (1984), Collins, Ledolter and Rayburn (1987), and Iqbal and Dheeriya (1991). Moreover this statistical evidence is supported by observed variation in factors believed to influence beta, such as financial leverage (see Hamada, 1972). Secondly, individual company beta estimates contain considerable sampling error, with the standard error typically exceeding 0.2. As a consequence of this, very low/high estimates tend to embody

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under/over estimation, i.e., "order bias" exists. A variety of methods have been suggested in the literature to deal with these problems. Two well-established methods that utilize only estimated betas are the Vasicek (1973) and Blume (1971, 1973) methods. The former deals only with the sampling error question, whilst the latter additionally captures any tendency for true betas to regress towards one over time. Examples of their use in the beta estimation industry are Value Line (1993), which supplies Blume betas, London Business School (1996), which supplies Vasicek betas, and Merrill Lynch (1992), whose betas can be viewed as Blume subject to the restriction that the parameters add to one. This paper seeks to examine and evaluate the Blume and Vasicek methods, and offer some suggestions for improvement in their application. However it focuses on the sampling error question, and ignores the multi-period problem of time varying betas.

Much work has been done on comparing these estimators with unadjusted betas as well as other estimation techniques (e.g., Klemkosky and Martin, 1975; Elton, Gruber and Urich, 1978; Eubank and Zumwalt, 1979; Dimson and Marsh, 1983). However, the comparisons here are purely empirical, with the test being the ability to predict future period-unadjusted estimates. By contrast, the primary concern here is theoretical. Furthermore, where empirical results are required, simulation rather than forecast ability is the preferred tool.

2. Vasicek betas

The Vasicek estimator of company j's true beta (β_j) is:

$$\beta_j^v = \beta_p(1 - x_j) + x_j \hat{\beta}_j \qquad (1)$$

where $\hat{\beta}_j$ is the OLS estimate of j's beta, β_p is the mean of the prior distribution (the belief about β_j exclusive of $\hat{\beta}_j$), and:

$$x_j = \frac{\sigma_p^2}{\sigma_p^2 + s^2(\hat{\beta}_j)} \qquad (2)$$

where σ_p^2 is the variance of the prior distribution, and $s^2(\hat{\beta}_j)$ the estimated variance of $\hat{\beta}_j$.

This estimator, springing from a Bayesian framework, pulls $\hat{\beta}_j$ in towards the prior mean β_p, with the degree depending upon the uncertainty about $\hat{\beta}_j$ relative to the spread in the prior distribution. Vasicek (1973, p. 1237) suggests that a prior might be an industry, and that the intra-industry distribution of $\hat{\beta}$ supplies the prior distribution:

> "Thus, if a utility stock is considered and it is known from previous measurements that betas of utilities are centered around 0.8, with a dispersion of 0.3 . . ."

Furthermore this interpretation is widespread. For example, Elton and Gruber (1995) say:

> "Let $\sigma^2(\overline{\beta}_i)$ stand for the variance of the distribution of the historical estimates of beta over the sample of stocks".

Also Alexander and Francis (1986) define the prior distribution's standard deviation to be the

> ". . . standard deviation for the cross-sectional distribution of $\hat{\beta}_j$'s . . ."

However the prior is not the intra-industry distribution of estimated betas ($\hat{\beta}$) but the intra-industry distribution of true betas (β). Clearly the best estimator of $E(\beta)$ is the sample mean of the $\hat{\beta}$'s (designated $\overline{\hat{\beta}}$). However the best estimator of $Var(\beta)$ is <u>not</u> $Var(\hat{\beta})$. Since the intra-industry $\hat{\beta}$ distribution comprises the β distribution and a distribution of estimation errors (e), presumed to be independent of β, then:

$$Var(\hat{\beta}) = Var(\beta) + Var(e)$$

and so:

$$Var(\beta) = Var(\hat{\beta}) - Var(e)$$

Thus an unbiased estimator of $Var(\beta)$ is not $Var(\hat{\beta})$ but:

$$Var(\hat{\beta}) - \hat{V}ar(e)$$

with Var(e) estimated by the sample average of the $s^2(\hat{\beta}_i)$ [denoted $\overline{s^2}(\hat{\beta}_i)$]. Lest one wonder at the significance of subtracting $\hat{V}ar(e)$, a typical $s^2(\hat{\beta}_i)$ is about 0.25^2 and this is quite substantial in relation to the intra industry $Var(\hat{\beta})$. Furthermore the mistaken use of $Var(\hat{\beta})$ instead of $Var(\beta)$ means that x_j becomes:

$$x_j = \frac{Var(\beta) + Var(e)}{Var(\beta) + Var(e) + s^2(\hat{\beta}_j)}$$

So even if $Var(\beta)$ were zero, in which case Vasicek should place zero weight on the OLS $\hat{\beta}_j$ [i.e., $x_j = 0$], this error will constrain x_j to approximately 0.5 [as $Var(e) \simeq s^2(\hat{\beta}_j)$]. Interestingly, Blume (1973) clearly recognizes the distinction between $Var(\beta)$ and $Var(\hat{\beta})$, but without associating the former (rather than the latter) with the variance of the prior distribution.

Summarizing the above discussion, Vasicek's beta is then:

$$\beta_j^V = \bar{\hat{\beta}}(1 - x_j) + x_j \hat{\beta}_j$$

$$x_j = \frac{\sigma_p^2}{\sigma_p^2 + s^2(\hat{\beta}_j)} = \frac{Var(\hat{\beta}) - \overline{s^2}(\hat{\beta}_i)}{Var(\hat{\beta}) - \overline{s^2}(\hat{\beta}_i) + s^2(\hat{\beta}_j)}$$

3. Blume betas

The Blume estimator of company j's beta is:

$$\beta_j^B = \hat{a} + \hat{b}\hat{\beta}_j$$

where $\hat{a}$ and $\hat{b}$ are the coefficients from cross-sectionally regressing betas estimated from one period against those estimated from an earlier period (Blume's parameters were 0.33 and 0.67 respectively). This process not only deals with order bias, but it extrapolates into the future any tendency for true betas to regress towards one over time (or the reverse). Blume provides evidence that such regression towards one has occurred, and others (e.g., Francis, 1979, Dimson and Marsh, 1983) provide supporting evidence. So, Blume's method involves both an estimate of the past beta and an implicit forecast of change.

Blume's presentation of the process utilized all firms in a single cross-sectional regression, and subsequent applications (e.g., Value Line, 1993) have followed the same practice. However this is not implicit in the method. Like Vasicek, the process could be applied to "industry" subsets. In this event the anchor, towards which individual $\hat{\beta}_j$ would be pulled, would be (like Vasicek) the industry mean rather than the global mean of one.

4. Sources of difference

The preceding discussion has already revealed two sources of difference between Blume and Vasicek betas: Blume's method involves an implicit forecast of change in true beta, and typical applications of Vasicek, but not Blume, partitions firms into "industry" subsets.

To identify any further sources of difference between them it is now assumed that the two procedures are applied to the same set of firms, i.e., Blume is applied to each industry, or Vasicek is applied to all firms in aggregate. Also, and again purely to isolate any further sources of difference between the two methods, it is assumed that true betas are constant over time. As noted, Blume's estimator for company j is:

$$\beta_j^B = \hat{a} + \hat{b}\hat{\beta}_j$$

where $\hat{\beta}_j$ is the OLS estimate of β_j and $\hat{a}$ and $\hat{b}$ are the coefficients from a cross-sectional regression of OLS beta in some period on that in an earlier period. Denoting these two periods as 1 and 2 then:

$$\hat{\beta}_{j1} = \beta_{j1} + e_{j1} \qquad \hat{\beta}_{j2} = \beta_{j2} + e_{j2}$$

By virtue of OLS:

$$\hat{b} = \frac{Cov(\hat{\beta}_2, \hat{\beta}_1)}{Var(\hat{\beta}_1)} \text{ where } \wedge \text{ indicates sample estimate}$$

$$= \frac{Cov(\beta_2 + e_2, \beta_1 + e_1)}{Var(\hat{\beta}_1)}$$

$$= \frac{Cov(\beta_1,\beta_2) + Cov(\beta_2,e_1) + Cov(\beta_1,e_2) + Cov(e_1,e_2)}{Var(\hat{\beta}_1)}$$

Since true beta is assumed constant over time, then $\beta_1 = \beta_2 \equiv \beta$. So:

$$\hat{b} = \frac{Var(\beta) + Cov(\beta,e_1) + Cov(\beta,e_2) + Cov(e_1,e_2)}{Var(\hat{\beta}_1)} \tag{3}$$

Also:

$$\hat{a} = \bar{\hat{\beta}}_2 - \hat{b}\bar{\hat{\beta}}_1 \qquad \text{where } \bar{} \text{ indicates sample mean}$$

So:

$$\beta_j^B = \bar{\hat{\beta}}_2 - \hat{b}\bar{\hat{\beta}}_1 + \hat{b}\hat{\beta}_j \tag{4}$$

By contrast, Vasicek's estimator for company j, using the latest (period 2) data, is:

$$\beta_j^V = \bar{\hat{\beta}}_2(1 - x_j) + x_j \hat{\beta}_j \tag{5}$$

$$x_j = \frac{Var(\hat{\beta}_2) - \overline{s^2}(\hat{\beta}_i)}{Var(\hat{\beta}_2) - \overline{s^2}(\hat{\beta}_i) + s^2(\hat{\beta}_j)}$$

$$= \frac{Var(\beta + e_2) - \overline{s^2}(\hat{\beta}_i)}{Var(\hat{\beta}_2) - \overline{s^2}(\hat{\beta}_i) + s^2(\hat{\beta}_j)}$$

$$= \frac{Var(\beta) + Var(e_2) + 2Cov(\beta,e_2) - \overline{s^2}(\hat{\beta}_i)}{Var(\hat{\beta}_2) - \overline{s^2}(\hat{\beta}_i) + s^2(\hat{\beta}_j)} \tag{6}$$

A comparison of equations (3) and (4) with (5) and (6) now reveals the conditions under which Blume and Vasicek are identical:

(a) $\bar{\hat{\beta}}_1 = \bar{\hat{\beta}}_2$ whereupon:

$$\beta_j^B = \bar{\hat{\beta}}_2(1 - \hat{b}) + \hat{b}\hat{\beta}_j$$

(b) $Cov(\beta,e_1) = Cov(\beta,e_2) = Cov(e_1,e_2) = 0$, and $Var(\hat{\beta}_1) = Var(\hat{\beta}_2)$, hence:

$$\hat{b} = \frac{Var(\beta)}{Var(\hat{\beta}_2)}$$

(c) $Var(e_2) = \overline{s^2}(\hat{\beta}_i)$ and $Cov(\beta,e_2) = 0$, whereupon:

$$x_j = \frac{Var(\beta)}{Var(\hat{\beta}_2) - \overline{s^2}(\hat{\beta}_i) + s^2(\hat{\beta}_j)}$$

(d) $\overline{s^2}(\hat{\beta}_i) = s^2(\hat{\beta}_j)$ whereupon $\hat{b} = x_j$ and so:

$$\beta_j^B = \overline{\hat{\beta}}_2(1 - x_j) + x_j\hat{\beta}_j = \beta_j^V$$

Conditions (a) and (b) reveal that Blume will differ from Vasicek due to time-series noise terms peculiar to Blume. Condition (c) reveals differences due to cross-sectional noise terms peculiar to Vasicek. Finally condition (d) reveals a difference due to Blume acting as if all security error variances are identical. So the sources of difference between Vasicek and Blume can be summarised as follows:

(i) Both Blume and Vasicek contain noise terms peculiar to their estimation processes.
(ii) Blume acts as if the error variance is the same for all securities.
(iii) Blume implicitly extrapolates any tendency for true betas to regress towards one over time, whilst Vasicek is forecast-free.
(iv) Blume is (but need not be) conventionally applied to all companies in aggregate, while Vasicek is conventionally applied to industry sets.

For comparison, it is interesting to note that Dimson and Marsh (1983) state that Blume and Vasicek betas will be equivalent if the error variances are the same for all securities and true betas are stationary over time. This corresponds to (ii) and (iii) above. The preceding analysis notes two further conditions : (i) and (iv).

5. Evaluation of Blume and Vasicek

5.1. Noise terms and constant error variance

Having identified the sources of difference, their relative merits can now be evaluated. Firstly, consider the distinct noise terms inherent in Blume and Vasicek. By virtue of being noise they are undesirable in an estimation process. However it is not clear which is the lessor evil.

Secondly, consider the Blume "presumption" that the error variance is the same for all securities. In general this will not be true, and Vasicek admits this possibility. So Vasicek is superior.

The remaining two distinctions between Blume and Vasicek warrant more detailed discussion, and this is conducted below:

5.2. Blume's forecast

As observed, Blume's method embodies both an estimate of past beta and a forecast for true beta to regress towards one. This package can be decomposed. Regarding the estimation element, the preceding section reveals that this can be obtained by simply applying Vasicek's method to the Blume company set, and with each $s^2(\hat{\beta}_j)$ set equal to the cross-sectional average. The forecast element of Blume is then the normal Blume output net of this estimation element. By contrast, Vasicek's method involves only estimation. Thus any desired forecast, including Blume's, could be coupled with it. Furthermore the option to desist from forecasting in some situations is present. However, should Blume's method omit or replace the forecast element, it would cease to be Blume. Consequently, Vasicek's method, by decoupling estimation and forecasting, cannot be inferior and may be superior.

A discussion of whether Blume's forecasting method is optimal takes one into the issue of time varying betas, which is beyond the scope of this paper. Furthermore even Blume (1973) recognizes that there is much more to the forecasting question than regression to one. However Blume's explanation for the observed tendency of true betas to regress towards one invites certain doubts. Blume (1973) attributes the regression to the fact that

> "... new projects taken on by firms may tend to have less extreme risk characteristics than existing projects"

However there is no reason to believe that this is an immutable law. If it were true, all betas would eventually become one! The most that one can really say is that:

(a) over the sample period, firms, on average, undertook projects with less extreme asset betas, possibly in the course of diversifying over industries; and/or
(b) over the sample period certain financing changes in firms occurred that caused beta regression towards one, on average. For example, Hamada (1972) shows that leverage increases equity beta, and therefore cross-sectional variation in leverage magnifies cross-sectional variation in equity betas. Thus, if cross-sectional leverage variation declined during the sample period, so too would cross-sectional variation in equity betas. Hence true betas would on average regress towards one.

Neither of these sample period behaviors look like immutable laws. In fact, the diversification explanation may very well have reversed during the 1980s when conglomerate mergers became less popular and spin-offs abounded. Furthermore these behaviors are at best only true for firms on average.

5.3. The partitioning question

As noted, Blume's method is conventionally applied to all companies in aggregate whilst Vasicek is conventionally applied to industry sets. To focus on this issue it is necessary to eliminate all other differences between the two methods. This is achieved by examining Vasicek betas with and without partitioning. The consequences of partitioning for beta estimation will depend upon the purpose of estimation. The following purposes are considered: estimating a specific firm's beta, estimating an industry average beta, and forming a portfolio of a specified beta.

In approaching this partitioning question, the possible techniques are simulation and, as referred to earlier, examining the accuracy of forecasts of future OLS estimates. However the latter technique's results impound accuracy in both estimating current betas and in forecasting time variation. The focus in this section is purely on the former. So simulation, which permits this, is the preferred technique. Consider the following cross-sectional distribution for β:

Industry A:	0.5	(10 firms)
	0.7	(10 firms)
Industry B:	0.9	(10 firms)
	1.1	(10 firms)
Industry C:	1.3	(10 firms)
	1.5	(10 firms)

For each β, let the OLS estimate $\hat{\beta}$ be unbiased as follows:

$\hat{\beta}$:	$\beta - 0.4$,	$\beta - 0.3$,	$\beta - 0.2$,	$\beta - 0.1$,	β,	$\beta + 0.1$,	$\beta + 0.2$,	$\beta + 0.3$,	$\beta + 0.4$
prob:	0.1,	0.1,	0.1,	0.1,	0.2,	0.1,	0.1,	0.1,	0.1

This distribution for $\hat{\beta}$ implies a standard deviation for $\hat{\beta}$ of 0.25, which is a typical actual outcome. Also a cross-sectional regression of β on $\hat{\beta}$ would yield, in a fully representative sample, intercept and slope of 0.34 and 0.66, which correspond almost exactly to Blume's parameters. So the simulation here is a fair imitation of reality.

Figure 1 represents the outcome from a representative sample, i.e., for each β the sampled $\hat{\beta}$ correspond to the population distribution (and are represented by *). If no partitioning is done then the prior distribution has mean one and variance of:

$$\sigma_p^2 = \text{Var}(\hat{\beta}) - \overline{\sigma^2}(\hat{\beta}_i) = 0.177 - 0.25^2 = 0.117$$

So, from equation (2):

$$x_j = \frac{\sigma_p^2}{\sigma_p^2 + s^2(\hat{\beta}_j)} = \frac{0.117}{0.117 + 0.25^2} = 0.66$$

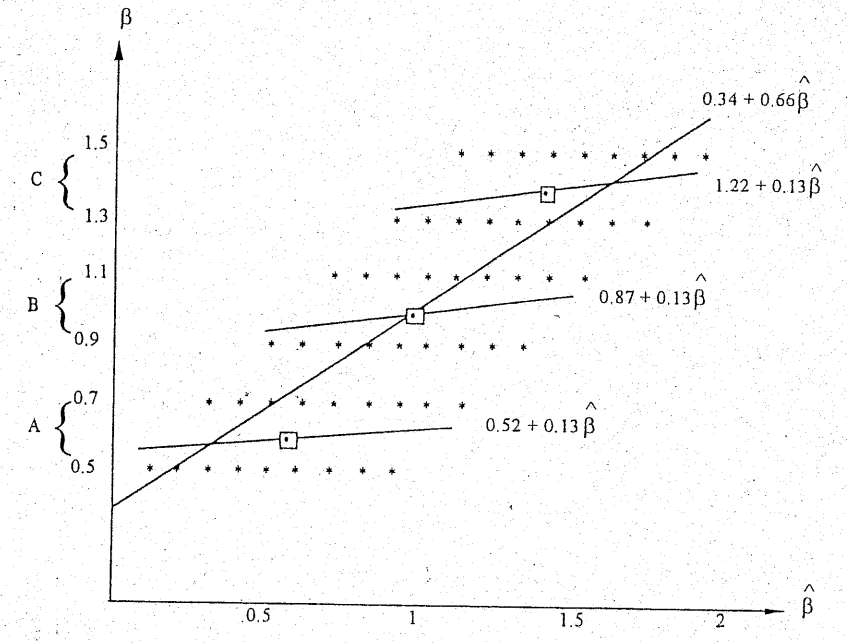


Figure 1
True β and OLS $\hat{\beta}$
The figure above shows the true betas (β) of six firms, the possible values (*) of their OLS estimates ($\hat{\beta}$), and the estimated linear relationship between the two, both in aggregate and for each of three industry sets (A, B, C).

and the estimator equation is then, from equation (1):

$$\beta_j^v = 0.34 + 0.66\,\hat{\beta}_j$$

This is shown in Figure 1 [these are the same parameters as those arising from regressing β on $\hat{\beta}$, confirming that Blume and Vasicek are identical when, inter alia, applied to the same company set]. Instead, if partitioning by industry occurs, then there is a separate estimator equation for each industry, calculated similarly to the above, and shown in Figure 1.

A: $\hat{\hat{\beta}}_j = 0.52 + 0.13\hat{\beta}_j$

B: $\hat{\hat{\beta}}_j = 0.87 + 0.13\hat{\beta}_j$

C: $\hat{\hat{\beta}}_j = 1.22 + 0.13\hat{\beta}_j$

Now consider the three purposes of estimating betas. First, consider estimating betas for individual firms. With no partitioning, the estimator is $0.34 + 0.66\hat{\beta}_j$.

Accordingly, the error for a firm represented in Figure 1 at (*) is the vertical distance of (*) from the line $0.34 + 0.66\hat{\beta}_j$. By contrast, with partitioning, the error is instead the vertical distance of (*) from the relevant "industry" estimator equation. Clearly the absolute errors with partitioning are dramatically smaller. Furthermore, partitioning eliminates the tendency for stocks in low β industries to be overestimated, and those in high β to be underestimated; instead low (high) β stocks within an industry tend to be overestimated (underestimated). To quantify the difference in errors, the MAD for no partitioning is 0.164, whilst partitioning almost halves it to 0.087. This simply reflects the fact that the unpartitioned estimator ignores a firm's industry, and this is very useful information in estimating β.

A dramatic example of this is in U.S. electric utilities. A typical such firm has an estimated beta (unadjusted) of around 0.4 (Value Line, 1993). By virtue of being typical, the Vasicek estimate, with prior corresponding to this industry, will also be 0.4. By contrast, Blume adjusts the 0.4 to 0.6 [i.e. 0.33 + 0.67(0.4)]. The result is a dramatic overestimate by Blume, because a singularly relevant fact is ignored, i.e., membership of an industry whose average estimated, and therefore presumably also true, beta is well below one. Given that these firms have output prices that are set so as to recover costs, including the cost of equity, and they have substantial equity investment, then the implications of using Blume betas (i.e., not partitioning into industries) for measuring costs of equity are particularly severe.

Second, consider estimating industry average betas. The unpartitioned estimator involves errors, and also bias in that low (high) beta industries are overestimated (underestimated). This is revealed in Figure 1 by the vertical spread between the industry means (□) and the estimator line $0.34 + 0.66\hat{\beta}_j$. For industries A, B, and C the errors are 0.136, 0, −0.136. By contrast, the partitioned estimators are error-free. As before the unpartitioned estimator ignores a highly useful piece of information in the form of the firm's industry. This absence of error from the partitioned estimators is simply due to the fact that the partitioning corresponds exactly to the industry classification (as well as the perfectly representative nature of the sample).

In general, there might be industry classifications which were more or less refined than the partitioning undertaken for purpose of beta estimation. In that event industry means would be estimated with error, even with a perfectly representative sample. For example, industry A might comprise two subsets (A1, A2), with A1 having 75% of its members with $\beta = 0.5$ and the rest $\beta = 0.7$, whilst A2 reversed the proportions. Applying a partitioned estimator to A as a whole, the average estimated beta for firms in A1 would be 0.592 and for A2 0.605. By contrast, the true average betas would be 0.55 and 0.65 respectively. Accordingly, the mean absolute error would be 0.044. With the unpartitioned estimator the average estimated betas for A1 and A2 would be 0.703 and 0.769, and so the mean absolute error would still be considerably larger (at 0.136). The fact that industries might be subsets of partitions leads to the question of why they might differ. This involves the issue of optimal partitioning, and is taken up below.

Third, consider forming a portfolio of a specific beta. As an example, consider all firms with $\hat{\beta} = 0.5$. Without partitioning these $\hat{\beta}$ are transformed to 0.67, and these firms are the only ones with an estimated beta of 0.67. So, to form a portfolio with a β of 0.67, one might weight equally these firms. Observing in Figure 1 that there are twice as many firms at the point (0.5, 0.5) as at (0.5, 0.7) or (0.5, 0.9), then the true β of this portfolio would be 0.65. So the error is 0.02 [of course, a portfolio with a β of 0.67 could be formed in other ways, but this process provides a convenient way in which to assess the errors from forming portfolios when no partitioning is done]. Across the entire set of estimated beta values, the errors exhibit no pattern and have mean absolute value of 0.041. By contrast, with partitioning, the mean absolute error, calculated in the same way, is much lower at 0.028. So again, partitioning is superior.

5.4. Sampling errors and partitioning

The above simulation reveals that if the intra industry distributions for $\hat{\beta}$ match the probability distribution (i.e., a fully representative sample), then partitioning by industry is superior for all three applications of beta estimates. The results are not an artifact of the particular example. They arise from the fact that partitioning causes the estimator equations to "fit" the data better (see Figure 1), because industries differ in their average betas.

The only significantly unrealistic characteristic of the simulation is the assumption of a perfectly representative sample. Naturally this does not generally arise, implying random errors in the estimator equations. This increases the errors described earlier. Furthermore these "sampling errors" will be graver for partitioned estimators because of their lower sample sizes. Conceivably these greater sample errors might be sufficient to outweigh the clear advantage which partitioning otherwise exhibits. This leads one to the idea of an optimal degree of partitioning, i.e., the degree of partitioning of firms into industries which trades off the advantages of partitioning (shown in the above simulation) against the disadvantages (greater "sample errors"), so as to minimize some function of the errors (mean absolute or mean squared, for example).

Since the simulation demonstrates a strong advantage to partitioning in the presence of fully representative samples (for all three purposes), and the disadvantage of partitioning must be slight when the degree of partitioning is slight, this indicates that some degree of partitioning will be optimal for all three purposes. Even the most elementary level of partitioning (say five "super industries") would still leave so many firms in each industry that "sample errors" would be insignificant, and so partitioning would be optimal. Beyond this it is difficult to say more without simulations. However, such simulations would offer conclusions about the optimal degree of partitioning which would be valid only for the particular scenario posed, and the intended purpose of the beta estimate. So this issue is not pursued here.

5.5. Summary of Blume versus Vasicek

The evaluation of Blume and Vasicek can now be summarised. Firstly, both Blume and Vasicek contain noise elements peculiar to their estimation process, and neither seems better in this respect. Secondly, Blume acts as if the error variance is the same for all securities under examination. Vasicek admits the contrary possibility, and therefore is superior. Thirdly, Blume is constrained to both engage in forecasting and to adopt a particular forecasting technique, when at least one of these may be undesirable in a particular situation. Since Vasicek is not constrained in this way, it cannot be inferior and may be superior. Lastly, for all three purposes of beta estimation, some degree of partitioning of firms into "industries" is optimal, with the degree possibly varying with the purpose in mind. Conventional applications of Blume do not do this (although it is entirely compatible with the process) whilst Vasicek does.

In light of these conclusions, the results of the purely empirical research into the relative merits of Blume and Vasicek are now recalled. The balance of these studies (e.g., Klemkosky and Martin, 1975; Elton, Gruber and Urich, 1978; Eubank and Zumwalt, 1979; Dimson and Marsh, 1983) marginally favors Blume in the sense of its accuracy in forecasting future OLS estimates. However, in all of these studies, no preliminary partitioning of firms into industry sets is carried out. So the advantage of partitioning which has been stressed above, and which is typically, but need not be, associated only with Vasicek is in no way contradicted by these results. Considering the remaining sources of difference between the two methods, the advantage demonstrated by Blume in these studies presumably reflects the fact that true betas on average regressed towards one over the sample period, which only Blume reflects, and this advantage more than offsets the disadvantage of assuming equal error variances for all securities. However, as argued, there is no reason to believe that this historical tendency, evident in the sample period, constitutes an immutable law. Moreover, any belief that the trend will continue, and which is considered relevant in a particular situation, can be coupled with the Vasicek estimate.

A process for maximizing the benefits of partitioning is now, finally, considered in the next section. This section co-mingles financial and statistical models in order to improve the beta estimates.

6. Reducing beta dispersion via Hamada's leverage formula

It has been argued that, for all three purposes of estimating betas, some degree of partitioning is probably optimal. This is because it produces sets of companies with less dispersion in β, but at the price of greater sample error due to reduction in the number of firms in each set. This implies that firms should be partitioned into groups according to their perceived β. Equally importantly it points to the

desirability of any preliminary adjustments to OLS betas which can further reduce intra group dispersion.

An extreme case of an adjustment process to OLS betas is that of Rosenberg and Guy (1976), in which other micro variables, which have been found empirically to improve beta estimation, are utilized. However a discussion of this takes one well beyond the realms of Blume and Vasicek, and so is not pursued here. An alternative approach, consistent with Blume and Vasicek, is to correct for some beta differences using a theoretical formula. The only apparent such opportunity is in the use of a Hamada (1972) type formula to correct for financial leverage. The researcher would convert OLS betas to asset betas using this formula, then apply Blume or Vasicek to these asset betas, and finally readjust back to equity betas (using the same leverage level as the firm or industry of concern, according to whether the subject of estimation was an individual firm or an industry average beta). Of course, the leverage formula may not be correct. But, so long as its application yields a value closer to the truth than by acting as if financial leverage does not affect equity beta, then it will be desirable to do so.

To illustrate this point, suppose all firms in an industry have the same asset beta (0.6) but exhibit differences in leverage (0 and 0.5). Then equity betas will vary, i.e., the unlevered firms will have equity betas of 0.6 and, using Hamada's (1972) formula with a corporate tax rate of 0.33, the rest will have equity betas of:

$$0.6\left[1 + (1 - 0.33)\frac{50}{50}\right] = 1$$

As we have seen, such intra-industry variation in equity betas yields biased estimates of individual firm equity betas, i.e., the low-equity beta stocks will tend to be overestimated and the high-equity stocks to be underestimated. However, if equity betas are first converted to asset betas, then the common asset beta would be estimated without bias. Having done this, gearing up the asset beta then produces an unbiased estimate of the firm's equity beta. In short, just as Vasicek-type partitioning improves beta estimates by recognizing a critical variable in the form of industry membership, so too does a preliminary adjustment to asset beta, by recognizing an additional variable in the form of financial leverage.

One final point here deserves mention. Having converted to asset betas, application of Vasicek requires the standard error on each asset beta estimate. However standard errors are only available on equity betas. This problem is easily overcome. In Hamada's formula:

$$\beta_e = \beta_a\left[1 + \frac{B}{S}(1 - T_c)\right]$$

where β_a is the asset beta, B the firm's debt level over the period, S its equity value, and T_c the corporate tax rate. This formula holds not merely for true β_e and β_a, but also for their estimates $\hat{\beta}_e$ and $\hat{\beta}_a$. So:

$$\text{Var}(\hat{\beta}_e) = \text{Var}(\hat{\beta}_a)\ [1 + \frac{B}{S}(1 - T_c)]^2$$

Given the estimate of $\text{Var}(\hat{\beta}_e)$ from OLS regression, then $\text{Var}(\hat{\beta}_a)$ is obtained from this equation.

7. Summary

This paper has examined the Vasicek and Blume methods for correcting OLS beta estimates. The conclusions follow. First, typical applications of Vasicek's method mistakenly equate the prior distribution with the cross-sectional distribution of estimated rather than true betas, and this leads to a significant overestimate of the prior variance. Second, Vasicek has the advantage of admitting cross-sectional differences in error variances. Third, Vasicek has the further advantage of avoiding an implicit forecast of any tendency for true betas to regress towards one over time, thereby allowing any desired forecast to be coupled with it. Fourth, the partitioning of firms into "industries" before applying the correction process is desirable, with the optimal partitioning possibly dependent on the specific purpose of the beta estimate. Finally, preliminary conversion of OLS equity betas to asset betas, before application of Blume or Vasicek, offers further improvements to the estimation process.

Extending this analysis into a multi-period context that brings time varying betas into the analysis is a task left for future research.

References

Alexander, G., and J. Francis, 1986. *Portfolio Analysis*, 3rd ed., (Prentice Hall, New Jersey).
Blume, M., 1971. On the assessment of risk, *Journal of Finance* 26, 1–10.
Blume, M., 1973. Betas and their regression tendencies, *Journal of Finance* 30, 785–795.
Bos, T., and P. Newbold, 1984. An empirical investigation of the possibility of stochastic systematic risk in the market model, *Journal of Business* 57, 35–41.
Collins, D., J. Ledolter, and J. Rayburn, 1987. Some further evidence on the stochastic properties of systematic risk, *Journal of Business* 60, 425–448.
Dimson, E., and P. Marsh, 1983. The stability of U.K. risk measures and the problem of thin trading, *Journal of Finance* 38, 753–783.
Elton, E., and M. Gruber, 1995. *Modern Portfolio Theory And Investment Analysis*, 5th ed., (Wiley, New York).
Elton, E., M. Gruber, and T. Urich, 1978. Are betas best, *Journal of Finance* 28, 1375–1384.
Eubank, A., and J. Zumwalt, 1979. An analysis of the forecast error impact of alternative beta adjustment techniques and risk classes, *Journal of Finance* 36, 761–776.
Fabozzi, F., and J. Francis, 1978. Beta as a random coefficient, *Journal of Financial and Quantitative Analysis* 13, 101–116.
Francis, J., 1979. Statistical analysis of risk surrogates for NYSE stocks, *Journal of Financial and Quantitative Analysis* 14, 981–997.
Hamada, R., 1972. The effect of the firm's capital structure on the systematic risk of common stocks, *Journal of Finance* 27, 435–458.
Iqbal, Z., and P. Dheeriya, 1991. A comparison of the market model and the random coefficients model using mergers as an event, *Journal of Economics and Business* 43, 87–93.
Klemkosky, R., and J. Martin, 1975. The adjustment of beta forecasts, *Journal of Finance* 30, 147–153.

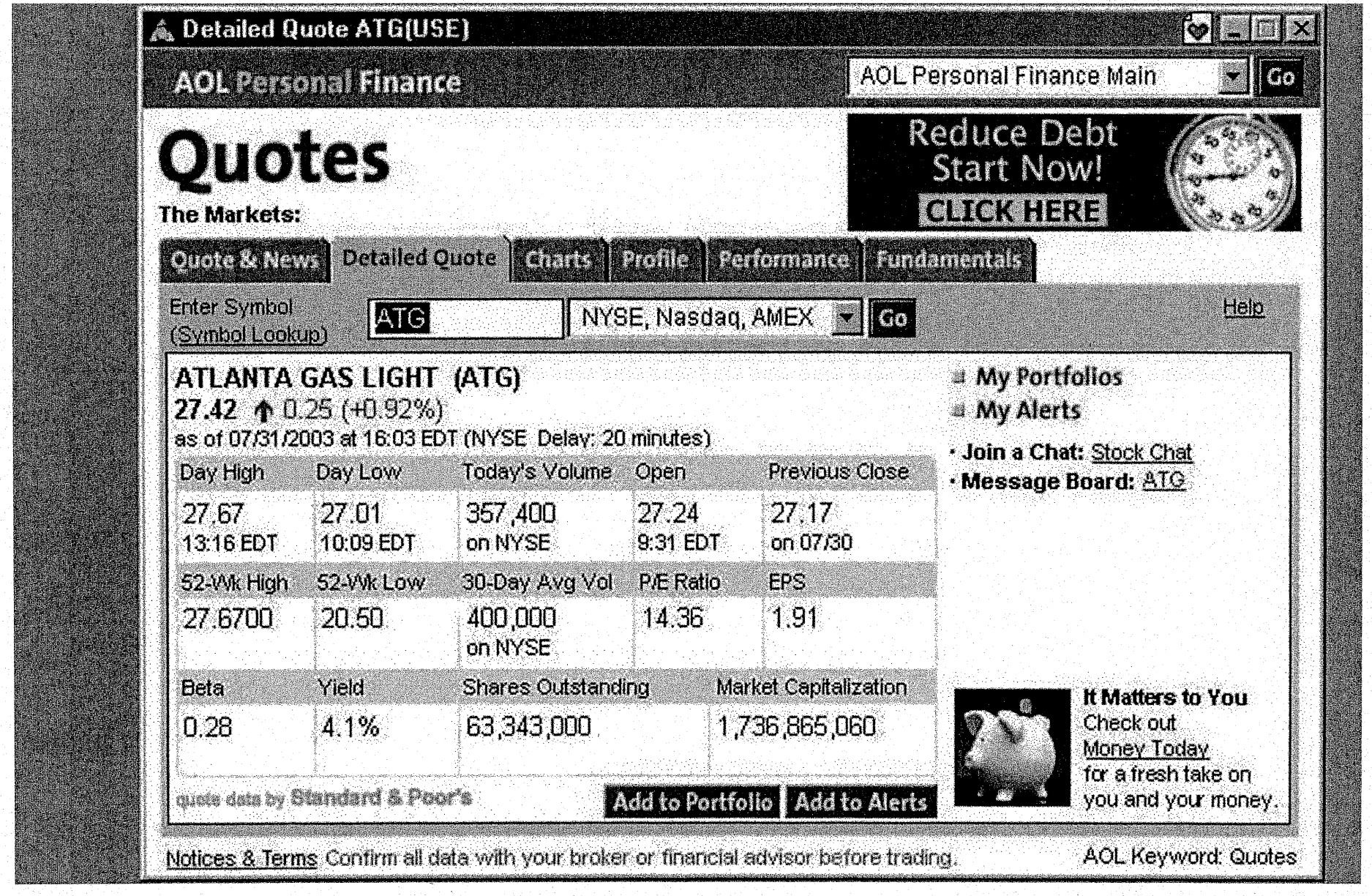
London Business School, 1996. *Risk Measurement Service.*
Merrill Lynch, Pierce Fenner and Smith, Inc, 1992. *Security Risk Evaluation.*
Rosenberg, B., and J. Guy, 1976. Prediction of beta from investment fundamentals: Part II, *Financial Analysts Journal,* July–Aug, 62–70.
Vasicek, O., 1973. A note on using cross-sectional information in Bayesian estimation of security betas, *Journal of Finance* 28, 1233–1239.
Value Line Publishing, Inc, 1993. *Value Line Investment Survey.*

Response to Request 27 of 39

27. In reference to the prefiled testimony of Consumer Advocate witness Brown set forth at page 58, lines 18 and 19 and Schedule SB 15, please provide a copy of each and every source document from which Mr. Brown draws "other" beta values and identify the date and source of publication thereof.

Answer:

Data for CAPD calculations is provided on the enclosed diskette. Screen copies of Standard & Poor's and Yahoo data sheets are attached. Screen copies were made on July 31, 2003 - as indicated by the July 31 date in the Standard & Poor's data sheets.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ATLANTA GAS LIGHT (ATG)
27.42 0.25 (+0.92%)
as of 07/31/2003 at 16:03 EDT (NYSE Delay: 20 minutes)
Day High
27.67
13:16 EDT
Day Low
27.01
10:09 EDT
Today's Volume
357,400
on NYSE
Open
27.24
9:31 EDT
Previous Close
27.17
on 07/30
52-Wk High
27.6700
52-Wk Low
20.50
30-Day Avg Vol
400,000
on NYSE
P/E Ratio
14.36
EPS
1.91
Beta
0.28
Yield
4.1%
Shares Outstanding
63,343,000
Market Capitalization
1,736,865,060
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ATMOS ENERGY CP (ATO)

24.37 ↓ 0.16 (-0.65%)

as of 07/31/2003 at 16:02 EDT (NYSE Delay: 20 minutes)

Day High	Day Low	Today's Volume	Open	Previous Close
24.68 11:15 EDT	24.31 15:38 EDT	108,600 on NYSE	24.51 9:35 EDT	24.53 on 07/30
52-Wk High	**52-Wk Low**	**30-Day Avg Vol**	**P/E Ratio**	**EPS**
25.50	20.41	253,000 on NYSE	13.54	1.80
Beta	**Yield**	**Shares Outstanding**		**Market Capitalization**
0.05	4.8%	49,904,000		1,216,160,480

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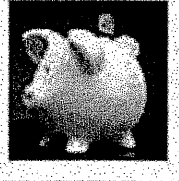

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NICOR INC (GAS)

36.28 ↑ 0.02 (+0.06%)

as of 07/31/2003 at 16:03 EDT (NYSE Delay: 20 minutes)

Day High	Day Low	Today's Volume	Open	Previous Close
36.80 12:05 EDT	36.28 16:03 EDT	215,700 on NYSE	36.51 9:37 EDT	36.26 on 07/30
52-Wk High	**52-Wk Low**	**30-Day Avg Vol**	**P/E Ratio**	**EPS**
39.30	23.70	308,000 on NYSE	11.70	3.10
Beta	**Yield**	**Shares Outstanding**		**Market Capitalization**
0.29	5.1%	44,021,000		1,597,081,880

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NORTHWEST NAT GAS (NWN)

28.47 ↑ 0.44 (+1.57%)

as of 07/31/2003 at 16:04 EDT (NYSE Delay: 20 minutes)

Day High	Day Low	Today's Volume	Open	Previous Close
28.65 14:09 EDT	28.06 9:32 EDT	78,200 on NYSE	28.06 9:32 EDT	28.03 on 07/30
52-Wk High	**52-Wk Low**	**30-Day Avg Vol**	**P/E Ratio**	**EPS**
30.70	24.05	62,000 on NYSE	17.57	1.62
Beta	**Yield**	**Shares Outstanding**		**Market Capitalization**
-0.07	4.4%	25,663,000		730,625,609

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N J RESOURCES CP (NJR)

34.88 ↑ 0.08 (+0.23%)

as of 07/31/2003 at 16:01 EDT (NYSE Delay: 20 minutes)

Day High	Day Low	Today's Volume	Open	Previous Close
35.05 10:45 EDT	34.62 10:09 EDT	102,300 on NYSE	34.90 9:30 EDT	34.80 on 07/30
52-Wk High	**52-Wk Low**	**30-Day Avg Vol**	**P/E Ratio**	**EPS**
36.87	29.50	72,000 on NYSE	14.47	2.41
Beta	**Yield**	**Shares Outstanding**		**Market Capitalization**
0.09	3.5%	27,127,000		946,189,760

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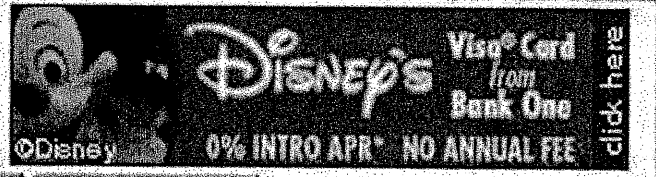

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PEOPLES ENERGY CP (PGL)

40.99 ↓ 0.39 (-0.94%)

as of 07/31/2003 at 16:04 EDT (NYSE Delay: 20 minutes)

Day High	Day Low	Today's Volume	Open	Previous Close
41.45 10:46 EDT	40.99 15:39 EDT	225,300 on NYSE	41.39 9:36 EDT	41.38 on 07/30
52-Wk High	**52-Wk Low**	**30-Day Avg Vol**	**P/E Ratio**	**EPS**
45.25	27.80	180,000 on NYSE	14.13	2.90
Beta	**Yield**	**Shares Outstanding**		**Market Capitalization**
0.05	5.1%	36,052,000		1,477,771,480

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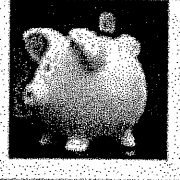

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PIEDMONT NAT GAS CO (PNY)

38.23 ↑ 0.16 (+0.42%)

as of 07/31/2003 at 16:01 EDT (NYSE Delay: 20 minutes)

Day High	Day Low	Today's Volume	Open	Previous Close
38.43 14:17 EDT	37.93 10:09 EDT	111,600 on NYSE	38.26 9:33 EDT	38.07 on 07/30
52-Wk High	**52-Wk Low**	**30-Day Avg Vol**	**P/E Ratio**	**EPS**
41.50	31.55	172,000 on NYSE	18.83	2.03
Beta	**Yield**	**Shares Outstanding**		**Market Capitalization**
0.08	4.3%	33,441,000		1,278,449,429

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WGL HOLDINGS INC (WGL)

25.51 ↓ 0.07 (-0.27%)

as of 07/31/2003 at 16:02 EDT (NYSE Delay: 20 minutes)

Day High	Day Low	Today's Volume	Open	Previous Close
25.97 9:46 EDT	25.50 15:56 EDT	148,100 on NYSE	25.75 9:30 EDT	25.58 on 07/30
52-Wk High	**52-Wk Low**	**30-Day Avg Vol**	**P/E Ratio**	**EPS**
28.79	21.94	204,000 on NYSE	13.02	1.96
Beta	**Yield**	**Shares Outstanding**		**Market Capitalization**
0.14	5.0%	48,583,000		1,239,352,330

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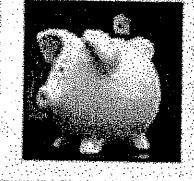

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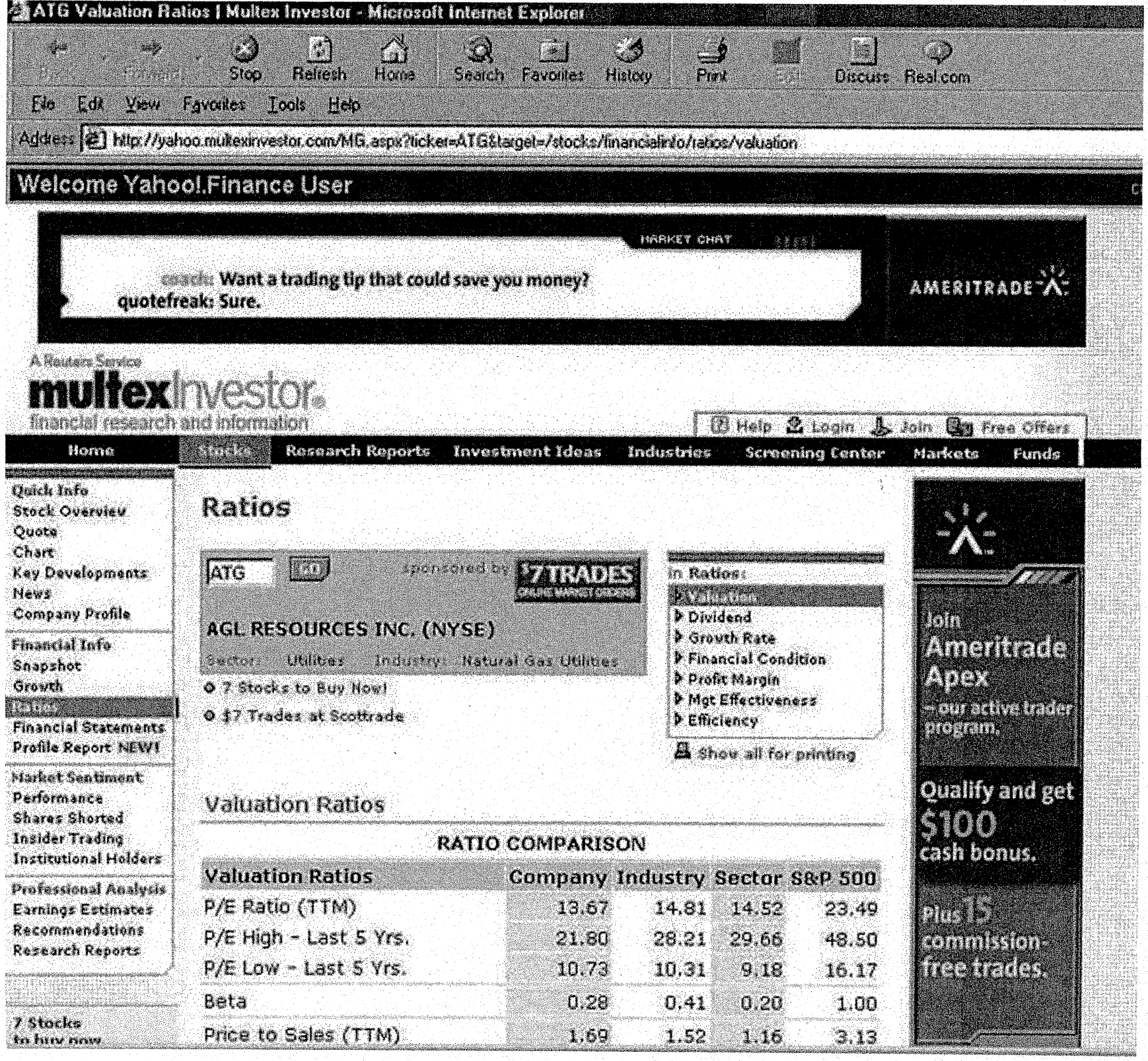
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Favorites
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Discuss
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RATIO COMPARISON
Valuation Ratios | Company | Industry | Sector | S&P 500
P/E Ratio (TTM) | 13.67 | 14.81 | 14.52 | 23.49
P/E High - Last 5 Yrs. | 21.80 | 28.21 | 29.66 | 48.50
P/E Low - Last 5 Yrs. | 10.73 | 10.31 | 9.18 | 16.17
Beta | 0.28 | 0.41 | 0.20 | 1.00
Price to Sales (TTM) | 1.69 | 1.52 | 1.16 | 3.13
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Valuation Ratios

RATIO COMPARISON

Valuation Ratios	Company	Industry	Sector	S&P 500
P/E Ratio (TTM)	13.47	14.81	14.52	23.49
P/E High - Last 5 Yrs.	40.57	28.21	29.66	48.50
P/E Low - Last 5 Yrs.	12.56	10.31	9.18	16.17
Beta	0.05	0.41	0.20	1.00

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Sector: Utilities Industry: Natural Gas Utilities

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In Ratios:

- Valuation
- Dividend
- Growth Rate
- Financial Condition
- Profit Margin
- Mgt Effectiveness
- Efficiency

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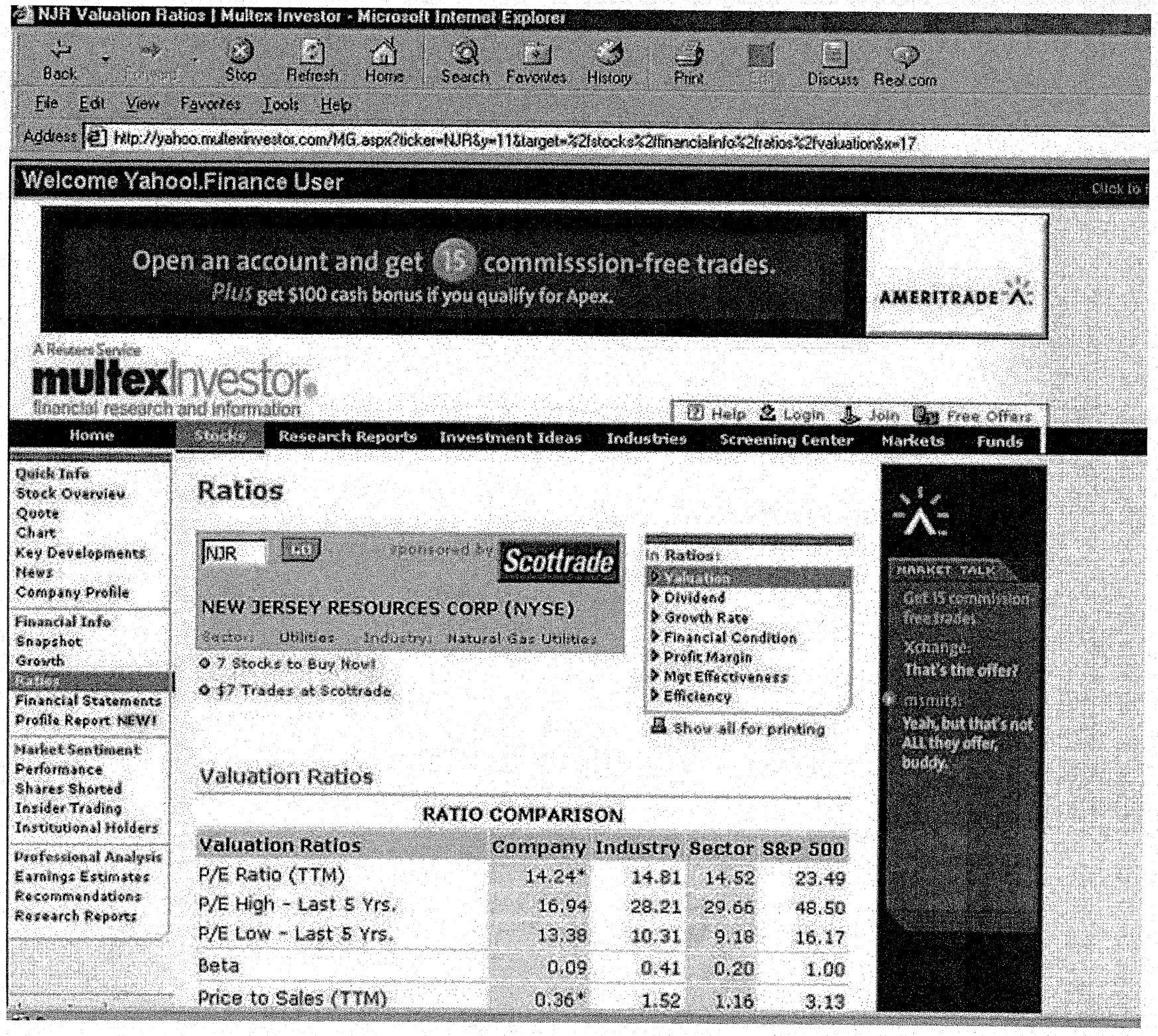
Valuation Ratios

RATIO COMPARISON

Valuation Ratios	Company	Industry	Sector	S&P 500
P/E Ratio (TTM)	10.96*	14.81	14.52	23.49
P/E High - Last 5 Yrs.	85.10	28.21	29.66	48.50
P/E Low - Last 5 Yrs.	8.97	10.31	9.18	16.17
Beta	0.30	0.41	0.20	1.00
Price to Sales (TTM)	0.61*	1.52	1.16	3.13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RATIO COMPARISON
Valuation Ratios Company Industry Sector S&P 500
P/E Ratio (TTM) 14.24* 14.81 14.52 23.49
P/E High - Last 5 Yrs. 16.94 28.21 29.66 48.50
P/E Low - Last 5 Yrs. 13.38 10.31 9.18 16.17
Beta 0.09 0.41 0.20 1.00
Price to Sales (TTM) 0.36* 1.52 1.16 3.13
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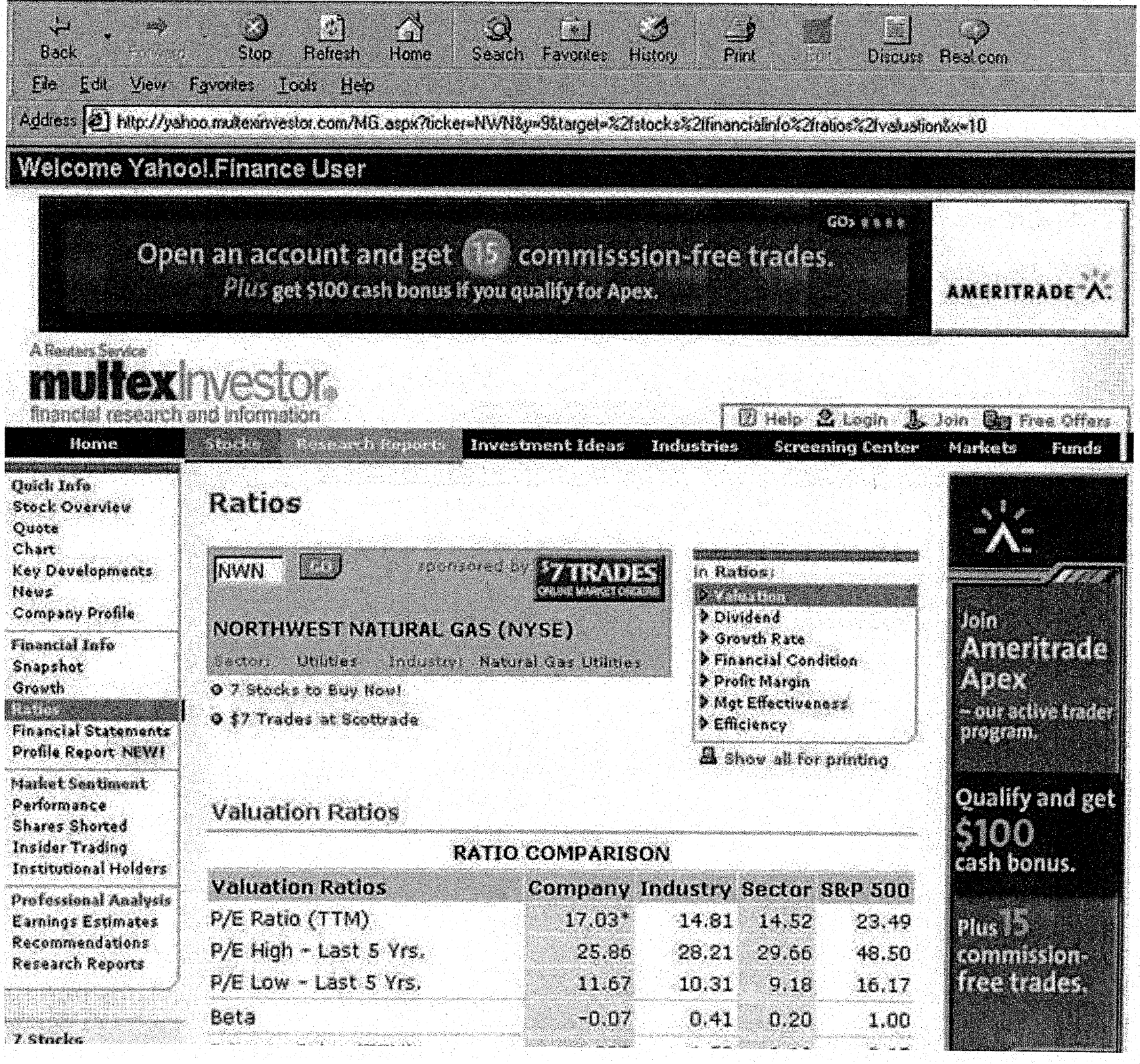
That's the offer?
msmith:
Yeah, but that's not ALL they offer, buddy.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RATIO COMPARISON
Valuation Ratios | Company | Industry | Sector | S&P 500
P/E Ratio (TTM) | 17.03* | 14.81 | 14.52 | 23.49
P/E High - Last 5 Yrs. | 25.86 | 28.21 | 29.66 | 48.50
P/E Low - Last 5 Yrs. | 11.67 | 10.31 | 9.18 | 16.17
Beta | -0.07 | 0.41 | 0.20 | 1.00
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PEOPLES ENERGY CORP. (NYSE)

Sector: Utilities Industry: Natural Gas Utilities

Valuation Ratios

RATIO COMPARISON

Valuation Ratios	Company	Industry	Sector	S&P 500
P/E Ratio (TTM)	14.17	14.81	14.52	23.49
P/E High - Last 5 Yrs.	19.61	28.21	29.66	48.50
P/E Low - Last 5 Yrs.	9.85	10.31	9.18	16.17
Beta	0.05	0.41	0.20	1.00

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PIEDMONT NATURAL GAS CO. (NYSE)

Sector: Utilities Industry: Natural Gas Utilities

in Ratios:

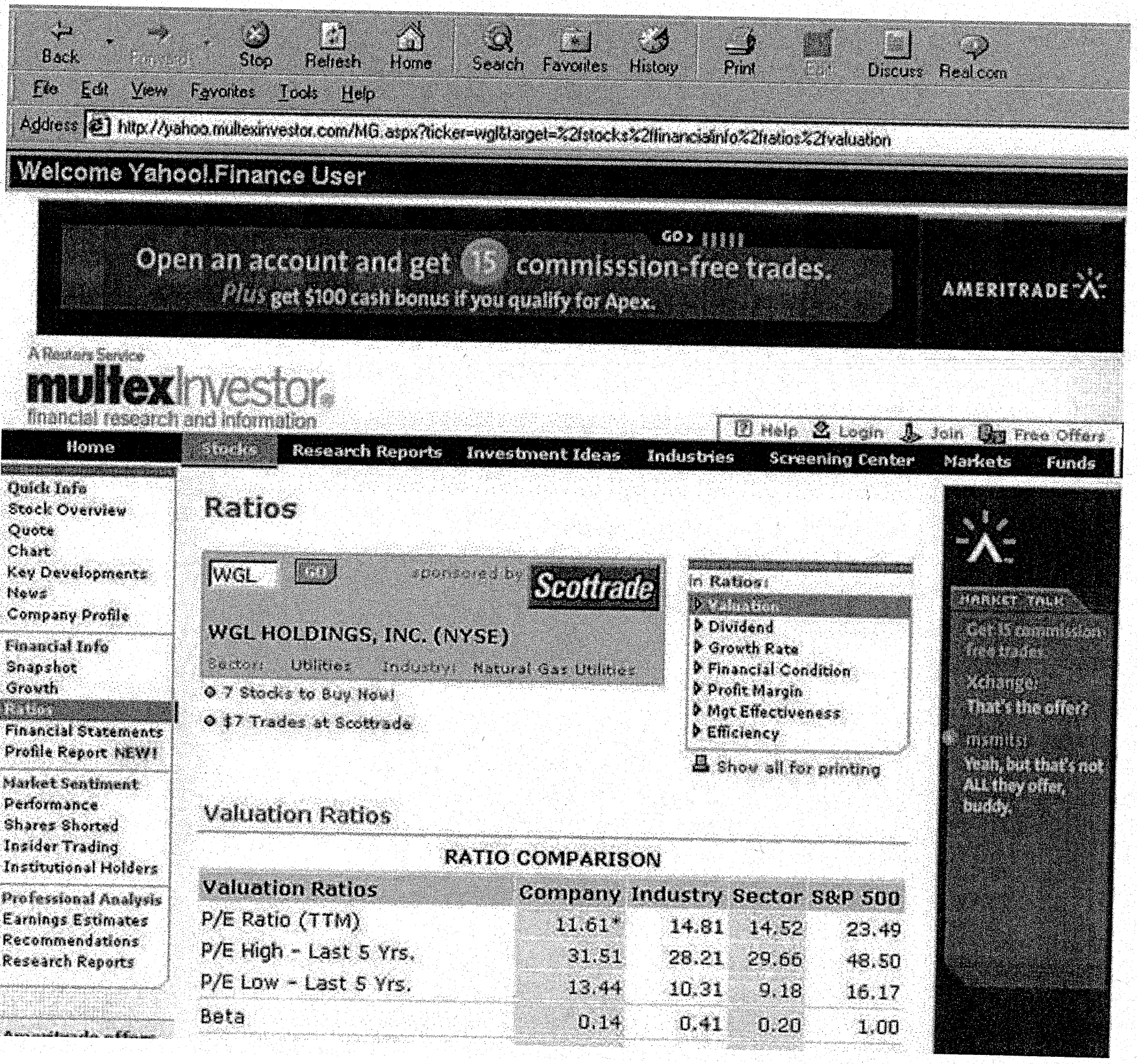
- Valuation
- Dividend
- Growth Rate
- Financial Condition
- Profit Margin
- Mgt Effectiveness
- Efficiency

Show all for printing

Valuation Ratios

RATIO COMPARISON

Valuation Ratios	Company	Industry	Sector	S&P 500
P/E Ratio (TTM)	18.56	14.81	14.52	23.49
P/E High - Last 5 Yrs.	21.58	28.21	29.66	48.50
P/E Low - Last 5 Yrs.	13.07	10.31	9.18	16.17
Beta	0.08	0.41	0.20	1.00
Price to Sales (TTM)	1.09	1.52	1.16	3.13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Valuation Ratios
RATIO COMPARISON
Valuation Ratios | Company | Industry | Sector | S&P 500
P/E Ratio (TTM) | 11.61* | 14.81 | 14.52 | 23.49
P/E High - Last 5 Yrs. | 31.51 | 28.21 | 29.66 | 48.50
P/E Low - Last 5 Yrs. | 13.44 | 10.31 | 9.18 | 16.17
Beta | 0.14 | 0.41 | 0.20 | 1.00
MARKET TALK
That's the offer?
Yeah, but that's not ALL they offer, buddy.

28. Please provide a copy of each and every source document from which the beta values reflected on Schedule SB 18 are derived and identify the date and source of publication thereof.

Answer:

Data for CAPD calculations is provided on the diskette enclosed for response no. 27.

29. In reference to the prefiled testimony of Consumer Advocate witness Brown set forth at page 64, lines 12 through 18, please explain, in detail, every reason or fact supporting Mr. Brown 's assertion that "If the betas from Standard & Poor's or Yahoo were used in Dr. Murry's CAPM analysis, the equity returns would be about 7.2 percent" and provide a copy of each and every workpaper, document, treatise or financial accounting principle upon which Mr. Brown relied in reaching such conclusion.

Answer:

That assertion is just a conclusion arrived at by taking the values of the Standard & Poor's betas from Dr. Brown's Schedule 15 and substituting them for the Value Line betas in Dr. Murry's Schedules DAM-16 and DAM-17. The results approximate 7.2 percent

30. In reference to the prefiled testimony of Consumer Advocate witness Brown set forth at page 74, lines 9 through 13, please explain, in detail, every reason or fact supporting Mr. Brown's assertion that Dr. Murry's "recommended return is not credible because it relies on Value Line's long-term earnings growth rates, which are untested and unlikely to be achieved in the future" and provide a copy of each and every document, treatise or financial accounting principle upon which Mr. Brown relied in reaching such conclusion.

Answer:

Value Line forecasts an eight percent annual growth rate in earnings, a growth rate not achievable in today's economic circumstances, see the attached article.

The Federal Reserve Board and the Stock Market Bubble

THE RELATIONSHIP IS MORE COMPLEX THAN IT APPEARS.

By Spencer F. England

Spencer England publishes "Spencer England's Equity Review (SEER)," an independent equity strategy product for professional investors. Prior to 1987, he was an economist-strategist for two different investment management firms. He began his career as an international economist for the Central Intelligence Agency. He is a former President of the Boston Association of Business Economists.

The stock market rose to unprecedented valuations in the late 1990 and was widely considered to be a bubble. The Federal Reserve Board has come under severe criticism recently for causing the bubble and has felt compelled to defend its record. Monetary policy has long been considered a major factor driving the stock market P/E. But how monetary policy impacts the market is more complex than the Federal Reserve Board and its critics realize, and both have made major analytical errors. A simple adaptive behavioral model that uses the percent of the time the market has been in a bull market over the prior twenty years as a measure of the risk premium, as well as interest rates and inflation, demonstrates that an S&P 500 P/E of over twenty is justified and why the relationship between interest rates and the market P/E underwent structural changes in the late 1950s and 1990s. It also shows that if the Federal Reserve Board had tried to prick the 1990s market bubble they would have had to raise rates enough to severely damage the economy. Results from the model also carry major implications for the future relationship between monetary policy and the stock market.

The Federal Reserve Board is now coming under so much criticism and blame for the stock market bubble and its aftermath that it has felt compelled to defend its record. But the Board and its critics have made critical analytical errors on both the stock market bubble and the weak performance of the economy. Until recently, these errors had little impact, but now they may be contributing to monetary policy being too tight.

The one clear measure of the market bubble is the market price-to-earnings ration (P/E).[1] It has been greater than twenty on trailing operating earnings since mid-1997. This is the only time in history that an S&P 500 P/E above twenty has been sustained. It had only been above twenty some five times before—1929, 1938,

[1]The P/E used in this article is always the S&P 500 trailing earnings P/E. Prior to 1989, it is based on reported earnings as calculated and reported by Standard and Poors. Trailing P/Es are based on what is known at the time. So the January and February P/E is based on trailing third quarter earnings per share (EPS), March, April and May is based on trailing fourth quarter EPS, June, July and August on first quarter EPS, and so on. Since 1989, the P/E is based on trailing operating earnings calculated by the author, using the S&P methodology and data. S&P has just recently started calculating and reporting the operating earnings P/E. In December 1996 when Federal Reserve Board Chairman Alan Greenspan made the "Irrational Exuberance"speech the operating earnings P/E was 17.2 and the reported earnings P/E was 19.1.

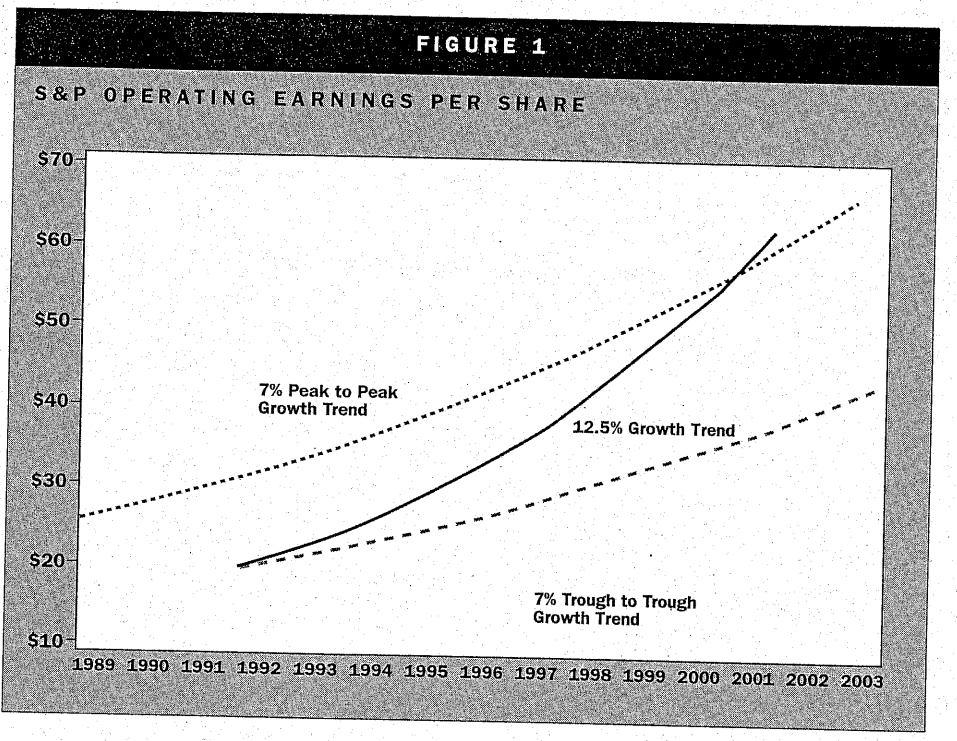
1946, 1962 and 1987. Each of those times it was above twenty for only a very short period, and each episode preceded a major stock market crash. Actually, if one had put all assets into cash in June 1997, when the P/E rose above twenty, they would now have higher returns than if they had ridden the market up and back down.

The market P/E is generally viewed simply as a valuation measure, but it is much more than that. It represents what investors are willingly to pay for growth at any given time. The P/E of both the market and individual stocks is a function of their expected growth rate. A low grower will sell at a discount to the market P/E, and a superior grower will sell at a premium. Changes in P/Es are largely governed by the rules of present value analysis and compound interest rates. Bull and bear markets are almost exclusively a function of P/E expansion and compression rather than earnings changes. Thus, a bear market results when the perceived present value of the future stream of income falls, and a bull market results when the perceived present value of that income stream rises. Also, the higher an individual stock's P/E, the more severe will be the impact of a change in the market's P/E on its own P/E. For example, if the market P/E is cut in half, a growth stock's P/E might fall two-thirds, while a value stock's P/E would only fall one quarter. Thus, growth stocks outperform a bull market and under perform a bear market.

There are two new-era arguments as to why the stock market is different this time and why we are now in a new and sustained higher level of market valuation. The first is based on earnings themselves and holds that we have entered a new era of stronger earnings growth. The Federal Reserve Board and its critics have focused on this argument. (It is also the argument that Irving Fisher made in 1929.) The second has to do with investor psychology about those earnings and holds that the risk premium should be lower and the P/E higher because the economy and market have become more stable. This is the argument Jeremy Siegel made in *Stocks for the Long Run* (2002). It was also the argument behind James Glassman and Kevin Hassett in *Dow 36,000* (2000).

Figure 1 shows that from 1991 to 2000, S&P operating earnings per share grew at a 12.5 percent annual average rate, a rate significantly higher than its post-World War II era seven percent long-term trend. Moreover, during the same period productivity broke out of its 1974-1995 trend of only 1.5 percent growth versus its earlier long-term three percent trend. Wall Street quickly pounced on these shifts as evidence that we were in a new era of permanently higher earnings growth and incorporated double-digit earnings growth trends into long-run earnings forecasts. This upward shift of analysts' growth expectations to double-digit levels is what the Federal Reserve Board repeatedly cites as justification for higher P/Es.

FIGURE 1



But in the 1990s, S&P earnings growth on a peak-to-peak basis, and on a trough-to-trough basis was still seven percent, its prior long-term trend. Wall Street had simply mistaken a double-digit trough-to-peak earnings rebound —a perfectly normal cyclical development—for a new secular trend. This error was easy to make because while the early 1990s earnings decline was relatively shallow, it was prolonged. In a typical cycle, S&P earnings surpass their prior peak in about two years. But this time it took five years. So in the mid-to-late 1990s, when companies started reporting double digit long-term earnings growth, it was understandable that Wall Street overlooked that it was a distorted trough-to-peak trend. But given the Federal Reserve Board's reputation for knowing and understanding the data, it is hard to understand how it made the same analytical error. Moreover, while productivity growth has improved, it is still below its pre-1975

trend of three percent. Finally, we just had the most severe earnings decline since the depression.

Put simply, there is no evidence that the economy has entered a new era of permanently higher earnings growth, even though Wall Street analysts still forecast double-digit growth. But from current depressed levels, it would take years of double-digit earnings growth just to return earnings growth to the seven percent long-term trend. The argument that permanently higher earnings justify higher P/Es has been disproved.

The second justification for higher P/Es is that the economy and market are more stable now and this justifies a lower risk premium and higher P/Es. In contrast to earnings, inflation and interest rates—where measures of trends and changes are readily available—there is no clear measure of the risk premium. The risk premium is thought of as the extra return investors demand for investing in volatile stocks rather than more stable bonds. A standard definition of the equity risk premium is the extra return that the overall stock market or a particular stock must provide over the rate on Treasury Bills to compensate for market risk.

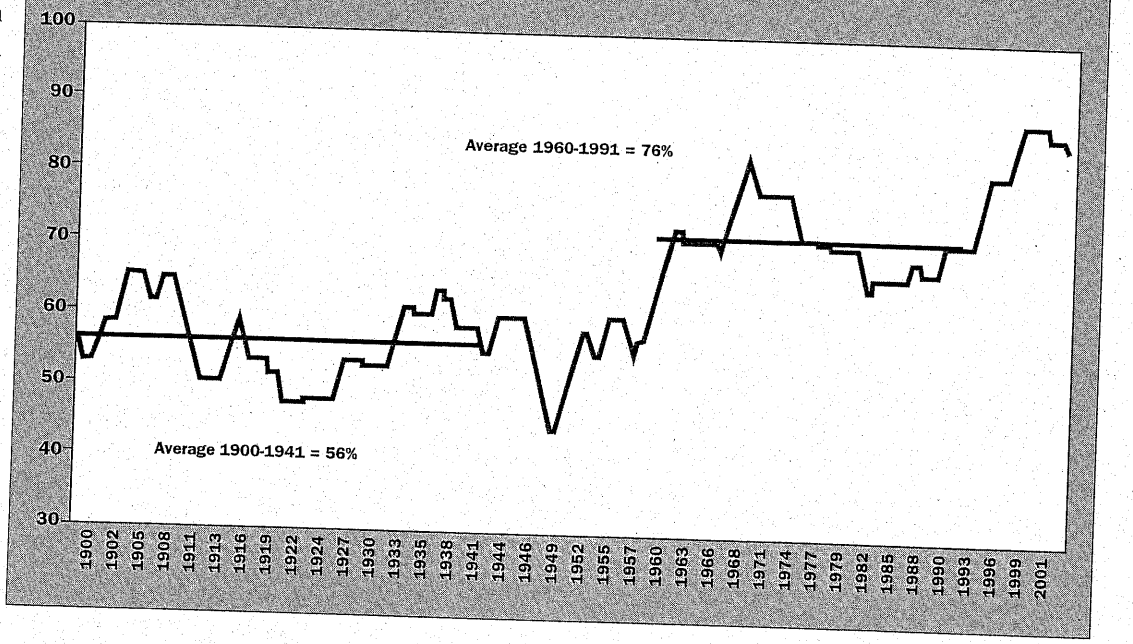
Wall Street generally ignores the risk premium because it is not perceived as a market mover. Wall Street's P/E analysis focuses almost exclusively on interest rates and inflation. The market P/E is an inverse function of inflation, rates, and the risk premium. The market P/E represents the present value of a perpetual stream of seven percent earnings growth adjusted for current inflation, interest rates, and the risk premium. However, since WW II there have been two major changes in the relationship between the market P/E and rates and inflation. These occurred in the late 1950s and the late 1990s. P/E equations based on rates and inflation that worked between 1960 and 1990 no longer worked in the late 1990s and they had never worked for the 1950s. Since there was no change in the long-term rate of earnings growth in either the late 1950s or late 1990s, these shifts in the market P/E's relationship to rates and inflation had to stem from a change in the risk premium.

One needs to find a measure of the risk premium that explains these shifts in the P/E. One measure of the risk premium that captures both trends and short-run changes is the frequency of bull and bear markets. This is not the standard definition, but it is a very useful concept. Figure 2 shows that before WW II stocks were in a bear market almost fifty percent of the time. From WW II to the early 1960s the frequency of bear markets underwent a secular change so that by the early 1960s stocks experienced a bear market only some twenty-five percent of the time. In the 1990s, the frequency of bear markets apparently changed again, as from 1980 to 2000 stocks were in a bear market only eleven percent of the time. Historically, this measure is essentially a constant for very long periods—from 1960 to 1990, for example. Consequently, when it is stable it has little impact on the market P/E, so interest rates and inflation appear to explain P/E moves. But when it moves from one level to another, as it did in the 1950s and 1990s it has a major impact on the market P/E.

The reduced risk premium and its associated decline in the frequency of bear markets stemmed from two factors. One, the cyclical sectors of the economy, like manufacturing and agriculture, became less important as sectors like government, education, and healthcare became more important. Second, the Fed learned to implement a

FIGURE 2

PERCENT OF TIME IN BULL MARKET OVER PRIOR 20 YEARS



counter-cyclical monetary policy. Before WW II, monetary policy ranged from random to pro-cyclical, which contributed to recessions and bear markets being more frequent and severe than after WW II. The Fed was created to do two things: dampen the business cycle and keep financial panics from spreading to the real economy. In this context, the Federal Reserve's greatest contribution to the bull market was its success in helping the economy achieve a record business expansion.

Investor psychology and expectations are based largely on investors' experiences. They gradually adapt and change as their experience changes. That is, investors tend to see the future in the rear-view mirror. But this is common for all types of human activities, and behavioral economists frequently build such behavior into their models. Thus, investors' experience with bull and bear markets should be a very good measure of the risk premium behind the stock market P/E. This is shown in Figure 3.

Equation (1), which incorporates the percent of the time the market has been in a bull market (RISK) over the past twenty years, explains the shifts between the market P/E and rates and inflation that occurred in both the 1950s and 1990s. It is significant that this P/E equation works for the entire post WW II era , as most P/E equations, based only on rates and inflation, only work for limited time spans. The equation was estimated on monthly data for 1946-2000. It uses the all commodities producer price index (PPI) as a measure of inflation because monthly consumption deflator data are not available for the entire time span. In addition, the PPI is a better leading indicator of the stock market P/E than the consumer price index. Data on several measures of Fed policy, such as the Fed funds rate rate and zero maturity money supply, are not available for the entire time span either. The equation also contains a dummy variable to adjust for a quality of earnings issue in the late 1970s when inflation significantly distorted depreciation and reported earnings. The equation has an R-squared of 84. All t-values (in italics) are statistically significant. Figure 4 shows the degree to which the equation fits the actual data.

(1) P/E= -4.7(DUMMY) + 0.28(RISK) -0.22 (PPI) –0.59 (T-BOND)
-11.7 *68.5* *-12.1* *-13.4*

In the late 1990s, the monthly increase in RISK (which is negatively related to risk premium) had an enormous impact on the market P/E. The model implies that the impact of a monthly change in RISK was about the same as a twenty basis point change in T-bond yields. Over a twelve-month period, its cumulative impact raised the market P/E about 125 basis points. This is about the same market impact as a 200 to 250 basis point change in T-bond yields, or over a ten percent change in earnings.

Fed critics contend that if the Board had followed the irrational exuberance speech in December 1966 with a modest tightening they could have deflated the bubble. But this analysis of the market P/E clearly shows that the Board is correct that it would have required a significant tightening. From December 1996—when Federal Reserve Board Chairman Alan Greenspan made his "Irrational Exuberance" speech—until July 1998, the peak just prior to the Long-Term Capital correction, the S&P 500 P/E on trailing operating earnings rose from 17.2 to 26.0, a 51.1 percent jump. Over this period the Fed funds rate target was increased once from 5.25 percent to 5.50 percent. T-bonds started at about 6.30 percent, and fell to under 5.0 percent. Inflation, as measured by the personal consumption expenditures (PCE) deflator fell from 2.4 percent to 1.0 percent, and the percent of

FIGURE 3

PERCENT OF TIME IN BULL MARKET AND S&P 500 P/E

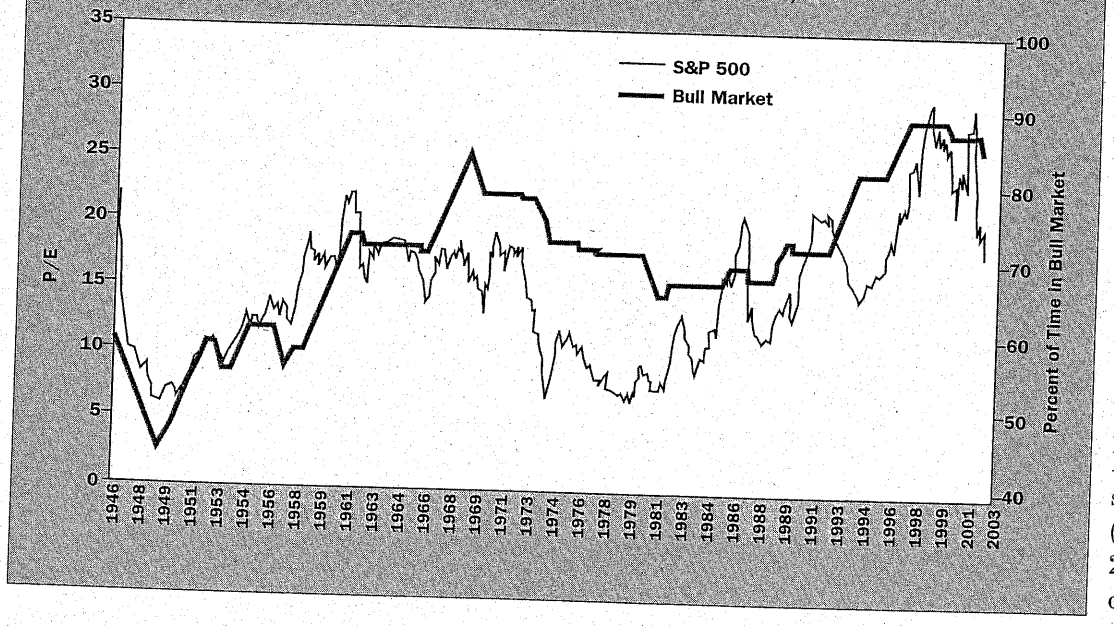
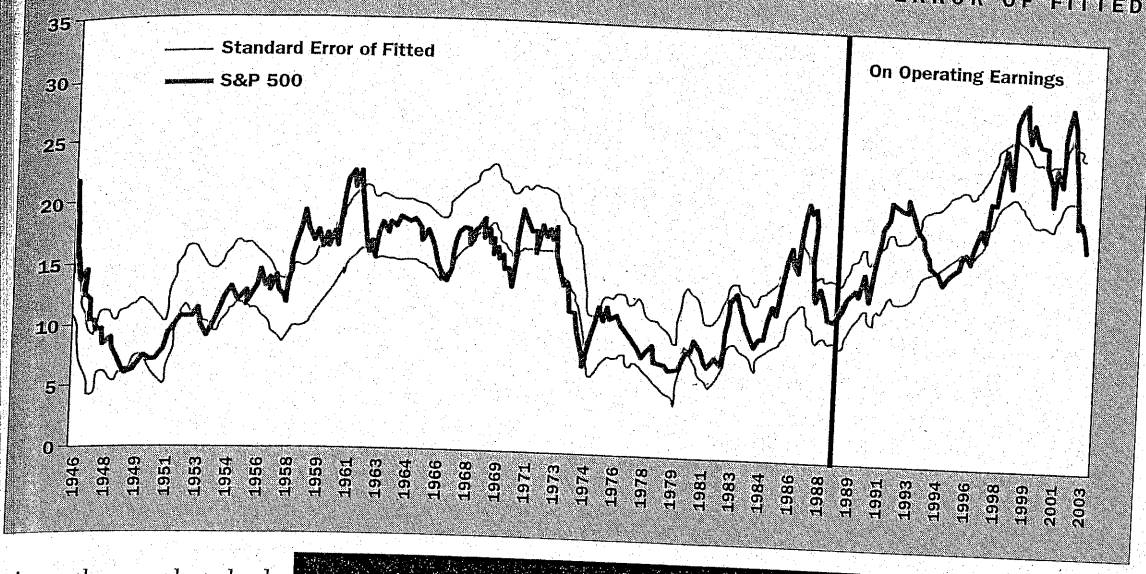


FIGURE 4

ACTUAL S&P 500 P/E COMPARED TO +/- ONE STANDARD ERROR OF FITTED



time the market had been in a bull market over the prior twenty years rose from 82 percent to 88.75 percent. To offset these positive factors and an almost 800 basis point P/E rise would have required a major tightening.

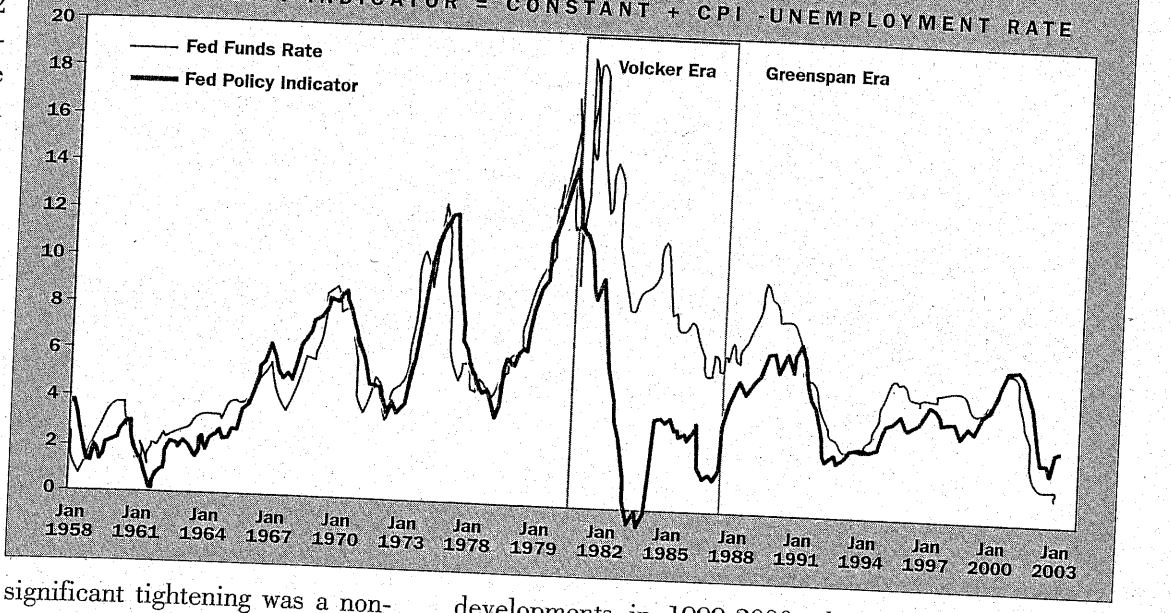
Over this period there was an undercurrent of criticism from Congress and Wall Street that the Fed was too tight, and Figure 5 shows that my Fed Policy Indicator was well below the Fed funds rate.[2] A significant tightening was a nonstarter. This analysis clearly shows that the argument that the Fed could have easily deflated the bubble in 1997-98 is a horrible case of Monday morning quarterbacking. Actually, as explained below, the Fed funds rate may not be the best Fed policy measure to use in evaluating the impact of Fed policy on the stock market, but this still does not change the conclusion that a minor tightening would not have deflated the stock market bubble. It also reinforces the earlier conclusion that the Fed's greatest contribution to the bubble was its very success in contributing to a record long business expansion and reducing inflation.

These conclusions are reinforced by developments in 1999-2000 when the Fed raised the funds target rate from 4.75 percent in June 1999 to 6.50 percent in May 2000. Inflation as measured by the PCE deflator rose from 1.5 percent in May 1999 to a peak of 3.0 percent in March 2000 before easing back to 2.5 percent in May 2000. T-bond yields rose from under 6.00

FIGURE 5

FEDERAL FUNDS RATE AND THE FED POLICY INDICATOR

FEDERAL POLICY INDICATOR = CONSTANT + CPI -UNEMPLOYMENT RATE



[2]The Fed Policy Indicator is a version of the Taylor Rule. The indicator uses the unemployment rate rather than the gap between potential and actual real GDP used in the Taylor rule for two reasons. One, the GDP gap is dependent on the accuracy of estimated productivity growth and is suspect. Historic estimates of potential GDP have undergone several significant revisions. Second, because the GDP gap is quarterly, there is a three-to-five month lag before it is known, while the unemployment rate is available with only a five- to six-week lag. Federal Open Market Committee policy discussions focus much more on the unemployment rate than the GDP gap. The wide spread between the index and fed funds in the 1980s reflects the disinflationary policy under Chairman Volcker. The index implies that Fed policy in the 1990s was not that different from policy under previous Feds or the policy of simply applying a mechanical decision rule.

percent to over 6.50 percent while the risk premium was unchanged. Over this time the market P/E fell from 28.9 to 26.9, a 6.9 percent decline, while earnings growth was almost twenty percent. The P/E drop was not enough to offset the surge in earnings. Moreover, regression analysis indicates that the rise in inflation and bond yields played a larger role in the P/E decline than the Fed funds rate increase. Remember, the consensus expected each of the six Fed tightenings to be the last, and stocks rallied after each one.

Most of the criticism of the Fed over the bubble does not stem from quantitative analysis of P/E changes. It is probably much more a reaction to Greenspan's repeated speeches and testimony that were so optimistic about the new economy. Historically, such "Open Mouth" policies rarely have more than a fleeting impact on markets. But given investors' faith in the "Greenspan Put," it could account for much of the unexplained residual in the P/E model, especially since the P/E rose from below to above one standard error of the model, as shown in Figure 4. However, as with Greenspan's analysis of the 1990s profits growth, his analysis of the productivity rebound and capital spending boom may have been seriously flawed.

For productivity, there is a body of research, some of it by Fed economists (Oliner and Sichel, 2000, 2002; Stiroh, 2001, 2002; Whelan, 2000), showing that the productivity improvement since 1995 was very narrowly focused within the high tech industry. A broad consensus has emerged that about half the post-1995 productivity improvement stemmed from both the production and use of high tech equipment. Some contend that high tech production alone may have accounted for up to half the improvement. To the extent that productivity increases stemmed from high tech production, it was only the result of a naturally high productivity sector experiencing strong, above trend growth. The 4.1 percent productivity gain in 2002 is cited as evidence that the productivity revolution is intact. But productivity has a strong cyclical pattern of above trend growth in the recovery phase and slowing sharply in expansions. In the last six cycles, excluding the aborted 1981 one, productivity growth averaged 4.7 percent in the first year, 2.2 percent in the second year, and 1.8 percent in the third year. On this basis, the 2002 productivity gain was one of the weakest on record. Moreover, the normal cyclical slowdown seems to be appearing right on schedule. Productivity data now includes a recession and recovery, so the post-1995 period approximates a full cycle. Since 1995, productivity has averaged 2.4 percent versus the 3.0 percent pre-1975 trend and 1.5 percent trend from 1975 to 1995. Productivity has improved, but it is not a revolution, and how narrowly focused it has been is still an open question.

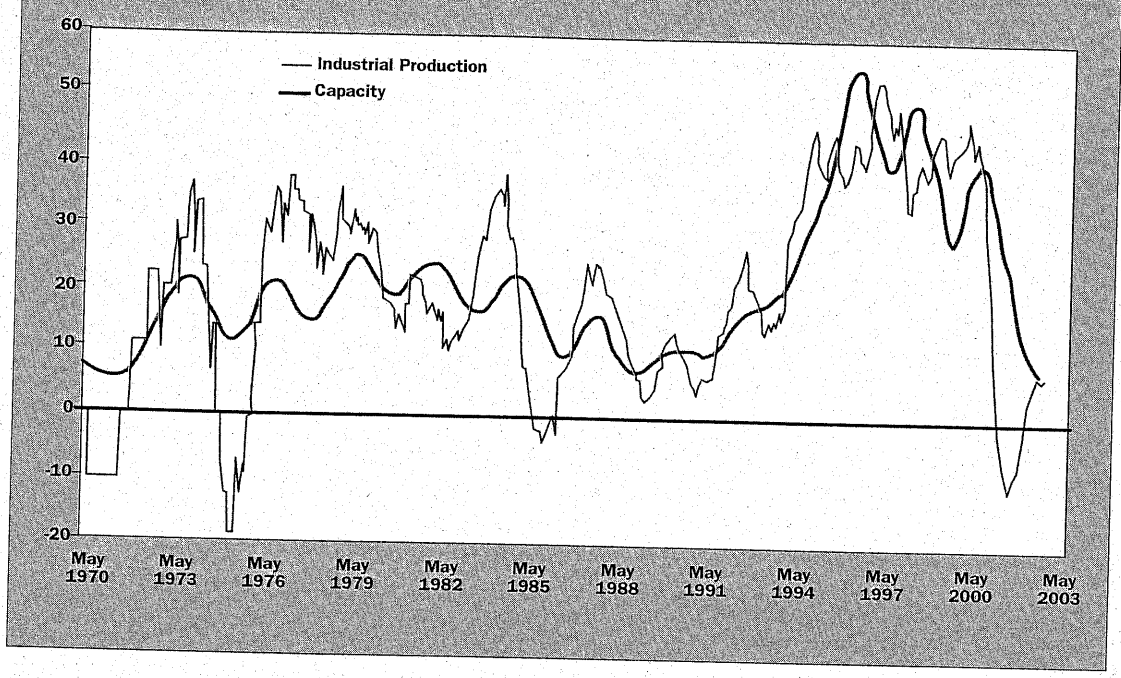
The second aspect of the 1990s bubble was the massive increase in capital spending on technology. The Federal Reserve Board and most analysts viewed this as a widespread increase in investments throughout the economy. But an insight developed by Jay Forrester (1961,1968), using a system dynamics approach to the question of why capitalist economies are subject to cycles, suggests that the nature of the capital spending boom was very different.[3] Forrester's insight was that when a capital spending boom develops, it quickly encounters bottlenecks because the capital goods sector itself had insufficient capacity. Consequently, the capital goods sector starts ordering massive amounts of capital goods from itself to expand its own capacity. This creates a self-reinforcing feedback loop—but in a way, they are simply taking in each other's laundry.

From 1995 to 2000, industrial production of high tech goods grew at a forty percent annual rate, more than double its long run trend. But over the same period, high tech capacity growth was also about forty percent. The high tech sector is very high tech intensive, and its capacity growth had to be a massive source of high tech demand, maybe on the order of fifty percent or more. It undoubtedly was the primary reason capital spending reached record levels in the 1990s. But this meant that when demand slowed just a little, this self-reinforcing feedback loop reversed. As demand weakened, producers concluded that they needed less capacity and canceled orders. This created a self-reinforcing downward spiral that may not be over. The data imply that the 1990s capital spending boom was exactly the self-reinforcing bubble that Forrester's models describe. The consequent volatility of production and capacity is shown in Figure 6. This type of feedback mechanism is also is a major reason that the information tech collapse and economic downturn was not a consequence

[3]Forrester pioneered the development of systems dynamics, a field to apply the engineering principles of feedback and control to social institutions and policies. The methodology relies heavily on stock versus flow analysis. Because it incorporates feedback loops and other techniques, systems dynamics is very good at discovering and demonstrating how institutions and policies that appear correct may actually be counterproductive and self-defeating. A simple example might be the impact of the stock market on savings and corporate profits. If an individuals' goal is to accumulate a million-dollar stock portfolio at retirement, it is easy to calculate the inflow of savings to the portfolio needed under an assumption of average long run stock returns. But if stock market returns are above the long run average the individual may elect to reduce the inflow of savings. Thus, the extended bull market could be a major reason for the recent decline in savings rates, especially since savings and stock ownership are both concentrated in the same upper income groups. This is exactly the concept firms use to calculate their contributions to defined-benefit programs and is a feedback loop whereby bull markets tend to inflate reported profits and bear markets reduce them.

FIGURE 6

COMPUTERS, COMMUNICATION EQUIPMENT AND SEMICONDUCTORS
YEAR-OVER-YEAR PERCENT CHANGE

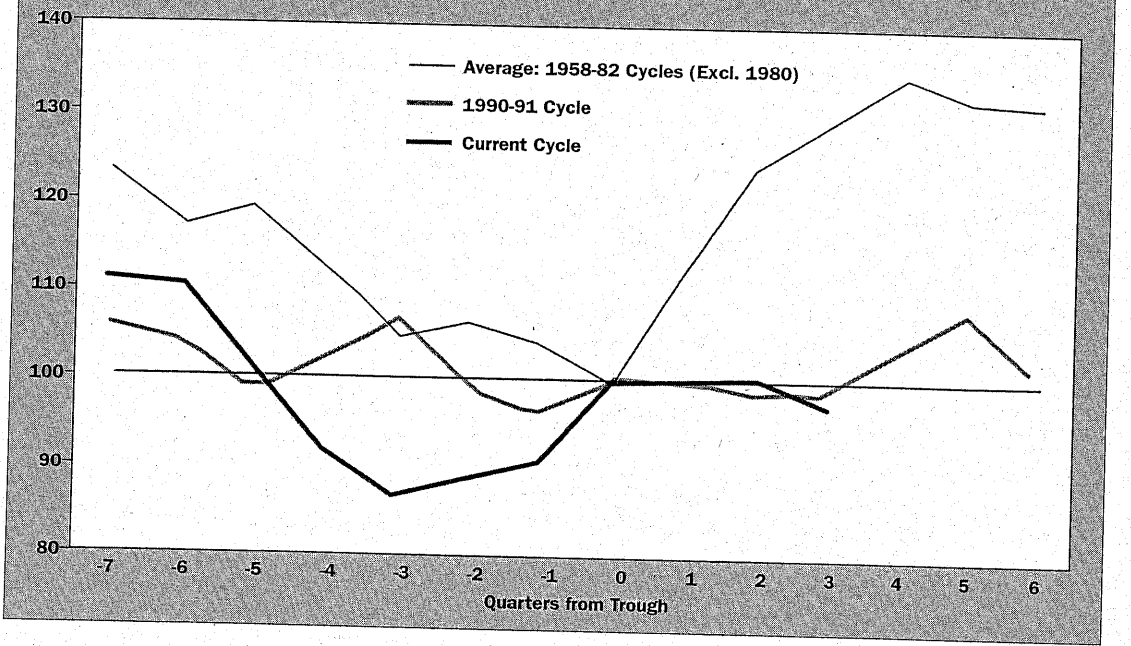


of tight money or oil shocks, as other post WW II recessions have been. It is the dominant reason this economic cycle is so different.

The aftermath of the stock market bubble and capital spending boom has created a very unusual economic environment for stocks. If 2002 was the first year of a recovery, it was among the weakest on record, and the only one without a rising stock market. Moreover—because of suppar productivity growth, rising fringe benefits (largely healthcare and pension costs), and weak pricing—the normal cyclical earnings re-bound is not materializing. Nonfinancial corporate profits per unit are now lower than at the economic bottom, as shown in Figure 7. Typically, this measure rebounds thirty-three percent in the first year of a recovery. Although S&P 500 operating earnings rose almost twenty percent in 1992, the gain was largely because there were fewer write-offs. Adjusted for this, S&P earnings were only up about six percent. In August, 2002 Greenspan cited the consensus bottom-up estimate that S&P 500 earnings would be $60 in 2003 to justify stock's high P/E. As of April 2003, that estimate is quickly approaching $50. Although bottom-up analysts' year-ahead forecasts are usually too optimistic, this downward revision of expectations is exceptionally large. Most importantly, the market P/E has declined despite a major drop in bond yields and Fed easing.

FIGURE 7

NONFINANCIAL CORPORATE PROFITS PER UNIT
INDEX: 100 = RECESSIONS TROUGH



In 2001, the Fed undertook what it viewed as a very aggressive easing. The Fed reaction was based partly on its study of the Japanese experience and a conclusion that the best policy response to a potentially deflationary, stagnant economy was to ease early and aggressively. If policy was too easy it could always be reversed. But my Fed Policy Indicator implies that the Fed easing was within historic norms and may not have been as aggressive as they think.

The Fed can only target one objective, and it now targets short-term interest rates. But historically, the Fed has targeted other measures. In the 1980s, the target was money supply; and for a time in the 1950s, it was free reserves. Currently, there is much discussion of the idea that the Fed should target inflation. Although the Fed is now targeting the Fed funds rate, and policy analysis is virtually always couched in term of rates, this does not mean that the other measures cannot be used to evaluate policy. In P/E regression models, both free reserves and money supply are clearly superior policy indicators to the Fed funds rate. In P/E regressions including free reserves and money supply, the Fed funds rate drops out as an insignificant variable. This may be an example of Bank of England Advisor Charles Goodhart's law that any variable used as a policy instrument becomes irrelevant and gives false signals. But it is probably more that the relationship between interest rates and the stock market is linear. This means that at low rates and high P/Es, interest rate changes have a smaller market impact. For example, if a given rate decline leads to a 200 basis point P/E increase, at a P/E of ten it is a twenty percent impact but at a P/E of twenty it is only ten percent.

FIGURE 8

RELATIONSHIP BETWEEN S&P 500 P/E AND FREE RESERVES

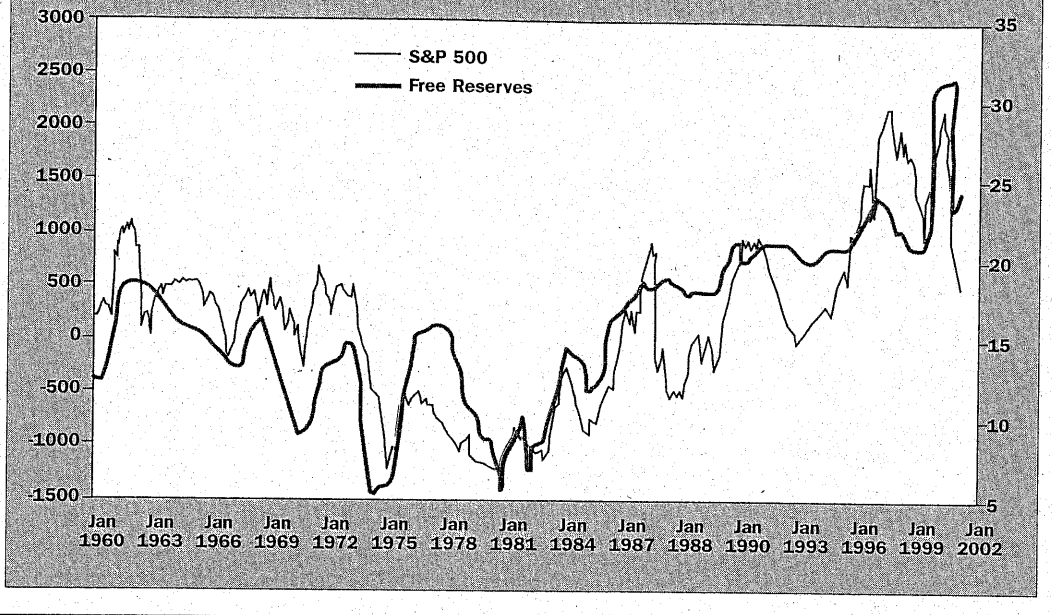


FIGURE 9

RELATIONSHIP BETWEEN S&P 500 P/E AND REAL ZERO MATURITY MONEY YEAR-OVER-YEAR CHANGE

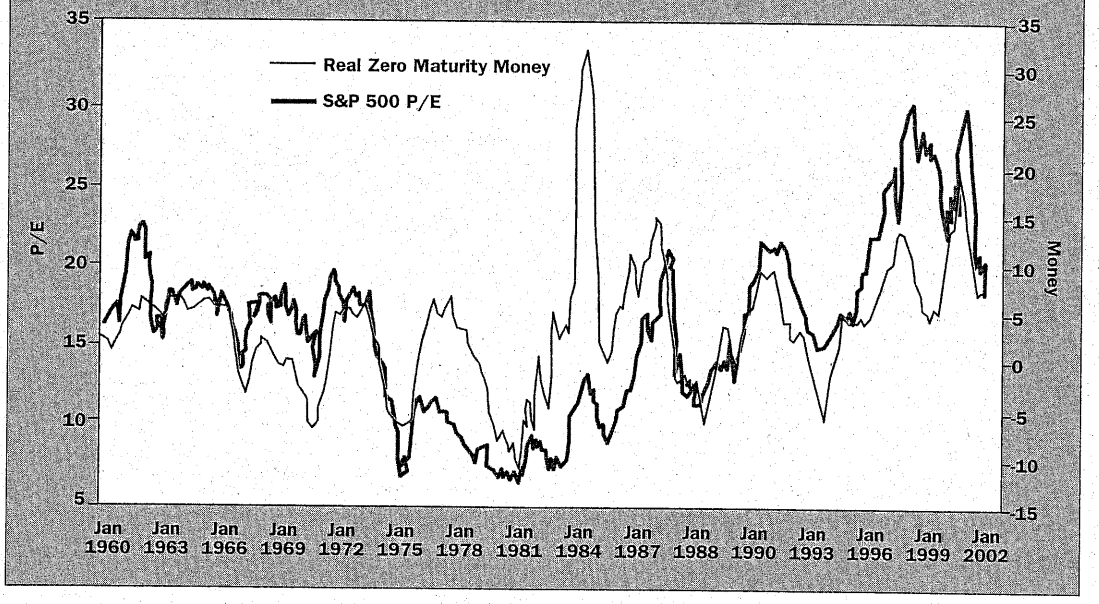
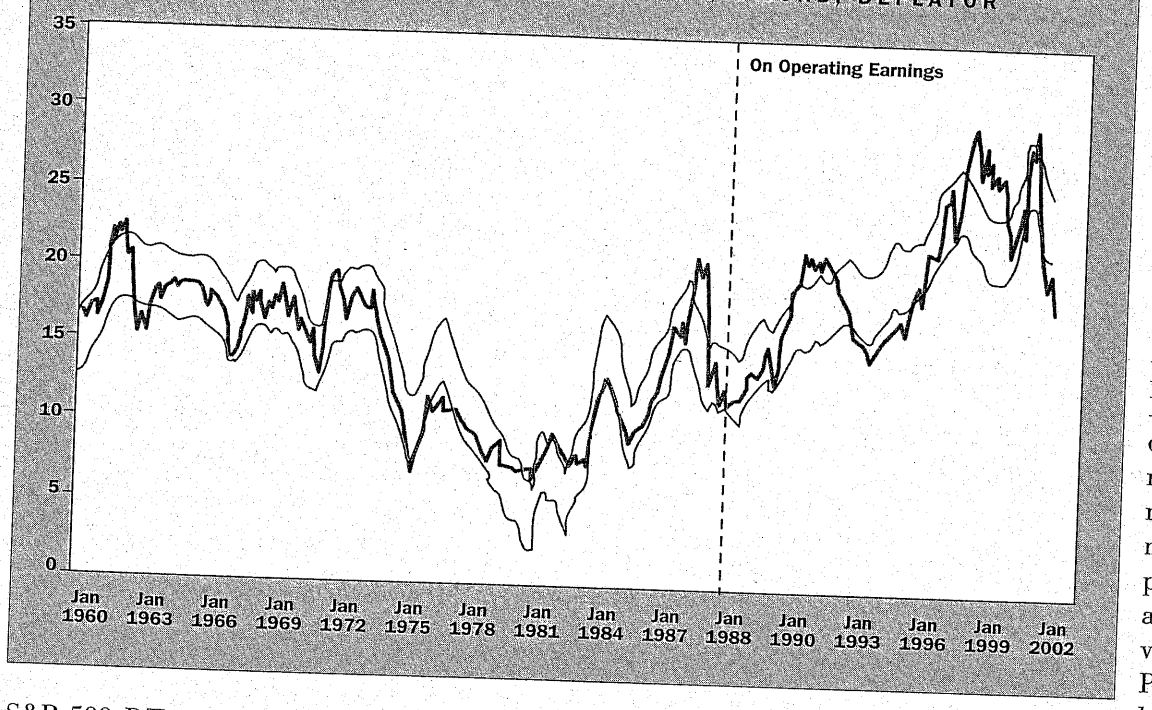


Figure 8 and Figure 9 show the relationships of the

[4]Real zero maturity money supply equals money supply deflated by the PCE deflator. Because free reserves data are not seasonally adjusted, the data in the chart and regression are a twelve-month moving average.

FIGURE 10

ACTUAL S&P 500 P/E VS +/- ONE STANDARD ERROR FITTED P/E EQUATION (RISK, FREE RESERVES, REAL MZM, T-BOND, DEFLATOR



S&P 500 P/E to free reserves and to real zero maturity money (MZM) supply growth. Recently they have captured aspects of Fed policy and P/E moves that were not reflected in Fed funds rate.[4] In particular, after the terrorist attacks on September 11, 2001, the Fed flooded the system with reserves. After it became obvious that 9/11 would not generate the feared economic shock, the Fed drained the massive reserve injection. But also note that there has been a significant change in the behavior of free reserves after 1987. Prior to 1987, free reserves demonstrated very large swings. Since 1987, there have been large increases, but the large declines virtually disappeared—the only significant declines were in 1998-99 and in 2000, and both preceded significant P/E declines. In recent years, especially after the development of sweep accounts, free reserves were widely considered irrelevant so virtually no one paid any attention to the data. The changed behavior of free reserves may be an unintended consequence of targeting interest rates.

Very significant differences between Fed funds rate and free reserves and money supply growth occurred over the past year. Both free reserves and money supply growth weakened significantly while the Fed funds rate was flat to falling. From June 2002 to March 2003 the S&P 500 P/E fell from 29.7 to 20.1, a 32.3 percent plunge while T-bond yields fell over 130 basis points, inflation rose about 100 basis points, and the Fed funds rate fell 50 basis points. Virtually no Wall Street strategist or economist foresaw this P/E plunge, and conventional analysis using short and long term interest rates does not explain it. Obviously, some of this P/E plunge reflects war fears but that probably was not significant until the last few months. A P/E equation based on my measure of the risk premium, free reserves, real zero maturity money supply growth, T-bonds, and inflation explains virtually the entire P/E plunge until the last few months. The equation has an R-squared of 92 and a standard error of 2.0. The dummy variable is used to adjust for a quality of earnings issue in the late 1970s when inflation significantly distorted depreciation and reported earnings. After 1980 it has a value of zero, so it does not impact results in the 1990s. Moreover, except for T-bonds, these variables led the P/E decline. The association of actual and fitted values of P/E is shown in Figure 10.

(2) P/E = -4.0(DUMMY) - 0.24(RISK) + 0.25(RESERVES) +
-10.5 *-32.3* *7.8*
0.13(MONEY) - 0.6(T-BOND) –0.3(DEFLATOR)
7.4 *-12.9* *-4.2*

The stock market is now in an environment where earnings are stagnant and may be falling. Second, as long as the bear market continues, the risk premium measure—which reflects investor confidence—is deteriorating. Third, currently (April 2003) the Fed funds rate target is 1.25 percent, so—by this policy measure—the Fed is running out of ammunition. Fourth, real MZM growth is slowing. Note that many Wall Street strategists argue that money supply growth should be boosting the market. However, as observed above, the relationship between the market P/E and money supply growth may be linear. Consequently, for the money supply growth to be a positive for the stock market, it has to be accelerating. Fourth, inflation is rising al-though this is largely because of high oil

prices. Fifth, T-bonds yields appear to have bottomed. Finally, the Fed has been adding reserves to the system, and free reserves are starting to rise. But the increase in free reserves is not sufficient to offset the other negatives.

So how do we get out of this quagmire? If a war rally and the positive impact of lower oil prices on inflation does not kick start a new bull market, my advice is to repeat Federal Reserve Board Chairman Paul Volcker's Saturday night massacre and abandon interest rates as a target. Switch to money supply or some other variable and use it to mask an inflationary monetary policy. Maybe target inflation, because the problem may turn out to be deflation. Meanwhile, flood the system with reserves just like after 9/11. Only, this time do not drain them until earnings are growing strongly. Finally, do not depend on a questionable estimate of future earnings growth by Wall Street analysts who have been unbelievably over optimistic in recent years. ■

REFERENCES

Forrester, Jay W. 1961. *Industrial Dynamics.* The MIT Press. Cambridge, MA.

———. 1968. *Principles of Systems.* The MIT Press. Cambridge, MA.

James K. Glassman, James K. and Kevin A. Hassett. 2000. *DOW 36,000 : The New Strategy for Profiting from the Coming Rise in the Stock Market.* Three Rivers Press. 1st edition.

Greenspan, Alan. 1996. *The Challenge of Central Banking in a Democratic Society* At the Annual Dinner and Francis Boyer Lecture of the American Enterprise Institute for Public Policy Research. Washington, D.C. December 5 speech.

———. 2002. *Economic Volatility.* At a symposium sponsored by the Federal Reserve Bank of Kansas City. Jackson Hole, Wyoming. August 30 speech.

Oliner, Stephen D., and Daniel E. Sichel. 2000. "The Resurgence of Growth in the Late 1990s: Is Information Technology the Story?" *Journal of Economic Perspectives.* Vol. 14, No. 4. Fall. Pp. 3-22.

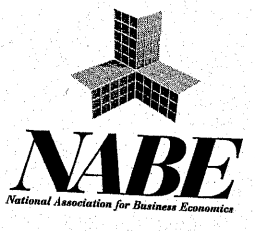
Oliner, Stephen D., and Daniel E. Sichel. 2002. "Information Technology and Productivity: Where Are We Now and Where Are We Going?" The Federal Reserve Board Finance and Discussion Papers. June. Pp. 2002-29.

Siegel, Jeremy J. 2002. *Stocks for the Long Run: The Definitive Guide to Financial Market Returns and Long-Term Investment Strategies.* McGraw-Hill Trade. 3rd edition.

Stiroh, Kevin J. 2001. "Investing in Information Technology: Productivity Payoffs for U.S. Industries." *Current Issues in Economics and Finance.* Vol. 7, No. 6. June.

Stiroh, Kevin J. 2002. "Information Technology and the U.S. Productivity Revival: a Review of the Evidence." *Business Economics.* January.

Whelan, Karl. 2000. "Computers, Obsolescence, and Productivity." Board of Governors of the Federal Reserve System. Finance and Economics Discussion Series. No. 2000-06. January.



31. Please provide copies of the articles referred to on page 2 lines 22-24 of Dr. Brown's Direct Testimony.

Answer:

The Consumer Advocate objects to Nashville Gas Company's request on the ground that it is contrary to the parties' agreement to streamline discovery by limiting the scope of background information and prior testimony of expert witnesses.

Response to Request 32 of 39

32. Please provide all work papers in support of Schedule 15 of Dr. Brown's testimony including the data and the calculations of betas. (A response in electronic format would be preferred, if available.)

Answer:

Data for CAPD calculations is provided on the diskette enclosed for response no. 27. Data on Standard & Poors and Yahoo already provided in response to requests 27 and 28.

33. Referring to page 46, lines 17-22 of Dr. Brown's Direct Testimony, please provide all studies, papers, articles and analyses, including previous testimony filed by Dr. Brown, that support his use of the embedded cost of debt of comparable companies for the cost of long-term debt of a utility in a rate proceeding.

Answer:

As already noted in the response to discovery request 20, Piedmont's position is that it has no obligation to inform the TRA of actual or intended changes in the company's capital structure which the company files in a rate case and which the company represents as a basis for setting prices for natural gas service.

Therefore, referencing the comparable companies' debt cost is a method to introduce accountability and objectivity into a long-term debt cost that is likely to change immediately after a Piedmont rate case is concluded.

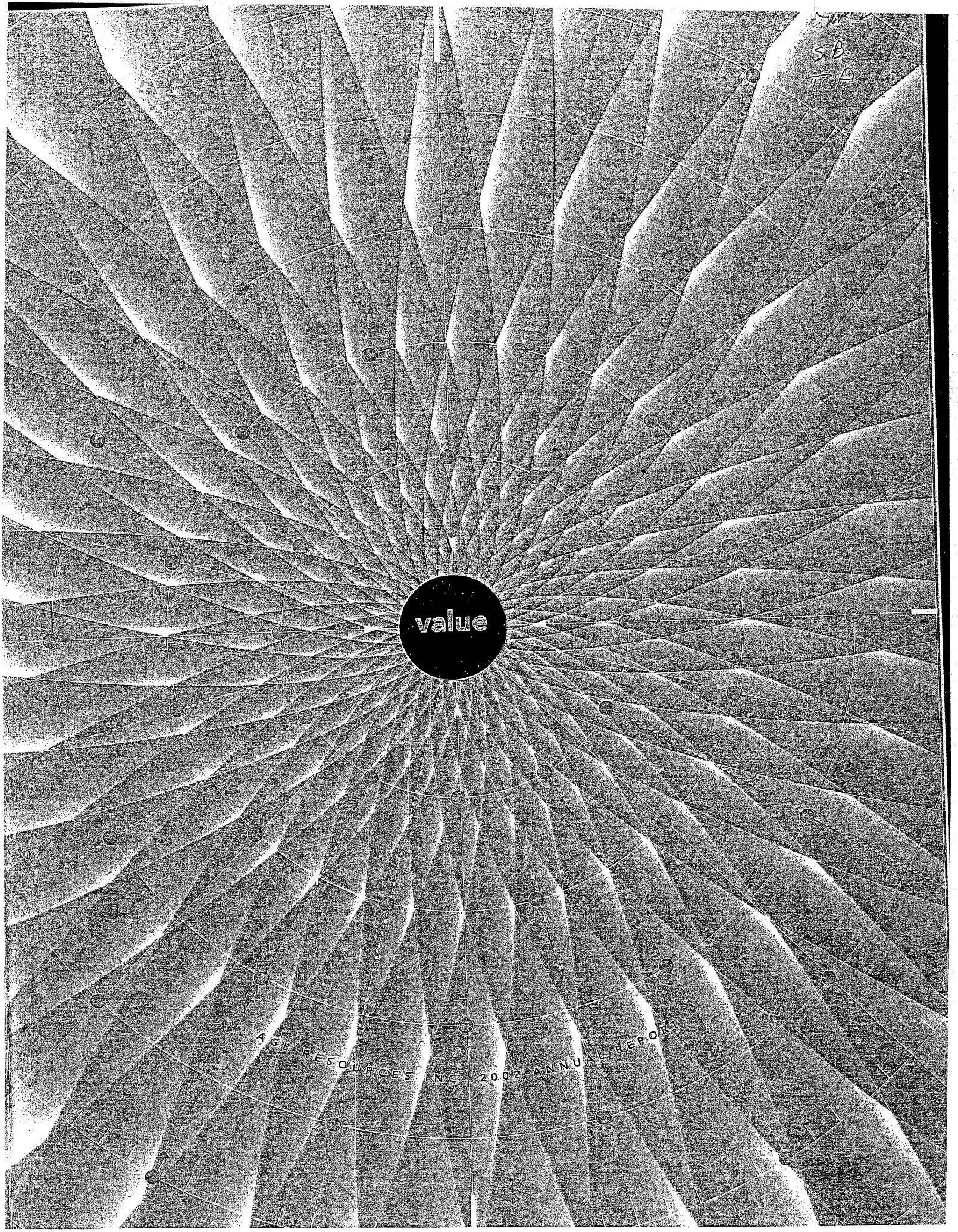
34. At page 25, line 11-13, Dr. Brown states "...my opinion is that the standard practice is to include short-term debt in the calculation of equity ratios and capital structure." Please provide all studies, analyses and citations that are in support of Dr. Brown's opinion.
(a) Does Dr. Brown believe that the gas distribution companies often use short-term debt to provide funds for short-term cash exigencies, such as acquiring gas supplies during the off-peak season?
(b) Does Dr. Brown believe that the natural gas that is forward purchased by a gas distributor should be included in the "rate base" of a gas distribution company?

Answers:

See Dr. Brown's direct testimony and Schedule 3. See the attached sheets from AGL's 2002 annual report, where the company describes its capital structure.

a) Dr. Brown has no opinion as to how often a company uses short-term debt to provide funds for short-term cash exigencies.

b) This question is unclear to Dr. Brown. Moreover, Dr. Brown does not discuss rate base in his testimony.



AGL RESOURCES INC. 2002 ANNUAL REPORT

FINANCING

Ratios AGL Resources is required by financial covenants in its Credit Facility, customer contracts and PUHCA requirements to maintain a ratio of total debt to total capitalization of no greater than 70.0%. As of December 31, 2002, AGL Resources was in compliance with this leverage ratio requirement. The components of AGL Resources' capital structure as of the dates indicated are summarized in the following table.

Dollars in millions	As of Dec. 31, 2002		As of Dec. 31, 2001		As of Sept. 30, 2001		As of Sept. 30, 2000	
Short-term debt	$ 388.6	18.3%	$ 384.7	17.6%	$ 303.4	14.6%	$ 141.2	9.8%
Current portion of long-term debt	30.0	1.4	93.0	4.3	45.0	2.2	20.0	1.4
Long-term debt	767.0	36.1	797.0	36.5	845.0	40.5	590.0	40.8
Trust preferred securities[1]	227.2	10.7	218.0	10.0	219.9	10.5	74.3	5.1
Common equity	710.1	33.5	690.1	31.6	671.4	32.2	620.9	42.9
Total capitalization	$2,122.9	100.0%	$2,182.8	100.0%	$2,084.7	100.0%	$1,446.4	100.0%
Debt to capitalization ratio		66.5%		68.4%		67.8%		57.1%

[1] Net of interest rate swaps of $6.1 million and $(2.2) million as of December 31, 2002 and December 31, 2001.

Short-term Debt On August 8, 2002, AGL Capital replaced its existing 364-day $450.0 million Credit Facility, scheduled to expire on October 3, 2002, with a $200 million 364-day Credit Facility and a $300 million three-year Credit Facility. The $200 million Credit Facility terminates on August 7, 2003 and the $300 million Credit Facility terminates on August 7, 2005. Loans outstanding on the date the $200 million Credit Facility terminates may be converted into a term loan, which will mature in one installment no later than August 7, 2004. As of February 28, 2003, there were no outstanding borrowings under the Credit Facility. This facility is used to support our commercial paper program. For calendar 2002, the average outstanding amount of commercial paper was $332.1 million with a weighted average interest rate of 2.2%.

Despite commercial paper market volatility caused by the impact of adverse developments and financial results at several prominent corporate issuers, AGL Resources has experienced strong liquidity support in the commercial paper market. During calendar 2002, AGL Capital had full access to the commercial paper market.

Sequent has a $15.0 million unsecured line of credit, which is used solely for the posting of exchange deposits and is unconditionally guaranteed by AGL Resources. This line of credit expires on July 3, 2003, and bears interest at the federal funds effective rate plus 0.5%. As of December 31, 2002, the line of credit had no outstanding balance. For calendar 2002, the average outstanding balance was $2.6 million with a weighted average interest rate of 2.2%.

Long-term Debt AGL Resources has $30.0 million in scheduled medium-term note payments in calendar 2003, with an interest rate of 5.90%. Management expects there will be available working capital and liquidity under the commercial paper program to fund these scheduled payments. During calendar 2002, AGL Resources did not issue long-term debt.

Interest Rate Swaps AGL Capital is a party to two interest rate swap transactions (Swaps) in the aggregate amount of $75.0 million executed as a hedge against the fair value of AGL Capital Trust II's 8.0% Trust Preferred Securities due 2041. Pursuant to the Swaps, AGL Capital receives interest rate payments on $75.0 million at an annual 8.0% interest rate, and pays floating interest rates on $75.0 million. AGL Capital pays interest each February 15, May 15, August 15 and November 15 at three-month LIBOR plus 1.315%, with no floor or ceiling. At December 31, 2002, the current rate was 2.7%. The expiration date of the Swaps is May 15, 2041, unless terminated earlier or called. Under hedge accounting treatment, AGL Capital records a long-term asset or liability and a corresponding adjustment to subsidiaries' obligated mandatorily redeemable preferred securities to reflect the assessed change in fair value of the Swaps to AGL Capital. The fair value changes as interest rates change from those that were in effect on the original settlement date. The fair value of these Swaps at December 31, 2002 and December 31, 2001 was $6.1 million and $(2.2) million, respectively.

35. Please provide any analysis, including work papers and showing results, performed by Dr. Brown concerning the times interest earned or debt coverage ratios of Piedmont or other companies used in his cost of capital analysis.

Answer:

None

36. Is it Dr. Brown's opinion that investors will not acquire shares of common stock in anticipation of earnings growth even when the company has no record of paying dividends and no forecasted payment of dividends?

Answer:

In Dr. Brown's opinion, this question is not relevant to this case because all comparable companies have a long history of paying dividends, and Dr. Murry included companies that paid a common stock dividend. Nonetheless, some investors may choose to invest in companies that have no dividend record.

37. Would Dr. Brown expect the price on a company's common stock traded on the New York Stock Exchange increase upon the announce of an increase in common stock earnings that exceeded estimates by most financial analysts? If not, please explain and provide any references and citations used by Dr. Brown to assist in his determination.

Answer:

Perhaps. The stock prices traded on the NYSE react to a number of variables, including, but not confined to: general economic conditions and reports, interest rates, natural disasters, terrorist attacks, etc. Stocks prices are not always driven directly by the subject company's financial condition or plans.

38. At several points in Dr. Brown's Direct Testimony, including at page 74, line 32, Dr. Brown refers to financial information provided by *Value Line* as "not credible." Has Dr. Brown ever used *Value Line* data as a basis for his analysis in cost of capital testimony? If so, please provide copies of all such testimony for cases that were active in the past three years. If none, please explain at what point in time and the circumstances which resulted in Dr. Brown not using *Value Line* data in his cost of capital testimony.

Answer:

None in the past three years. Many sources of financial information other than Value Line such as the FERC, SEC , MorningStar and others are now available on the Internet, and CAPD's office has connections to the Internet.

Response to Request 39 of 39

39. In Dr. Brown's Direct Testimony at page 55, line 32, Dr. Brown states in response to the question "What is your opinion of the forecasts and equity returns shown in Dr. Murry's schedules DAM-5 and DAM-7 as follows: "My opinion is that they are not credible." Has Dr. Brown ever used *Value Line* earnings and dividend forecasts as a basis for his analysis in cost of capital testimony? If so, please provide copies of all such testimony for cases that were active in the past three years. If none, please explain at what point in time and the circumstances which resulted in Dr. Brown not using *Value Line* data in his cost of capital testimony.

Answer:

None in the past three years. Many sources of financial information, other than Value Line such as the FERC, SEC , MorningStar and others are now available on the Internet, and CAPD's office has connections to the Internet.

CERTIFICATE OF SERVICE

I hereby certify that a true and exact copy of the foregoing has been served via the methods indicated on this 28th day of August, 2003, to the following:

Via hand delivery:

R. Dales Grimes
Bass, Berry & Sims, PLC
AmSouth Center
315 Deaderick Street, Suite 2700
Nashville, Tennessee 37238-3001

Via first-class U.S. mail, postage prepaid:

James H. Jeffries IV
Nelson, Mullins, Riley & Scarborough, L.L.P.
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Joe Shirley

JOE SHIRLEY
Assistant Attorney General

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