DEPARTMENT OF PUBLIC SERVICE REGULATION
BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MONTANA

IN THE MATTER OF THE APPLICATION	)	
of MONTANA-DAKOTA UTILITIES CO.,	)	REGULATORY DIVISION
a Division of MDU Resources Group, Inc.,	)	
for Authority to Establish Increased Rates for	)	DOCKET NO. D2012.9.100
Natural Gas Service	)	

MONTANA CONSUMER COUNSEL'S DATA RESPONSES TO THE MONTANA-DAKOTA UTILITIES CO.

MDU-001 Re: Embedded Class Cost of Service Study
Witness – Donkin

Please provide an electronic copy of Exhibit___(GLD-1).

RESPONSE:

Please see the response to PSC-148 a).

MDU-002 Re: Revenue Requirement
Witness –Clark

Please provide an electronic copy of Exhibit___(AEC-1), (AEC-2), (AEC-3), and (AEC-4).

RESPONSE:
Please see the response to PSC-148 a).

MDU-003 Re: Depreciation
Witness – Pous

For the most recent five year period, please provide:

a) A listing of gas distribution companies for which Mr. Pous has investigated depreciation rates, parameters (ASL/Curve and Net Salvage Factors, etc. and/or developed alternative depreciation proposal.
b) The jurisdiction, case number, and other pertinent information.
c) A copy of the depreciation parameter and expense summary table.

RESPONSE:

(a-c) Mr. Pous does not keep a listing of cases by time frame. However, the information contained on Attachment MDU-003 reflects what Mr. Pous believes are the gas distribution cases investigated during the past 5 years.

MDU-004 Re: Depreciation
Witness – Pous

Relative to Account 376-Distribution Mains, within each of the cases listed in MDU-003, please provide the company's original depreciation parameter proposal, Diversified Utility Consultants (DUC) alternate proposal, and the final settled or adjudicated resulting parameters (provide a notation whether the final result was a settlement or an adjudicated finding).

RESPONSE:

See the response to MDU-003. All cases were litigated with the exception of CenterPoint South and East Texas.

MDU-005 Re: Depreciation
Witness – Pous

Relative to Account 380-Services, within each of the cases listed in MDU-003, please provide the company's original depreciation parameter proposal, Diversified Utility Consultants (DUC) alternate proposal, and the final settled or adjudicated resulting parameters (provide a notation whether the final result was a settlement or an adjudicated finding).

RESPONSE:

See the response to MDU-003.

MDU-006 Re: Depreciation
Witness – Pous

Relative to Account 381-Meters, within each of the cases listed in MDU-003, please provide the company's original depreciation parameter proposal, Diversified Utility Consultants (DUC) alternate proposal, and the final settled or adjudicated resulting parameters (provide a notation whether the final result was a settlement or an adjudicated finding).

RESPONSE:

See the response to MDU-003.

MDU-007 Re: Depreciation
Witness – Pous

Relative to Account 390-Structures & Improvements, within each of the cases listed in MDU-003, please provide the company's original depreciation parameter proposal, Diversified Utility Consultants (DUC) alternate proposal, and the final settled or adjudicated resulting parameters (provide a notation whether the final result was a settlement or an adjudicated finding).

RESPONSE:

See the response to MDU-003.

MDU-008 Re: Depreciation
Witness – Pous

For the most recent five year period, please provide:

a) A listing of gas distribution companies for which Mr. Pous has completed a comprehensive depreciation study (as opposed to reviewing an existing depreciation study).
b) A copy of all reports related to any such depreciation studies.

RESPONSE:

See the response to MDU-003 as Mr. Pous performs comprehensive analyses based on the information a utility is willing to provide as it relates to depreciation analyses as well as budget and time considerations.

MDU-009 Re: Depreciation
Witness – Pous

With regard to DUC's alternative depreciation proposals, please provide a specific reference to all Company provided source records utilized to arrive at the resulting recommendations.

RESPONSE:

See Mr. Pous' testimony corresponding to each case identified in Appendix A. Mr. Pous' testimony is in the public record.

MDU-010 Re: Depreciation
Witness – Pous

For Account 376.2 Distribution Mains-Plastic contained on page 24 of Mr. Pous' testimony, please provide:

a) The historical data used to create the curve plot.
b) The underlying Observed Life Table and applicable retirement and experience bands for the plotted raw data points.
c) An explanation of the P:70 E:70 designations contained on the bottom of the charts.

RESPONSE:

a) See MDU's response to MCC-135.
b) See Attachment MDU-010.
c) P stands for the beginning year of the placement band and the E stands for the beginning year of the experience band. All bands go through the current period of information provided by the Company.

MDU-011 Re: Depreciation
Witness – Pous

For Account 376.1 Distribution Mains-Steel contained on page 27 of Mr. Pous' testimony, please provide:

a) The historical data used to create the curve plot.
b) The underlying Observed Life Table and applicable retirement and experience bands for the plotted raw data points.

RESPONSE:

a) See the response to MDU-010 (a).
b) See Attachment MDU-011.

MDU-012 Re: Depreciation
Witness – Pous

Please provide a copy of any workpapers and/or supporting data that was utilized in the process of developing Mr. Pous' testimony and exhibits that were filed in conjunction with Mr. Pous' testimony.

RESPONSE:
See Attachment MDU-012.

MDU-013 RE: Analysts Growth Expectations
Witness – Wilson, Page 12

Please provide any empirical data which supports Dr. Wilson's statement that "analysts' forecasts are somewhat more bullish than investors' actual expectations."

RESPONSE:

As Dr. Wilson testified, the fact that analysts' forecasts are somewhat more bullish than investors' actual expectations is evident from a number of observations, including stock market prices which are typically lower than analysts price forecasts. This is consistent with the notion that really valuable analysts are those who know something that the market does not already know. Over the past four decades Dr. Wilson has regularly compared analysts' forecasts (both IBES and Value Line) with actual market data. While there have been exceptions from time to time, it has generally been the case that analysts' published expectations (both with respect to stock market prices and earnings growth) have exceeded actual market experience.

MDU-014 RE: Dinson, March and Staunton Publication
Witness –Wilson, Page 24, Lines 13-15

Please provide a complete copy of the Dinson, March and Staunton publication cited in Lines 13-15 of Page 24.

RESPONSE:

A copy of the publication is provided in Attachment MDU-014.

MDU-015 RE: Fama and French Publication
Witness – Wilson, Page 25, Lines 14-17

Please provide a complete copy of the E. F. Fama and K. R. French publication cited in Lines 14-17 of Page 25.

RESPONSE:

A copy of the publication is provided in Attachment MDU-015.

MDU-016 RE: Welch Publication
Witness – Wilson, Page 26, Lines 4-6

Please provide a complete copy of the Ivo Welch publication cited in Lines 4-6 of Page 26.

RESPONSE:

A copy of the publication is provided in Attachment MDU-016.

MDU-017 RE: CAPM Cost of Equity Estimate
Witness – Wilson, Page 26, Line 10

Please reconcile the CAPM cost of equity estimate presented in Line 10 of Page 26 (*i.e.* 8.285%) with the CAPM cost of common equity return indicator presented in Exhibit_(JWW-8) (*i.e.* 6.28%).

RESPONSE:

The calculation presented in Exhibit (JWW-8) uses the mid-point of the risk-free range, whereas the calculation at page 26 uses the high value of that range.

MDU-018 RE: Earnings Growth Model
Witness – Wilson, Exhibit___(JWW-1)

Please provide a copy of the cited sources and source data, including any electronic spreadsheets, used to prepare Exhibit___(JWW-1).

RESPONSE:

Please see the response to PSC-148 a).

MDU-019 RE: Dividend Growth Model
Witness – Wilson, Exhibit___(JWW-2)

Please provide a copy of the cited sources and source data, including any electronic spreadsheets, used to prepare Exhibit___(JWW-2).

RESPONSE:

Please see the response to PSC-148 a).

MDU-020 RE: Book Value Growth Model
Witness – Wilson, Exhibit___(JWW-3)

Please provide a copy of the cited sources and source data, including any electronic spreadsheets, used to prepare Exhibit___(JWW-3).

RESPONSE:

Please see the response to PSC-148 a).

MDU-021 RE: Fundamental Growth Model
Witness – Wilson, Exhibit___(JWW-4)

Please provide a copy of the cited sources and source data, including any electronic spreadsheets, used to prepare Exhibit___(JWW-4).

RESPONSE:

Please see the response to PSC-148 a).

MDU-022 RE: Capital Asset Pricing Model
Witness – Wilson, Exhibit___(JWW-5)

Please provide a copy of the source data, including any electronic spreadsheets, used to prepare Exhibit___(JWW-5).

RESPONSE:

Please see the response to PSC-148 a).

MDU-023 RE: Comparable Expected Market Earnings Rates
Witness – Wilson, Exhibit___(JWW-6)

Please provide a copy of the cited sources and source data, including any electronic spreadsheets, used to prepare Exhibit___(JWW-6).

RESPONSE:

Please see the response to PSC-148 a).

MDU-024 RE: Comparative Risk Indicators
Witness – Wilson, Exhibit___(JWW-7)

Please provide a copy of the cited sources and source data, including any electronic spreadsheets, used to prepare Exhibit___(JWW-7).

RESPONSE:

Please see the response to PSC-148 a).

MDU-025 RE: Indicated Range of Reasonableness
Witness – Wilson, Exhibit___(JWW-8)

Please explain how the indicated range of reasonableness of 7% to 9% was established with specific references to the cost of common equity return indicators presented in Exhibit___(JWW-8).

RESPONSE:

The range of reasonableness generally encompasses the results of the individual models as shown above, although it is slightly higher than the CAPM and Comparable Expected Earnings results.

MDU-003

Attachment

D2012.9.100

Pous - D2012-9-100
ATTACHMENT MDU-003

AVERAGE SERVICE LIFE - IOWA CURVE

			376 Steel			376 Plastic			380 Steel			380 Plastic			381 Meters			390 Struct. & Imprvt.		
Company	Jurisdiction	Case No.	Utility	DUCI	Adopted	Utility	DUCI	Adopted	Utility	DUCI	Adopted	Utility	DUCI	Adopted	Utility	DUCI	Adopted	Utility	DUCI	Adopted
Southwest Gas	North Nevada	12-04005	47L2	60L1	50R2.5	47L2	60L1	50R2.5	39L3	DNA	43L2.5	39L3	DNA	43L2.5	34L1.5	DNA	34L1.5	40R3	55R3	45R3
Southwest Gas	South Nevada	12-04005	47R2.5	55R2	50R2.5	47R2.5	55R2	50R2.5	45R3	DNA	50L2	45R3	DNA	50L2	33S1	DNA	33S1	40R3	55R3	45R3
Sierra Pacific Power Co.	Nevada	10-06001	70R4	DNA	70R4	70R4	DNA	70R4	65R3	DNA	65R3	65R3	DNA	65R3	40R2	DNA	40R2	57R4	DNA	57R4
Atmos Energy	Mid-Tex	10170	70R0.5	75R0.5	70R0.5	65R2.5	70R2.5	70R2.5	37S0.5	41L1	37S0.5	37S0.5	41L1	37S0.5	37R1	35R1	37R1	45R2.5	55R2.5	45R2.5
Atmos Energy	West Texas	10041	70R1.5	78R1.5	70R1.5	70R1.5	78R1.5	70R1.5	60R3	68R2.5	60R3	60R3	68R2.5	60R3	30L1	DNA	30L1	40R2	DNA	40R2
CenterPoint	South Texas	10038	55R4	DNA	55R4	60R2.5	DNA	60R2.5	44R3	DNA	44R3	44S3	DNA	44S3	34R0.5	DNA	34R0.5	40R4	DNA	40R4
CenterPoint	East Texas	10182	64R4	DNA	64R4	60R3	DNA	60R3	49S6	DNA	49S6	40R2	DNA	40R2	33S4	DNA	33S4	55S1.5	DNA	55S1.5
CenterPoint	Houston	9902	48R3	DNA	48R3	53R3	DNA	53R3	40R2.5	DNA	40R2.5	44R2.5	DNA	44R2.5	33R0.5	DNA	33R0.5	50R3	DNA	50R3
Texas Gas Service	El Paso	9988	65R1.5	DNA	65R1.5	65R1.5	DNA	65R1.5	55R2	DNA	55R2	55R2	DNA	55R2	28R4	DNA	28R4	40R1.5	DNA	40R1.5
Southern California Gas	California	1012005	55R4	66R2.5	NA	55R4	66R2.5	NA	51L2	56S0.5	NA	51L2	56S0.5	NA	32S1	DNA	NA	20SQ	30SQ	NA
San Deago Gas & Electric	California	1012006	60S1	69R2.5	NA	60S1	69R2.5	NA	48R2.5	DNA	NA	48R2.5	DNA	NA	44L1.5	DNA	NA	26SQ	DNA	NA
ALTAGAS Utilities	Alberta	1606694	55R2	70R1.5	62.5R2	55R2	70R1.5	62.5R2	48R4	52S4	50R4	48R4	52S4	50R4	30R2.5	DNA	30R2.5	75R2	DNA	75R2
ATCO Gas	Alberta	1606822	60R3	69R2.5	66R2.5	60R3	69R2.5	66R2.5	55R3	59R2.5	57R2.5	55R3	59R2.5	57R2.5	20R0.5	DNA	20R0.5	40R2	DNA	40R2

NET SALVAGE

			376 Mains			380 Services			381 Meters			390 Struct. & Imprvt.		
Company	Jurisdiction	Case No.	Utility	DUCI	Adopted	Utility	DUCI	Adopted	Utility	DUCI	Adopted	Utility	DUCI	Adopted
Southwest Gas	North Nevada	12-04005	-10%	DNA	-10%	-35%	DNA	-35%	0%	DNA	0%	0%	DNA	0%
Southwest Gas	South Nevada	12-04005	-10%	DNA	-10%	-25%	DNA	-25%	0%	DNA	0%	0%	DNA	0%
Sierra Pacific Power Co.	Nevada	10-06001	-70%	-45%	-70%	-100%	-60%	-100%	-100%	-25%	-100%	-5%	DNA	-5%
Atmos Energy	Mid-Tex	10170	-40%	-30%	-40%	-20%	DNA	-20%	-10%	DNA	-10%	-5%	15%	-5%
Atmos Energy	West Texas	10041	-40%	DNA	-40%	-80%	-50%	-80%	-40%	DNA	-40%	0%	DNA	0%
CenterPoint	South Texas	10038	-25%	-20%		-70%	-50%		-15%	DNA	-15%	-10%	DNA	-10%
CenterPoint	East Texas	10182	-25%	DNA	-25%	-50%	DNA	-50%	0%	DNA	0%	0%	DNA	0%
CenterPoint	Houston	9902	-43%	-30%	-43%	-39%	-25%	-39%	-2%	DNA	-2%	-10%	DNA	-10%
Texas Gas Service	El Paso	9988	-20%	-5%	-20%	-30%	-15%	-30%	0%	DNA	0%	-5%	DNA	-5%
Southern California Gas	California	1012005	-55%	-40%	NA	-95%	DNA	NA	0%	DNA	NA	-25%	DNA	NA
San Deago Gas & Electric	California	1012006	-45%	DNA	NA	-75%	DNA	NA	-45%	DNA	NA	-25%	DNA	NA
ALTAGAS Utilities	Alberta	1606694	-10%	DNA	-10%	-75%	-30%	-30%	0%	DNA	0%	0%	DNA	0%
ATCO Gas	Alberta	1606822	-75%	-60%	-60%	-100%	DNA	-100%	0%	DNA	0%	0%	DNA	0%

DNA	Did not address
NA	Not available

MDU-010

Attachment

D2012.9.100

376.2 Distribution Mains Plastic
P & E 1970-2008

Pous - D2012.9.100
Attachment - MDU-010

Age Interval	OLT
0	100
0.5	99.994858
1.5	99.929499
2.5	99.834304
3.5	99.748165
4.5	99.543388
5.5	99.444535
6.5	99.332713
7.5	99.221717
8.5	99.109219
9.5	99.023303
10.5	98.862194
11.5	98.744902
12.5	98.645342
13.5	98.572441
14.5	98.048745
15.5	97.762122
16.5	97.694321
17.5	97.581452
18.5	97.379048
19.5	97.199763
20.5	97.095437
21.5	96.857455
22.5	96.759506
23.5	96.630466
24.5	96.240706
25.5	95.946827
26.5	95.787053
27.5	95.56936
28.5	95.472515
29.5	95.403427
30.5	95.11675
31.5	95.076951
32.5	95.037416
33.5	94.982197
34.5	87.816485
35.5	87.757695
36.5	87.74049
37.5	87.696027

MDU-011

Attachment

D2012.9.100

376.1 Distribution Mains Steel
P & E 1977-2008

Pous - D2012.9.100
Attachment - MDU-011

Age Interval	OLT
0	100
0.5	100
1.5	99.917777
2.5	99.87417
3.5	99.820385
4.5	99.762044
5.5	99.453678
6.5	99.377571
7.5	99.285633
8.5	99.004884
9.5	98.954456
10.5	98.282208
11.5	98.246901
12.5	97.746679
13.5	97.491243
14.5	96.660104
15.5	96.056129
16.5	95.919317
17.5	95.603824
18.5	95.409645
19.5	94.76089
20.5	94.463497
21.5	93.767648
22.5	93.484782
23.5	93.329103
24.5	93.261013
25.5	93.078493
26.5	93.057804
27.5	92.842926
28.5	92.842926
29.5	90.240626
30.5	90.240626

MDU-012

Attachment

D2012.9.100

DEPARTMENT OF PUBLIC SERVICE REGULATION
BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MONTANA

In the Matter of the Application of	)	**REGULATORY DIVISION**
MONTANA-DAKOTA UTILITIES CO.	)	
A Division of MDU Resources Group,	)	**DOCKET NO. D2012.9.100**
Inc., for Authority to Establish Increased	)	
Rates for Natural Gas Service	)	

Workpapers

of

Jacob Pous

On behalf of

Montana Consumer Counsel

Diversified Utility Consultants, Inc.
1912 West Anderson Lane, Suite 202
Austin, TX 78757

February 25, 2013

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MONTANA-DAKOTA UTILITIES CO.
MONTANA CONSUMER COUNSEL
DATA REQUEST
DATED JANUARY 11, 2013
DOCKET NO. D2012.9.100

MCC-150 RE: ACCOUNT 376
WITNESS: ROBINSON

Please provide a detailed narrative explaining specifically how the 47R4 life-curve combination was selected for Accounts 376.1 and 376.2 – Mains Steel and Plastic, respectively. To the extent SPR results were relied upon, provide all ranking criteria for selected curves, as well as full justification for which band analysis was relied upon, and why the results of other bands were not relied on.

Response:

Please see Attachment A for a general ranking of statistical best fit curve for varying experience bands. The output of the SPR analysis is not maintained in paper copy or other format. The databases and study software are electronic and the analysis was utilized to run numerous band analysis in real time during the course of completing the study. Plot outputs are provided in the depreciation study report for the service life parameters that were estimated for each of the property groups.

Please see Response No. MCC-135 for a complete copy of the historic depreciation database. The SPR is one additional tool of various items that are reviewed to identify the applicable service life for each of the applicable property groups.

Response No. MCC-150
Attachment A
Page 1 of 1

Montana-Dakota Utilities Company
Gas Division
376.00 MAINS

Summary of Simulated Curve Fitting Results
5 Year Band

Experience Band	Curve Dispersion	Ave. Serv. Life	Least Sum Of Square	Conformance Index	Index of Variation	Ret. Exp. Index
1916 - 2008	O3	160.6	7.818200E+13	28.38	35.23	43.37
2004 - 2008	O3	191.5	4.643100E+11	313.9	3.19	37.33
1999 - 2003	O3	172.9	5.993700E+11	227.5	4.4	40.78
1994 - 1998	O3	150.9	4.652100E+11	229.4	4.36	45.62
1989 - 1993	O4	185.3	3.044900E+11	216.8	4.61	48.26
1984 - 1988	S.5	61.2	2.596900E+11	197.7	5.06	79.35
1979 - 1983	O4	166.6	1.917100E+11	185.2	5.4	51.84
1974 - 1978	O4	140.6	1.526200E+11	163.1	6.13	57.46
1969 - 1973	R4	28.8	1.331000E+10	446.7	2.24	100
1964 - 1968	O4	114.5	2.242100E+09	784.2	1.28	63.88
1959 - 1963	R2.5	34.9	1.655100E+10	215.2	4.65	100
1954 - 1958	R2.5	36.3	7.171700E+08	699.5	1.43	100
1949 - 1953	S6	31.8	1.322600E+08	954.9	1.05	100

000002

MONTANA-DAKOTA UTILITIES CO.
MONTANA CONSUMER COUNSEL
DATA REQUEST
DATED FEBRUARY 4, 2013
DOCKET NO. D2012.9.100

MCC-177 RE: RESPONSE TO MCC-139
WITNESS: ROBINSON

In response to MCC-139, the Company states it performs an estimation of vintage level survivors based on both Development Survivor routines with the SPR data and more recent detailed line item records from the Company's Continuing Property Records. Regarding the Company's statement, provide the actual and estimated age data for Accounts 376 and 380, identifying which items of information were utilized, and specifically how, in the calculation for Accounts 376 and 380. Further, provide the Development Survivor routines on electronic medium in Excel readable format to the extent such are available in Excel. If not available in Excel, provide the information in hard copy and in its native electronic format. Further, provide all other documentation, assumptions, and information reviewed and/or relied upon in sufficient detail to permit replication of the Company's estimates for Accounts 376 and 380.

Response:

The actual balances for the simulated accounts are contained within the data provided in Response No. MCC-135. The simulated balances were calculated using the vintage gross additions, proposed Iowa curves, and related average service lives.

The Simulated Plant Record Method was the primary input for estimating the average service life parameters for Accounts 376 and 380. In addition, vintage level survivors were developed for individual sub account categories of Accounts 376 and 380 during the 2001 depreciation study. Those detailed calculations, performed more than ten years ago, are no longer available. In subsequent periods, efforts have been completed to continue to develop longer range actuarial files. The vintage sub-account files were also used to calculate the December 31, 2008 average remaining lives. The estimated average service life parameters and future net salvage percent for each property group gives consideration to the overall range of data recent experience.

With regard to the service life parameters, given the nature of the utility property contained in each property group in which quality property is placed in service with the expectation that large quantities of retirements are not anticipated shortly after being place in service, the estimated mode of survivor curve tends to be focused on more right mode or higher sub-script curves.

In Response No. MCC-135, Montana-Dakota provided a complete copy of the historic depreciation database. The SPR is a tool among various items that are reviewed to identify the estimated average service life for each of the applicable property groups.

ELECTRONIC CODE OF FEDERAL REGULATIONS

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e-CFR Data is current as of February 20, 2013

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Title 18: Conservation of Power and Water Resources

A. PART 201—UNIFORM SYSTEM OF ACCOUNTS PRESCRIBED FOR NATURAL GAS COMPANIES SUBJECT TO THE PROVISIONS OF THE NATURAL GAS ACT

AUTHORITY: 15 U.S.C. 717-717w, 3301-3432; 42 U.S.C. 7101-7352, 7651-7651o.

SOURCE: Order 219, 25 FR 5616, June 21, 1960, unless otherwise noted.

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting part 201, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and at *www.fdsys.gov*.

EFFECTIVE DATE NOTE: At 58 FR 18006, April 7, 1993, part 201 was amended by redesignating definitions 31 through 39 as 32 through 40 and adding a new definition 31; Accounts 182.3 and 254 were added under Balance Sheet Accounts; and Accounts 407.3 and 407.4 were added under Income Accounts. The added text contains information collection and recordkeeping requirements and will not become effective until approval has been given by the Office of Management and Budget.

NOTE: Order 141, 12 FR 8504, Dec. 19, 1947, provides in part as follows:

Prescribing a system of accounts for natural gas companies under the Natural Gas Act. The Federal Power Commission acting pursuant to authority granted by the Natural Gas Act (58) Stat. 821, as amended; 15 U.S.C. and Sup. 717 et seq.), particularly sections 8(a), 10(a) and 16 thereof, and finding such action necessary and appropriate for carrying out the provisions of said Act, ordered that:

(a) The accompanying system of accounts, entitled "Uniform System of Accounts Prescribed for Natural Gas Companies Subject to the Provisions of the Natural Gas Act," and the rules and regulations contained therein, be adopted;

(b) Said system of accounts and said rules and regulations contained therein be and the same are hereby prescribed and promulgated as the system of accounts and rules and regulations of the Commission to be kept and observed by natural gas companies subject to the jurisdiction of the Commission, to the extent and in the manner set forth therein;

(c) Said system of accounts and rules and regulations therein contained as to all natural gas companies now subject to the jurisdiction of the Commission, became effective on January 1, 1940, and as to any natural gas company which may hereafter become subject to the jurisdiction of the Commission, they shall become effective as of the date when such natural gas company becomes subject to the jurisdiction of the Commission.

Uniform System of Accounts Prescribed for Natural Gas Companies Subject to the Provisions of the Natural Gas Act

Definitions

When used in this system of accounts:

1. *Accounts* means the accounts prescribed in this system of accounts.

2. *Actually issued,* as applied to securities issued or assumed by the utility, means those which have been sold to bona fide purchasers for a valuable consideration, those issued as dividends on stock, and those which have been issued in accordance with contractual requirements direct to trustees of sinking funds.

3. *Actually outstanding,* as applied to securities issued or assumed by the utility, means those which have been actually issued and are neither retired nor held by or for the utility; provided, however, that securities held by trustees shall be considered as actually outstanding.

4. *Amortization* means the gradual extinguishment of an amount in an account by distributing such amount over a fixed period, over the life of the asset or liability to which it applies, or over the period during which it is anticipated the benefit will be realized.

5. A. *Associated (affiliated) companies* means companies or persons that directly or indirectly, through one or more intermediaries, control, or are controlled by, or are under common control with the accounting company.

B. *Control* (including the terms "controlling," "controlled by," and "under common control with") means the possession, directly or indirectly, of the power to direct or cause the direction of the management and policies of a company, whether such power is exercised through one or more intermediary companies, or alone, or in conjunction with, or pursuant to an agreement, and whether such power is established through a majority or minority ownership or voting of securities, common directors, officers, or stockholders, voting trusts, holding trusts, associated companies, contract or any other direct or indirect means.

6. *Book cost* means the amount at which property is recorded in these accounts without deduction of related provisions for accrued depreciation, depletion, amortization, or for other purposes.

7. *Commission,* means the Federal Energy Regulatory Commission.

8. *Continuing plant inventory record* means company plant records for retirement units and mass property that provide, as either a single record, or in separate records readily obtainable by references made in a single record, the following information:

A. For each retirement unit;

(1) The name or description of the unit, or both;

(2) The location of the unit;

(3) The date the unit was placed in service;

(4) The cost of the unit as set forth in Plant Instructions 2 and 3 of this part; and

(5) The plant control account to which the cost of the units is charged; and

B. For each category of mass property;

(1) A general description of the property and quantity;

(2) The quantity placed in service by vintage year;

(3) The average cost as set forth in Plant Instructions 2 and 3 of this part; and

(4) The plant control account to which the costs are charged.

9. *Cost* means the amount of money actually paid for property or services. When the consideration given is other than cash in a purchase and sale transaction, as distinguished from a transaction involving the issuance of common stock in a merger or a pooling of interest, the value of such consideration shall be determined on a cash basis.

10. *Cost of removal* means the cost of demolishing, dismantling, tearing down or otherwise removing gas plant, including the cost of transportation and handling incidental thereto. It does not include the cost of removal activities associated with asset retirement obligations that are capitalized as part of the tangible long-lived assets that give rise to the obligation. (See General Instruction 24).

11. *Debt expense* means all expenses in connection with the issuance and initial sale of evidences of debt, such as fees for drafting mortgages and trust deeds; fees and taxes for issuing or recording evidences of debt; cost of engraving and printing bonds and certificates of indebtedness; fees paid trustees; specific costs of obtaining governmental authority; fees for legal services; fees and commissions paid underwriters, brokers, and salesmen for marketing such evidences of debt; fees and expenses of listing on exchanges; and other like costs.

12. A. *Depletion,* as applied to natural gas producing land and land rights, means the loss in service value incurred in connection with the exhaustion of the natural resource in the course of service.

B. *Depreciation,* as applied to depreciable gas plant, means the loss in service value not restored by current maintenance, incurred in connection with the consumption or prospective retirement of gas plant in the course of service from causes which are known to be in current operation and against which the utility is not protected by insurance. Among the causes to be given consideration are wear and tear, decay, action of the elements, inadequacy, obsolescence, changes in the art, changes in demand and requirements of public authorities, and, in the case of natural gas companies, the exhaustion of natural resources.

MONTANA-DAKOTA UTILITIES CO.
GAS DIVISION

Depreciation Study
as of December 31, 2008

with an interpretation of ongoing and anticipated future events. Some of the revisions were not significant and typically reflect fine tuning of previously utilized depreciation rates while others were more substantial in nature. Several of the accounts did reflect more significant changes (as outlined in Section 4 of this report) from the previously utilized depreciation rates.

The most notable depreciation/amortization occurred relative to Account 376 - Mains, Account 380 - Services, Account 391.1 - Office Furniture and Equipment, Account 391.5 - Computer Equipment - Other and Account 392.20 - Transportation Equipment - Cars & Trucks.

The proposed depreciation rate for Account 376 – Mains, increased from 1.92 percent to 2.97 percent. The proposed depreciation rate is the result of combined changes of both the average service life and net salvage parameters for the various property categories that comprise the overall plant account. Based upon the Company's actual historical plant in service data individual service life parameters were estimated for each of the primary property groups (including Steel, Plastic, Valves, Manholes, and Bridge and River Crossings) as outlined in section 4 of the depreciation study report. The proposed average service life for each sub property group was changed in accordance with the life indication developed through an analysis of the Company's historical data and consideration of future expectations. The resulting proposed composite average service life of the various property groups is forty-seven (47) years, while the average service life underlying the present depreciation rate is an implicit forty-five (45) years. The future net salvage underlying the proposed depreciation rates is negative 50 percent while the future net salvage underlying the present depreciation rates is negative 60 percent. Notwithstanding the fact that both the estimated average service life was lengthen and the negative net salvage was reduced in developing the proposed depreciation rate, the resulting

Table 1

Montana-Dakota Utilities Company
Gas Division

Summary or Original Cost of Utility Plant in Service as of December 31, 2008
and Related Annual Depreciation Expense Under Present and Proposed Rates

Account No. (a)	Description (b)	Original Cost 12/31/08 (c)	Present Rates Rate % (d)	Present Rates Annual Accrual (e)	Proposed Rates: Proposed Plant Only Rates Rate % (f)	Proposed Rates: Proposed Plant Only Rates Annual Accrual (g)	Proposed Rates: Proposed Gross Salv Rates Rate % (h)	Proposed Rates: Proposed Gross Salv Rates Annual Accrual (i)	Proposed Rates: Proposed COR Rates Rate % (j)	Proposed Rates: Proposed COR Rates Annual Accrual (k)	Proposed Rates: Total Proposed Rates Rate % (l)	Proposed Rates: Total Proposed Rates Annual Accrual (m)	Net Change Depr., Exp. (n)
	DEPRECIABLE PLANT												
	Distribution Plant												
374.20	Rights of Way	322,677.60	0.75%	2,420.08	1.39%	4,485.22	0.00%	0.00	0.00%	0.00	1.39%	4,485.22	2,065.14
375.00	Distr. Meas & Reg Station Structures	609,311.11	2.57%	15,659.30	1.52%	9,261.53	0.18%	1,096.76	1.07%	6,519.63	2.77%	16,877.92	1,218.62
	Mains												
376.10	Mains-Steel	41,975,049.45	1.92%	805,920.95	1.77%	742,958.36	0.00%	0.00	1.07%	449,133.03	2.84%	1,192,091.40	386,170.45
376.20	Mains-Plastic	63,935,958.79	1.92%	1,227,570.41	1.99%	1,272,325.58	0.00%	0.00	1.06%	677,721.16	3.05%	1,950,046.74	722,476.33
376.30	Mains-Valves	447,328.09	1.92%	8,588.70	2.29%	10,243.81	0.00%	0.00	1.25%	5,591.60	3.54%	15,835.41	7,246.71
376.40	Mains-Manholes	69,919.29	1.92%	1,342.45	1.83%	1,279.52	0.00%	0.00	1.06%	741.14	2.89%	2,020.67	678.22
376.50	Mains-Bridge & River Crossings	19,818.03	1.92%	380.51	2.06%	408.25	0.00%	0.00	1.07%	212.05	3.13%	620.30	239.79
	Total Mains	106,448,073.65	1.92%	2,043,803.02	1.90%	2,027,215.54	0.00%	0.00	1.06%	1,133,398.98	2.97%	3,160,614.52	1,116,811.50
378.00	Meas & Reg Station Equip-General	2,140,308.63	2.96%	63,353.14	2.22%	47,514.85	0.00%	0.00	0.92%	19,690.84	3.14%	67,205.69	3,852.55
379.00	Meas & Reg Station Equip-City Gate	1,028,821.89	3.54%	36,420.29	2.81%	28,909.90	0.00%	0.00	0.94%	9,670.93	3.75%	38,580.82	2,160.53
	Services												
380.10	Services-Steel	7,285,187.87	5.66%	412,341.63	2.48%	180,672.66	0.00%	0.00	7.17%	522,347.97	9.65%	703,020.63	290,679.00
380.20	Services-Plastic	42,690,273.23	5.66%	2,416,269.46	2.50%	1,067,256.83	0.00%	0.00	5.41%	2,309,543.78	7.91%	3,376,800.61	960,531.15
380.30	Farm & Fuel Lines	248,640.18	5.66%	14,073.03	3.34%	8,304.58	0.00%	0.00	7.67%	19,070.70	11.01%	27,375.28	13,302.25
	Total Services	50,224,101.28	5.66%	2,842,684.12	2.50%	1,256,234.07	0.00%	0.00	5.68%	2,850,962.45	8.18%	4,107,196.52	1,264,512.40
381.00	Meters	55,172,050.24	3.19%	1,759,988.40	2.91%	1,605,506.66	0.00%	0.00	0.62%	342,066.71	3.53%	1,947,573.37	187,584.97
383.00	Service Regulators	5,555,207.98	2.59%	143,879.89	2.16%	119,992.49	-0.39%	(21,665.31)	0.00%	0.00	1.77%	98,327.18	(45,552.71)
385.00	Industrial Meas. & Reg. Station Equip	875,376.89	3.04%	26,611.46	2.43%	21,271.66	0.35%	3,063.82	0.53%	4,639.50	3.31%	28,974.98	2,363.52
	MISCELLANEOUS EQUIPMENT												
386.10	Misc Property on Customers Premise	1,679.84	5.19%	87.18	2.39%	40.15	0.00%	0.00	0.00%	0.00	2.39%	40.15	(47.03)
386.20	CNG Refueling station	261,880.34	3.70%	9,689.57	0.27%	707.08	0.00%	0.00	0.00%	0.00	0.27%	707.08	(8,982.49)
386.30	CNG Lease/Demo	0.00											
	TOTAL Account 386	263,560.18	3.71%	9,776.75	0.28%	747.23	0.00%	0.00	0.00%	0.00	0.28%	747.23	(9,029.52)
	OTHER EQUIPMENT												
387.10	Cathodic Protection Equipment	1,737,817.71	5.75%	99,924.52	3.21%	55,783.95	0.00%	0.00	0.00%	0.00	3.21%	55,783.95	(44,140.57)
387.20	Other Distribution Equipment	588,025.51	1.42%	8,349.96	0.99%	5,821.45	0.00%	0.00	0.00%	0.00	0.99%	5,821.45	(2,528.51)
	TOTAL Account 387	2,325,843.22	4.66%	108,274.48	2.65%	61,605.40	0.00%	0.00	0.00%	0.00	2.65%	61,605.40	(46,669.08)
	TOTAL Distribution Plant	224,965,332.67	3.14%	7,052,870.93	2.30%	5,182,744.55	-0.01%	(17,504.73)	1.94%	4,366,949.04	4.24%	9,532,188.85	2,479,317.92
	General Plant												
390.00	General Structures	5,835,295.28	3.73%	217,656.51	3.09%	180,310.62	-0.04%	(2,334.12)	0.41%	23,924.71	3.46%	201,901.22	(15,755.29)
	OFFICE FURNITURE & EQUIPMENT												
391.10	Office Furniture & Equipment	415,861.93	4.97%	20,668.34	6.59%	27,412.62	0.00%	0.00	0.00%	0.00	6.59%	27,412.62	6,744.28
391.30	Computer Equipment - PC	828,118.21	26.02%	215,476.36	11.28%	93,383.50	0.00%	0.00	0.00%	0.00	11.28%	93,383.50	(122,092.86)
391.50	Other Computer Equipment	53,696.84	0.00%	0.00	4.97%	2,667.08	0.00%	0.00	0.00%	0.00	4.97%	2,667.08	2,667.08
	TOTAL Account 391	1,297,676.98	18.20%	236,144.70	9.51%	123,463.20	0.00%	0.00	0.00%	0.00	9.51%	123,463.20	(112,681.50)

2-1

000009

MONTANA-DAKOTA UTILITIES

Gas Division

General

This report sets forth the results of our study of the depreciable property of Montana-Dakota Utilities - Gas (MDU or the Company) as of December 31, 2008 and contains the basic parameters (recommended average service lives and life characteristics) for the proposed average remaining life depreciation rates. All average service lives set forth in this report are developed based upon plant in service as of December 31, 2008.

The scope of the study included an analysis of MDU's historical data through December 31, 2008, discussions with Company management and staff to identify prior and prospective factors affecting the Company's plant in service, as well as interpretation of past service life data experience and future life expectancies to determine the appropriate average service lives of the Company's surviving plant. The service lives and life characteristics resulting from the in-depth study were utilized together with the Company's plant in service and book depreciation reserve to determine the recommended Average Remaining Life (ARL) depreciation rates for the Company's plant in service as of December 31, 2008.

In preparing the study, the Company's historical investment data were studied using various service life analysis techniques. Further, discussions were held with the MDU's management to obtain an overview of the Company's facilities and to discuss

the general scope of operations together with other factors which could have a bearing on the service lives of the Company's property.

The Company maintains property records containing a summary of its fixed capital investments by property account. This investment data was analyzed and summarized by property group and/or sub group and vintage then utilized as a basis for the various depreciation calculations.

Depreciation Study Overview

There are numerous methods utilized to recover property investment depending upon the goal. For example, accelerated methods such as double declining balance and sum of years digits are methods used in tax accounting to motivate additional investments. Broad Group (BG) and Equal Life Group (ELG) are both Straight Line Grouping Procedures recognized and utilized by various regulatory jurisdictions depending upon the policy of the specific agency.

The Straight Line Group Method of depreciation utilized in this study to develop the recommended depreciation rates is the Broad Group Procedure together with the Average Remaining Life Technique.

The distinction between the Whole Life and Remaining Life Techniques is that under the Whole Life Technique, the depreciation rate is based on the recovery of the investment and average net salvage over the average service life of the property group. In comparison, under the Average Remaining Life Technique, the resulting annual depreciation rate incorporates the recovery of the investment (and future net salvage) less any recovery experienced to date over the average remaining life of the property group.

curves are fitted. The fitted smooth curve provides the basis to determine the average service life of the property group under study.

Simulated Balances Method - In this method of analysis, simulated surviving balances are determined for each balance included in the test band by multiplying each proceeding year's original gross additions installed by the Company by the appropriate factor of each Standard Survivor Curve, summing the products, and comparing the results with the related year end plant balance to determine the "best fitting" curve and life within the test period. Various test bands are reviewed to determine trends or changes to indicated service lives in various bands of years. By definition, the curve with the "best fit" is the curve which produces simulated plant balances that most closely matches the actual plant balances as determined by the sum of the "least squares". The sum of the "least squares" is arrived at by starting with the difference between the simulated balances and the actual balance for a given year, squaring the difference, and the curve which produces the smallest sum (of squared difference) is judged to be the "best fit".

Period Retirements Method - The application of the Period Retirements Method is similar to the "Simulated Plant Balances" Method, except the procedure utilizes a Standard Survivor Curve and service life to simulate annual retirements instead of balances in performing the "least squares" fitting process during the test period. This procedure does tend to experience wider fluctuations due to the greater variations in level of experienced retirements versus additions and balances thereby producing greater variation in the study results.

Life Span Method - The Life Span or Forecast Method is a method utilized to

ACCOUNT – 376.10 Distribution Mains – Steel

Historical Experience

Plant Statistics
Plant Balance = $41,975,049
Original Gross Additions = $113,372,232 (Total Account)
Oldest Surviving Vintage = 1904
Retirements = $6,061,120 (Total Account) or 5.3% of historical additions.

Experience Bands 1916 – 2008 (Simulated) 47-R4

Historic Net Salvage: (68-08)

Three Year Average Net Salvage Percent			Full Depth
2004-06	2005-07	2006-08	1968-2008
-27%	-35%	-25%	-32%

Gross Salvage Trend Analysis			
20 Year	15 Year	10 Year	5 Year
2%	0%	0%	0%

Forecasted Net Salvage: -92%

Plant Considerations/Future Expectations

This property group is comprised of the Company's investment and related experience of Steel Distribution Mains. While portions of this property class (bare steel) were originally installed during earlier years, coated and wrapped steel has continue to be installed for higher pressure and larger size requirements. The earlier vintage assets in this account have aged considerably. Likewise, due to the lack of serviceability of the older vintaged property (which are Bare Steel Mains) contained within the Steel Mains category, they are being replaced.

Life Analysis Method: Simulated Plant Analysis Method

Average Remaining Life Development: Full Mortality

Current Depreciation Parameters

ASL/Curve: 45-R3
Net Salv: -60%

Proposed Depreciation Parameters

ASL/Curve: 47-R4
Future Net Salv: -50%

	New Rate @New Parameters	Old Rate @ Old Parameters
Rate	2.84%	1.92%
Average Remaining Life	22.3 years	N/A

(ASL – Average Service Life; NS – Net Salvage; FTA – Fit to Age; N/A—Not Available, Not Applicable

ACCOUNT – 376.20 Distribution Mains – Plastic

Historical Experience

Plant Statistics
Plant Balance = $63,935,959
Original Gross Additions = $113,372,232 (Total Account)
Oldest Surviving Vintage = 1969
Retirements = $6,061,120 (Total Account) or 5.3% of historical additions.

Experience Bands 1916 – 2008 (Simulated) 47-R4

Historic Net Salvage: (68-08)

Three Year Average Net Salvage Percent			Full Depth
2004-06	2005-07	2006-08	1968-2008
-27%	-35%	-25%	-32%

Gross Salvage Trend Analysis			
20 Year	15 Year	10 Year	5 Year
2%	0%	0%	0%

Forecasted Net Salvage: -92%

Plant Considerations/Future Expectations

This property group investment is comprised of the Company's investment and related experience of Plastic Distribution Mains and are typically related to the more recently installed portions of Mains. Studies of this class of property, in numerous completed depreciation studies, have identified that Plastic Mains routinely experience shorter lives than their metal counterparts. Such shorter lives are the product of higher levels of physical issues (e.g. physical damage, etc) impacting the mains as well as the fact that the Plastic mains have often been installed in areas that experience higher growth and replacements.

Life Analysis Method: Simulated Plant Analysis Method

Current Depreciation Parameters

ASL/Curve: 45-R3
Net Salv: -60%

Proposed Depreciation Parameters

ASL/Curve: 47-R4
Future Net Salv: -50%

	New Rate @New Parameters	Old Rate @ Old Parameters
Rate	3.05%	1.92%
Average Remaining Life	33.4 years	N/A

000014

(ASL – Average Service Life; NS – Net Salvage; FTA – Fit to Age; N/A—Not Available, Not Applicable

ACCOUNT – 380.10 Services – Steel

Historical Experience

Plant Statistics
Plant Balance = $7,285,188
Original Gross Additions = $54,121,206 (Total Account)
Oldest Surviving Vintage = 1928
Retirements = $3,625,013 (Total Account) or 6.7% of historical additions.

Experience Bands 1920– 2008 (Simulated) 40-R3

Historic Net Salvage: (68-08)

Three Year Average Net Salvage Percent			Full Depth
2004-06	2005-07	2006-08	1968-2008
-234%	-240%	-243%	-88%

Gross Salvage Trend Analysis			
20 Year	15 Year	10 Year	5 Year
0%	0%	0%	0%

Forecasted Net Salvage: -210%

Plant Considerations/Future Expectations

This property group is comprised of the Company's investment and related experience of Steel Services. The older vintage investments within the property group are related to Bare Steel Service which routinely experience higher replacement rates.

Life Analysis Method: Simulated Plant Analysis Method

Current Depreciation Parameters

ASL/Curve: 40-R2.5
Net Salv: -175%

Proposed Depreciation Parameters

ASL/Curve: 40-R3
Future Net Salv: -200%

	New Rate @New Parameters	Old Rate @ Old Parameters
Rate	9.65%	5.66%
Average Remaining Life	13.4 years	N/A

000015

(ASL – Average Service Life; NS – Net Salvage; FTA – Fit to Age; N/A—Not Available, Not Applicable

ACCOUNT – 380.20 Services – Plastic

Historical Experience

Plant Statistics
Plant Balance = $42,690,273
Original Gross Additions = $54,121,206 (Total Account)
Oldest Surviving Vintage = 1969
Retirements = $3,625,013 (Total Account) or 6.7% of historical additions.

Experience Bands 1920 – 2008 (Simulated) 40-R3

Historic Net Salvage: (68-08)

Three Year Average Net Salvage Percent			Full Depth
2004-06	2005-07	2006-08	1968-2008
-234%	-240%	-243%	-88%

Gross Salvage Trend Analysis			
20 Year	15 Year	10 Year	5 Year
0%	0%	0%	0%

Forecasted Net Salvage: -210%

Plant Considerations/Future Expectations

This property group is comprised of the Company's investment and related experience of Plastic Services. The future service life of this asset class is anticipated to generally be reflective the recent experience.

Life Analysis Method: Simulated Plant Analysis Method

Current Depreciation Parameters

ASL/Curve: 40-R3
Net Salv: -175%

Proposed Depreciation Parameters

ASL/Curve: 40-R3
Future Net Salv: -200%

	New Rate @New Parameters	Old Rate @ Old Parameters
Rate	7.91%	5.66%
Average Remaining Life	29.0 years	N/A

000016

(ASL – Average Service Life; NS – Net Salvage; FTA – Fit to Age; N/A—Not Available, Not Applicable

ACCOUNT – 380.30 Services – Farm & Fuel Lines

Historical Experience

Plant Statistics
Plant Balance = $248,640
Original Gross Additions = $54,121,206 (Total Account)
Oldest Surviving Vintage = 1977
Retirements = $3,625,013 (Total Account) or 6.7% of historical additions.

Experience Bands Estimated 30-R1.5

Historic Net Salvage: (68-08)

Three Year Average Net Salvage Percent			Full Depth
2004-06	2005-07	2006-08	1968-2008
-234%	-240%	-243%	-88%

Gross Salvage Trend Analysis

20 Year	15 Year	10 Year	5 Year
0	0%	0%	0%

Forecasted Net Salvage: -210%

Plant Considerations/Future Expectations

This property group is comprised of the Company's investment in a limited amount of Farm and Fuel service lines. The future service life of this asset class is anticipated to generally be reflective the recent experience.

Life Analysis Method: Simulated Plant Analysis Method

Current Depreciation Parameters

ASL/Curve: 30-R1.5
Net Salv: -175%

Proposed Depreciation Parameters

ASL/Curve: 30-R1.5
Future Net Salv: -200%

	New Rate @New Parameters	Old Rate @ Old Parameters
Rate	11.01%	5.66%
Average Remaining Life	17.9 years	N/A

000017

(ASL – Average Service Life; NS – Net Salvage; FTA – Fit to Age; N/A—Not Available, Not Applicable

ACCOUNT – 381 Meters

Historical Experience

Plant Statistics
Plant Balance = $55,172,050
Original Gross Additions = $63,302,194
Oldest Surviving Vintage = 1956
Retirements = $7,690,772 or 12.1% of historical additions.

Experience Bands 1933 - 2008 (Simulated) 35-R4

Historic Net Salvage: (68-08)

Three Year Average Net Salvage Percent			Full Depth
2004-06	2005-07	2006-08	1968-2008
-25%	-18%	-9%	7%

Gross Salvage Trend Analysis

20 Year	15 Year	10 Year	5 Year
10%	15%	16%	0%

Forecasted Net Salvage: -19%

Plant Considerations/Future Expectations

While no specific consideration has been factored into the estimated average service life of meters, in future years the Company's Meter can be anticipated to be impact by Automated Meter Reading technology. It is anticipated that the Company will is investigate the benefits and cost of installing such a Meter system. Under a typical Meter upgrade model/program customer's Meters would routinely be replaced with new property to enhance the efficiency of the Meter reading task. Accordingly, the current service life being achieved by this property class can be anticipated to be materially impacted (shortened) in future years.

Life Analysis Method: Simulated Plant Analysis Method

Current Depreciation Parameters

ASL/Curve: 35-R2.5
Net Salv: 0%

Proposed Depreciation Parameters

ASL/Curve: 35-R4
Future Net Salv: -15%

	New Rate @New Parameters	Old Rate @ Old Parameters
Rate	3.53%	3.19%
Average Remaining Life	24.1 years	N/A

000018

(ASL – Average Service Life; NS – Net Salvage; FTA – Fit to Age; N/A—Not Available, Not Applicable

Montana-Dakota Utilities Company
Gas Division
374.20 LAND RIGHTS

Forecasted Future Net Salvage
Based Upon Experienced Net Salvage 1985 - 2008

Year	Orginal Cost Of Retirements	Gross Salvage Amount	Gross Salvage %	Cost of Removal Amount	Cost of Removal %	Net Salvage Amount	Net Salvage %
Three - Year Rolling Bands							
1985 - 2008	1,819.54	14.73	0.81	0.00	0.00	14.73	0.81

Trend Analysis (End Year) 2008

*Based Upon Three - Year Rolling Averages

Annual Inflation Rate	2.75%
Average Service Life (ASL)	65.0
Average Retirement Age (Yrs)	8.2
Years To ASL	56.8
Inflation Factor At 2.75% to ASL	4.66

Gross Salvage
Linear Trend Analysis

1989-2008	20 - Year Trend	9.24%
1994-2008	15 - Year Trend	10.29%
1999-2008	10 - Year Trend	9.01%
2004-2008	5 - Year Trend	0.00% *

*Forecasted Gross Salvage Calculates To Less Than 0.00%---Percentage Set To A Floor of 0.00%.

Forcasted

Gross Salvage (Five Year Trend)	0.00% *
Cost Of Removal	0.00%
Net Salvage	0.00%

000019

Montana-Dakota Utilities Company
Gas Division
376.00, 376.10, 376.20, 376.30, 376.40, 376.50

Forecasted Future Net Salvage
Based Upon Experienced Net Salvage 1968 - 2008

Year	Orginal Cost Of Retirements	Gross Salvage Amount	Gross Salvage %	Cost of Removal Amount	Cost of Removal %	Net Salvage Amount	Net Salvage %
Annual Activity							
1968	200,220.26	16,598.28	8.29%	26,859.47	13.41%	(10,261.19)	-5.12%
1969	194,137.09	15,939.46	8.21%	43,168.49	22.24%	(27,229.03)	-14.03%
1970	267,046.03	23,230.21	8.70%	46,950.89	17.58%	(23,720.68)	-8.88%
1971	177,113.50	13,833.58	7.81%	56,809.25	32.08%	(42,975.67)	-24.26%
1972	157,195.80	13,435.85	8.55%	42,912.41	27.30%	(29,476.56)	-18.75%
1973	135,609.90	13,644.75	10.06%	27,848.00	20.54%	(14,203.25)	-10.47%
1974	79,682.47	4,158.86	5.22%	33,340.09	41.84%	(29,181.23)	-36.62%
1975	127,632.18	7,857.70	6.16%	43,072.35	33.75%	(35,214.65)	-27.59%
1976	195,879.62	9,760.39	4.98%	58,379.94	29.80%	(48,619.55)	-24.82%
1977	84,326.99	-3,773.39	-4.47%	25,097.78	29.76%	(28,871.17)	-34.24%
1978	116,364.42	10,832.09	9.31%	46,758.20	40.18%	(35,926.11)	-30.87%
1979	123,150.94	11,190.96	9.09%	36,244.68	29.43%	(25,053.72)	-20.34%
1980	88,516.03	3,479.59	3.93%	38,660.28	43.68%	(35,180.69)	-39.74%
1981	152,498.86	6,295.38	4.13%	46,691.72	30.62%	(40,396.34)	-26.49%
1982	127,572.66	-2,610.34	-2.05%	56,734.00	44.47%	(59,344.34)	-46.52%
1983	161,051.86	-581.14	-0.36%	104,094.70	64.63%	(104,675.84)	-65.00%
1984	185,619.78	-504.59	-0.27%	90,504.85	48.76%	(91,009.44)	-49.03%
1985	225.00	0.00	0.00%	94,130.78	1835.90%	(94,130.78)	-1835.90%
1986	164,397.14	-401.47	-0.24%	51,009.31	31.03%	(51,410.78)	-31.27%
1987	201,062.80	-231.86	-0.12%	90,443.45	44.98%	(90,675.31)	-45.10%
1988	281,758.55	-4,416.44	-1.57%	101,619.66	36.07%	(106,036.10)	-37.63%
1989	149,536.04	317.65	0.21%	69,598.16	46.54%	(69,280.51)	-46.33%
1990	92,157.64	-2,915.53	-3.16%	35,838.46	38.89%	(38,753.99)	-42.05%
1991	208,283.95	3,390.22	1.63%	72,574.40	34.84%	(69,184.18)	-33.22%
1992	261,776.43	-2,741.03	-1.05%	81,630.92	31.18%	(84,371.95)	-32.23%
1993	129,595.28	-3,971.17	-3.06%	60,124.58	46.39%	(64,095.75)	-49.46%
1994	362,204.01	-340.60	-0.09%	96,506.29	26.64%	(96,846.89)	-26.74%
1995	81,561.25	0.10	0.00%	22,341.68	27.39%	(22,341.58)	-27.39%

000020

Montana-Dakota Utilities Company
Gas Division
376.00, 376.10, 376.20, 376.30, 376.40, 376.50

Forecasted Future Net Salvage
Based Upon Experienced Net Salvage 1968 - 2008

Year	Orginal Cost Of Retirements	Gross Salvage		Cost of Removal		Net Salvage	
		Amount	%	Amount	%	Amount	%
Annual Activity							
1996	312,810.33	767.42	0.25%	83,391.55	26.66%	(82,624.13)	-26.41%
1997	182,351.81	56,675.22	31.08%	0.00	0.00%	56,675.22	31.08%
1998	196,796.74	805.67	0.41%	76,362.06	38.80%	(75,556.39)	-38.39%
1999	186,253.29	0.00	0.00%	82,439.31	44.26%	(82,439.31)	-44.26%
2000	158,497.94	0.00	0.00%	61,044.27	38.51%	(61,044.27)	-38.51%
2001	171,123.71	0.00	0.00%	74,109.60	43.31%	(74,109.60)	-43.31%
2002	118,946.90	0.00	0.00%	70,046.34	58.89%	(70,046.34)	-58.89%
2003	234,006.15	0.00	0.00%	150,701.69	64.40%	(150,701.69)	-64.40%
2004	390,887.97	0.00	0.00%	80,069.14	20.48%	(80,069.14)	-20.48%
2005	169,754.69	0.00	0.00%	57,360.40	33.79%	(57,360.40)	-33.79%
2006	122,131.96	804.98	0.66%	50,615.34	41.44%	(49,810.36)	-40.78%
2007	260,243.03	230.02	0.09%	85,572.48	32.88%	(85,342.46)	-32.79%
2008	443,390.53	155.02	0.03%	72,514.10	16.35%	(72,359.08)	-16.32%

000021

Montana-Dakota Utilities Company
Gas Division
376.00, 376.10, 376.20, 376.30, 376.40, 376.50

Forecasted Future Net Salvage
Based Upon Experienced Net Salvage 1968 - 2008

Year	Orginal Cost Of Retirements	Gross Salvage Amount	Gross Salvage %	Cost of Removal Amount	Cost of Removal %	Net Salvage Amount	Net Salvage %
Three - Year Rolling Bands							
1968 - 2008	7,453,371.53	190,915.84	2.56	2,544,171.07	34.13	(2,353,255.23)	-31.57

Trend Analysis (End Year) 2008

*Based Upon Three - Year Rolling Averages

Annual Inflation Rate	2.75%
Average Service Life (ASL)	47.0
Average Retirement Age (Yrs)	10.2
Years To ASL	36.8
Inflation Factor At 2.75% to ASL	2.71

Gross Salvage
Linear Trend Analysis

1989-2008	20 - Year Trend	1.53%
1994-2008	15 - Year Trend	0.00% *
1999-2008	10 - Year Trend	0.00% *
2004-2008	5 - Year Trend	0.23%

*Forecasted Gross Salvage Calculates To Less Than 0.00%---Percentage Set To A Floor of 0.00%.

Forcasted

Gross Salvage (Five Year Trend)	0.23%
Cost Of Removal	92.64%
Net Salvage	-92.41%

Montana-Dakota Utilities Company
Gas Division
380.00, 380.10, 380.20, 380.30

Forecasted Future Net Salvage
Based Upon Experienced Net Salvage 1968 - 2008

Year	Orginal Cost Of Retirements	Gross Salvage Amount	Gross Salvage %	Cost of Removal Amount	Cost of Removal %	Net Salvage Amount	Net Salvage %
Annual Activity							
1968	58,055.53	3,059.40	5.27%	27,723.99	47.75%	(24,664.59)	-42.48%
1969	55,853.48	845.59	1.51%	26,200.12	46.91%	(25,354.53)	-45.39%
1970	78,879.56	530.18	0.67%	23,001.10	29.16%	(22,470.92)	-28.49%
1971	52,774.35	880.28	1.67%	35,729.03	67.70%	(34,848.75)	-66.03%
1972	79,522.93	697.12	0.88%	32,010.82	40.25%	(31,313.70)	-39.38%
1973	65,093.43	0.00	0.00%	0.00	0.00%	0.00	0.00%
1974	64,653.14	596.73	0.92%	49,546.52	76.63%	(48,949.79)	-75.71%
1975	37,754.54	2,843.03	7.53%	50,159.99	132.86%	(47,316.96)	-125.33%
1976	68,213.75	0.00	0.00%	0.00	0.00%	0.00	0.00%
1977	192,462.86	0.00	0.00%	0.00	0.00%	0.00	0.00%
1978	-92,938.46	0.00	0.00%	0.00	0.00%	0.00	0.00%
1979	55,534.41	0.00	0.00%	0.00	0.00%	0.00	0.00%
1980	61,494.60	0.00	0.00%	0.00	0.00%	0.00	0.00%
1981	63,423.25	0.00	0.00%	0.00	0.00%	0.00	0.00%
1982	84,858.56	0.00	0.00%	0.00	0.00%	0.00	0.00%
1983	73,868.72	0.00	0.00%	0.00	0.00%	0.00	0.00%
1984	95,311.04	0.00	0.00%	0.00	0.00%	0.00	0.00%
1985	33,968.77	0.00	0.00%	0.00	0.00%	0.00	0.00%
1986	82,204.03	0.00	0.00%	0.00	0.00%	0.00	0.00%
1987	102,945.66	0.00	0.00%	0.00	0.00%	0.00	0.00%
1988	130,255.01	0.00	0.00%	0.00	0.00%	0.00	0.00%
1989	103,193.55	0.00	0.00%	0.00	0.00%	0.00	0.00%
1990	87,093.75	0.00	0.00%	0.00	0.00%	0.00	0.00%
1991	112,288.21	0.00	0.00%	0.00	0.00%	0.00	0.00%
1992	152,087.98	0.00	0.00%	0.00	0.00%	0.00	0.00%
1993	117,390.79	0.00	0.00%	0.00	0.00%	0.00	0.00%
1994	213,594.75	0.00	0.00%	0.00	0.00%	0.00	0.00%
1995	85,394.58	238.78	0.28%	132,997.10	155.74%	(132,758.32)	-155.46%

000023

Montana-Dakota Utilities Company
Gas Division
380.00, 380.10, 380.20, 380.30

Forecasted Future Net Salvage
Based Upon Experienced Net Salvage 1968 - 2008

Year	Orginal Cost Of Retirements	Gross Salvage Amount	Gross Salvage %	Cost of Removal Amount	Cost of Removal %	Net Salvage Amount	Net Salvage %
Annual Activity							
1996	190,887.20	489.25	0.26%	196,474.55	102.93%	(195,985.30)	-102.67%
1997	147,018.12	274.30	0.19%	167,867.03	114.18%	(167,592.73)	-113.99%
1998	156,868.35	165.57	0.11%	232,839.48	148.43%	(232,673.91)	-148.32%
1999	129,801.17	0.00	0.00%	205,972.55	158.68%	(205,972.55)	-158.68%
2000	134,394.03	0.00	0.00%	200,260.66	149.01%	(200,260.66)	-149.01%
2001	123,831.18	31.47	0.03%	203,228.57	164.12%	(203,197.10)	-164.09%
2002	95,019.90	0.00	0.00%	198,438.09	208.84%	(198,438.09)	-208.84%
2003	163,649.47	2,265.98	1.38%	269,303.25	164.56%	(267,037.27)	-163.18%
2004	184,931.55	0.00	0.00%	371,150.10	200.70%	(371,150.10)	-200.70%
2005	91,049.72	78.72	0.09%	257,936.56	283.29%	(257,857.84)	-283.21%
2006	107,041.95	275.02	0.26%	265,998.27	248.50%	(265,723.25)	-248.24%
2007	173,205.75	46.31	0.03%	367,375.64	212.10%	(367,329.33)	-212.08%
2008	112,617.91	461.23	0.41%	322,738.26	286.58%	(322,277.03)	-286.17%

Montana-Dakota Utilities Company
Gas Division
380.00, 380.10, 380.20, 380.30

Forecasted Future Net Salvage
Based Upon Experienced Net Salvage 1968 - 2008

Year	Orginal Cost Of Retirements	Gross Salvage		Cost of Removal		Net Salvage	
		Amount	%	Amount	%	Amount	%
Three - Year Rolling Bands							
1968 - 1970	192,788.57	4,435.17	2.30%	76,925.21	39.90%	(72,490.04)	-37.60%
1969 - 1971	187,507.39	2,256.05	1.20%	84,930.25	45.29%	(82,674.20)	-44.09%
1970 - 1972	211,176.84	2,107.58	1.00%	90,740.95	42.97%	(88,633.37)	-41.97%
1971 - 1973	197,390.71	1,577.40	0.80%	67,739.85	34.32%	(66,162.45)	-33.52%
1972 - 1974	209,269.50	1,293.85	0.62%	81,557.34	38.97%	(80,263.49)	-38.35%
1973 - 1975	167,501.11	3,439.76	2.05%	99,706.51	59.53%	(96,266.75)	-57.47%
1974 - 1976	170,621.43	3,439.76	2.02%	99,706.51	58.44%	(96,266.75)	-56.42%
1975 - 1977	298,431.15	2,843.03	0.95%	50,159.99	16.81%	(47,316.96)	-15.86%
1976 - 1978	167,738.15	0.00	0.00%	0.00	0.00%	0.00	0.00%
1977 - 1979	155,058.81	0.00	0.00%	0.00	0.00%	0.00	0.00%
1978 - 1980	24,090.55	0.00	0.00%	0.00	0.00%	0.00	0.00%
1979 - 1981	180,452.26	0.00	0.00%	0.00	0.00%	0.00	0.00%
1980 - 1982	209,776.41	0.00	0.00%	0.00	0.00%	0.00	0.00%
1981 - 1983	222,150.53	0.00	0.00%	0.00	0.00%	0.00	0.00%
1982 - 1984	254,038.32	0.00	0.00%	0.00	0.00%	0.00	0.00%
1983 - 1985	203,148.53	0.00	0.00%	0.00	0.00%	0.00	0.00%
1984 - 1986	211,483.84	0.00	0.00%	0.00	0.00%	0.00	0.00%
1985 - 1987	219,118.46	0.00	0.00%	0.00	0.00%	0.00	0.00%
1986 - 1988	315,404.70	0.00	0.00%	0.00	0.00%	0.00	0.00%
1987 - 1989	336,394.22	0.00	0.00%	0.00	0.00%	0.00	0.00%
1988 - 1990	320,542.31	0.00	0.00%	0.00	0.00%	0.00	0.00%
1989 - 1991	302,575.51	0.00	0.00%	0.00	0.00%	0.00	0.00%
1990 - 1992	351,469.94	0.00	0.00%	0.00	0.00%	0.00	0.00%
1991 - 1993	381,766.98	0.00	0.00%	0.00	0.00%	0.00	0.00%
1992 - 1994	483,073.52	0.00	0.00%	0.00	0.00%	0.00	0.00%
1993 - 1995	416,380.12	238.78	0.06%	132,997.10	31.94%	(132,758.32)	-31.88%
1994 - 1996	489,876.53	728.03	0.15%	329,471.65	67.26%	(328,743.62)	-67.11%
1995 - 1997	423,299.90	1,002.33	0.24%	497,338.68	117.49%	(496,336.35)	-117.25%

Montana-Dakota Utilities Company
Gas Division
380.00, 380.10, 380.20, 380.30

Forecasted Future Net Salvage
Based Upon Experienced Net Salvage 1968 - 2008

Year	Orginal Cost Of Retirements	Gross Salvage		Cost of Removal		Net Salvage	
		Amount	%	Amount	%	Amount	%
Three - Year Rolling Bands							
1996 - 1998	494,773.67	929.12	0.19%	597,181.06	120.70%	(596,251.94)	-120.51%
1997 - 1999	433,687.64	439.87	0.10%	606,679.06	139.89%	(606,239.19)	-139.79%
1998 - 2000	421,063.55	165.57	0.04%	639,072.69	151.78%	(638,907.12)	-151.74%
1999 - 2001	388,026.38	31.47	0.01%	609,461.78	157.07%	(609,430.31)	-157.06%
2000 - 2002	353,245.11	31.47	0.01%	601,927.32	170.40%	(601,895.85)	-170.39%
2001 - 2003	382,500.55	2,297.45	0.60%	670,969.91	175.42%	(668,672.46)	-174.82%
2002 - 2004	443,600.92	2,265.98	0.51%	838,891.44	189.11%	(836,625.46)	-188.60%
2003 - 2005	439,630.74	2,344.70	0.53%	898,389.91	204.35%	(896,045.21)	-203.82%
2004 - 2006	383,023.22	353.74	0.09%	895,084.93	233.69%	(894,731.19)	-233.60%
2005 - 2007	371,297.42	400.05	0.11%	891,310.47	240.05%	(890,910.42)	-239.95%
2006 - 2008	392,865.61	782.56	0.20%	956,112.17	243.37%	(955,329.61)	-243.17%

Montana-Dakota Utilities Company
Gas Division
380.00, 380.10, 380.20, 380.30

Forecasted Future Net Salvage
Based Upon Experienced Net Salvage 1968 - 2008

Year	Orginal Cost Of Retirements	Gross Salvage		Cost of Removal		Net Salvage	
		Amount	%	Amount	%	Amount	%
Three - Year Rolling Bands							
1968 - 2008	4,125,549.07	13,778.96	0.33	3,636,951.68	88.16	(3,623,172.72)	-87.82

Trend Analysis (End Year) 2008

*Based Upon Three - Year Rolling Averages

Annual Inflation Rate	2.75%
Average Service Life (ASL)	40.0
Average Retirement Age (Yrs)	8.0
Years To ASL	32.0
Inflation Factor At 2.75% to ASL	2.38

Gross Salvage
Linear Trend Analysis

1989-2008	20 - Year Trend	0.33%
1994-2008	15 - Year Trend	0.32%
1999-2008	10 - Year Trend	0.33%
2004-2008	5 - Year Trend	0.00% *

*Forecasted Gross Salvage Calculates To Less Than 0.00%---Percentage Set To A Floor of 0.00%.

Forcasted

Gross Salvage (Five Year Trend)	0.00% *
Cost Of Removal	209.83%
Net Salvage	-209.83%

Montana-Dakota Utilities Company
Gas Division
381.00 METERS

Forecasted Future Net Salvage
Based Upon Experienced Net Salvage 1968 - 2008

Year	Orginal Cost Of Retirements	Gross Salvage Amount	Gross Salvage %	Cost of Removal Amount	Cost of Removal %	Net Salvage Amount	Net Salvage %
Annual Activity							
1996	143,875.77	8,202.93	5.70%	0.00	0.00%	8,202.93	5.70%
1997	163,997.79	3,569.20	2.18%	0.00	0.00%	3,569.20	2.18%
1998	167,984.94	395.20	0.24%	0.00	0.00%	395.20	0.24%
1999	105,617.04	1,111.77	1.05%	0.00	0.00%	1,111.77	1.05%
2000	82,561.94	12,514.29	15.16%	0.00	0.00%	12,514.29	15.16%
2001	417,486.88	3,201.41	0.77%	92,372.21	22.13%	(89,170.80)	-21.36%
2002	1,907.40	755.86	39.63%	78.00	4.09%	677.86	35.54%
2003	13,397.63	10,850.29	80.99%	837.73	6.25%	10,012.56	74.73%
2004	29,662.11	13,191.45	44.47%	6,515.30	21.97%	6,676.15	22.51%
2005	1,342,411.55	35,501.30	2.64%	418,681.00	31.19%	(383,179.70)	-28.54%
2006	46,151.70	29,808.13	64.59%	6,552.00	14.20%	23,256.13	50.39%
2007	569,985.49	11,103.05	1.95%	0.00	0.00%	11,103.05	1.95%
2008	53,910.77	48,607.78	90.16%	143,105.00	265.45%	(94,497.22)	-175.28%

Montana-Dakota Utilities Company
Gas Division
381.00 METERS

Forecasted Future Net Salvage
Based Upon Experienced Net Salvage 1968 - 2008

Year	Orginal Cost Of Retirements	Gross Salvage Amount	Gross Salvage %	Cost of Removal Amount	Cost of Removal %	Net Salvage Amount	Net Salvage %
Three - Year Rolling Bands							
1968 - 2008	6,743,332.52	1,140,281.20	16.91	668,124.10	9.91	472,157.10	7.00

Trend Analysis (End Year) 2008

*Based Upon Three - Year Rolling Averages

Annual Inflation Rate	2.75%
Average Service Life (ASL)	35.0
Average Retirement Age (Yrs)	11.7
Years To ASL	23.3
Inflation Factor At 2.75% to ASL	1.88

Gross Salvage
Linear Trend Analysis

1989-2008	20 - Year Trend	10.29%
1994-2008	15 - Year Trend	14.91%
1999-2008	10 - Year Trend	15.62%
2004-2008	5 - Year Trend	0.00% *

*Forecasted Gross Salvage Calculates To Less Than 0.00%—Percentage Set To A Floor of 0.00%.

Forcasted

Gross Salvage (Five Year Trend)	0.00% *
Cost Of Removal	18.66%
Net Salvage	-18.66%

MONTANA-DAKOTA UTILITIES CO.
MONTANA CONSUMER COUNSEL
DATA REQUEST
DATED JANUARY 11, 2013
DOCKET NO. D2012.9.100

MCC-151 RE: ACCOUNT 380

Please provide a detailed narrative explaining specifically how the 40R3 life-curve combination was selected for Account 380 – Services. To the extent SPR results were relied upon, provide all ranking criteria for selected curves, as well as full justification for which band analysis was relied upon and why the results of other bands were not relied on.

Response:

Please see Attachment A for a general ranking of statistical best fit curves for varying experience bands. The output of the SPR analysis is not maintained in paper copy or other format. The databases and study software are electronic and the analysis was utilized to run numerous additional band analyses in real time during the course of completing the study and plot outputs are provided (in the depreciation study report) for of the service life parameters that were estimated for each of the property groups.

Please see Response No. MCC-135 for a complete copy of the historic depreciation database. The SPR is one additional tool of various items that are reviewed to identify the applicable service life for each of the applicable property groups.

Montana-Dakota Utilities Company
Gas Division
380.00 SERVICES

Summary of Simulated Curve Fitting Results
5 Year Band

Experience Band	Curve Dispersion	Ave. Serv. Life	Least Sum Of Square	Conformance Index	Index of Variation	Ret. Exp. Index
1920 - 2008	O4	186.4	5.230700E+12	42.15	23.73	46.56
2004 - 2008	SQ	39	1.445400E+11	258.1	3.87	100
1999 - 2003	O4	187	8.619500E+10	248.9	4.02	46.46
1994 - 1998	O4	169	2.466400E+10	382	2.62	49.87
1989 - 1993	O4	160.1	1.470400E+10	373.2	2.68	51.68
1984 - 1988	R1	48.4	3.031200E+10	218.9	4.57	98.3
1979 - 1983	R3	35	6.566000E+09	356.0	2.81	100
1974 - 1978	R4	30.5	2.039000E+09	451.9	2.21	100
1969 - 1973	R1	41.2	5.071400E+08	600.3	1.67	100
1964 - 1968	R2.5	35.1	1.657900E+08	702.4	1.42	100
1959 - 1963	R4	34.4	2.809400E+08	393.8	2.54	100
1954 - 1958	S1.5	40.1	5.575800E+06	1879	0.53	100
1949 - 1953	L3	37.7	6.839800E+06	1077	0.93	100

MONTANA-DAKOTA UTILITIES CO.
MONTANA CONSUMER COUNSEL
DATA REQUEST
DATED JANUARY 11, 2013
DOCKET NO. D2012.9.100

MCC-135 RE: DATA
WITNESS: ROBINSON

Please provide the original cost, by vintage, by account as reflected in Section 9 of the depreciation study, on electronic medium in Excel readable format for each account separately.

Response:

There is no Section 9 in either the Montana-Dakota Gas or Common Plant depreciation study report. The SPR depreciation data etc. and related developed survivors along with the Company's historical salvage data are being provided electronically on the enclosed CD entitled 'MCC-135 Depr Data Base.zip'.

MONTANA-DAKOTA UTILITIES CO.
MONTANA CONSUMER COUNSEL
DATA REQUEST
DATED JANUARY 11, 2013
DOCKET NO. D2012.9.100

MCC-156 RE: ACCOUNT 376
WITNESS: ROBINSON

Please segregate the investment in Account 376.1 – Distribution Steel Mains between bare steel, coated steel, and wrapped steel, as well as when each type of investment was first installed in the system and when the Company no longer installed such type of main.

Response:

Montana-Dakota does not track steel mains by bare, coated, or wrapped.

MONTANA-DAKOTA UTILITIES CO.
MONTANA CONSUMER COUNSEL
DATA REQUEST
DATED JANUARY 11, 2013
DOCKET NO. D2012.9.100

MCC-161 RE: DATA
WITNESS: ROBINSON

Please provide a copy of each of Mr. Robinson's gas-related depreciation studies, including all testimony and exhibits submitted during the past five years.

Response:

Please see the enclosed CD for the electronic file entitled 'MCC-161 Aus Depr Study Reports' for Mr. Robinson's gas related depreciation studies, including testimony and exhibits.

MONTANA-DAKOTA UTILITIES CO.
MONTANA CONSUMER COUNSEL
DATA REQUEST
DATED FEBRUARY 4, 2013
DOCKET NO. D2012.9.100

MCC-179 RE: RESPONSE TO MCC-155
WITNESS: ROBINSON

In response to MCC-155, the Company claims that it does not have available in its fixed assets systems the requested information. At this time, please identify to the best of the Company's ability the different generations of plastic pipe it installed as well as the approximate years each different generation of plastic pipe was installed and when it ceased placing each generation of plastic pipe in service corresponding to plant in Account 376.2 – Distribution Plastic Mains. Further,
provide all bases for the response.

Response:

Montana-Dakota has only used PE as the material for its plastic mains and services in Montana. The PE formulations have changed significantly over the years. Montana-Dakota first started installing PE pipe in the late 1960's and early 1970's in its Districts. This first PE plastic pipes were from Dupont LDIW Aldyl "A" PE 2306, and they were installed up until approximately early1973. The "Standard" formula Dupont Adyl "A" was installed from 1973 to 1984, and "Improved" Dupont Adyl "A" was installed from 1984 -1985 when Montana-Dakota switched totally to other 2406 yellow pipe MDPE materials from various manufactures. Montana-Dakota does have some HDPE materials in service and some areas had a very brief time frame of installing orange 2306 Plexco PE in the 1984 – 1985 date ranges. Montana-Dakota has never used PVC in mains or services in Montana.

An approximate breakdown of mains in Montana is:

Pre-1973 LDIW Adyl A Dupont Mains - 183,484'

"Standard" 2306 Adyl A Dupont Mains - 1,582,769' (1973-1984)

Post 1984 2406 MDPE yellow (various) - 2,784,358'

Below is an approximate breakdown of the number of services: The services are an estimate of the total number of services using date ranges of total footage:

Pre-1973 LDIW Adyl A Dupont Services – 4,600

"Standard" 2306 Adyl A Dupont Services – 16,100 (1973 – 1984)

Post 1984 2406 MDPE yellow (various) - 29,650

Montana-Dakota did not document and record information for each pipe section

installed as to the specific manufacture or PE characteristics. It is based on knowledge of subject matter experts and conservative estimates when products were purchased and charged in each operating district of the Company. It is also dependent on unknowns such as when material turnover resulted in a complete change to a particular pipe material. Montana-Dakota is currently moving to Bimodal PE with superior plastic characteristics.

MONTANA-DAKOTA UTILITIES CO.
MONTANA CONSUMER COUNSEL
DATA REQUEST
DATED FEBRUARY 4, 2013
DOCKET NO. D2012.9.100

MCC-180 RE: RESPONSE TO MCC-156
WITNESS: ROBINSON

In response to MCC-156, the Company claims that it does not track steel mains by bare, coated, or wrapped for investment in Account 376.1 – Distribution Steel Mains. At this time please identify the different types of steel mains the Company has placed in service, when each separate type of steel main was placed into service to the best of the Company's knowledge, and when it no longer installed each such type of main.

Response:

The types of steel pipe at Montana-Dakota is difficult to determine as pipe was only mapped as bare and coated in most cases and the history of the different coatings used also varied among operating areas of the Company. Typically mill wrapped type coatings were used up until approximately the late 1960's to early 1970's. Extruded poly or PE type coatings were used during the years after mill wrap pipe and today the standard is fusion bond epoxy coatings on steel pipes.

The Company has very little below ground bare steel in the pipeline system in Montana. 3.918 miles of bare steel main is currently listed in the 2011 Montana Department of Transportation (DOT) 7100 Annual Report of Distribution and much of this is above ground in various stations, such as town border stations and district regulator stations. Montana-Dakota carried out an active bare steel pipe replacement capital project beginning around 1993 that has replaced most of the bare steel pipe in the system. If any bare steel pipe is found in the system from unknown or mapping/record issues it is typically scheduled for replacement. 50 bare steel services were reported in the 2011 Montana DOT 7100 Annual Report of Distribution.

The estimated typical steel pipe coatings found in the Montana system are:

400 miles of mill wrap coated mains
20,000 services in the mill wrap coating years

300 miles of extruded poly type coatings
5,000 services in the extruded poly type coatings

50 miles of fusion bond epoxy coatings
2,500 service with fusion bond epoxy coatings

These are estimates as Montana-Dakota did not track coating type on the map features and various operating areas used different types of coated pipe at different times.

MONTANA-DAKOTA UTILITIES CO.
COMMON PLANT

Depreciation Study
as of December 31, 2008

Table 2 - Plant Only

Montana-Dakota Utilities Company
Common Plant

Summary of Original Cost of Utility Plant in Service and Calculation of Annual Depreciation Rates and Depreciation Expense Based Upon Utilization of Book Deprecation Reserve and Average Remaining Lives as of December 31, 2008

Account No. (a)	Description (b)	Original Cost 12/31/08 (c)	Estimated Future Net Salvage % (d)	Estimated Future Net Salvage Amount (e)	Original Cost Less Salvage (f)	Book Depreciation Reserve (g)	Net Original Cost Less Salvage (h)	A.S.L./ Survivor Curve (i)	Average Remaining Life (j)	Annual Depreciation Accrual (k)	Annual Depr. Rate (l)
	DEPRECIABLE PLANT										
	General Plant										
390.0	General Structures	26,865,571.47	0%	0.00	26,865,571.47	9,843,802.26	17,021,769.21	35-R1	25.2	675,467.03	2.51%
	OFFICE FURNITURE & EQUIPMENT										
391.1	Office Furniture & Equipment	3,072,248.50	0%	0.00	3,072,248.50	1,438,080.62	1,634,167.88	N/A	N/A	207,227.63	6.75% *
391.2	Computer Equipment - Honeywell	0.00	0%	0.00	0.00	0.00	0.00	N/A	N/A	0.00	0.00% *
391.3	Computer Equipment - PC	2,168,689.65	0%	0.00	2,168,689.65	2,130,757.41	37,932.24	N/A	N/A	157,939.09	7.28% *
391.4	Computer Equipment - Prime/Sun	7,552.14	0%	0.00	7,552.14	7,806.34	-254.20	N/A	N/A	51.47	0.68% *
391.5	Computer Equipment - Other	1,049,321.00	0%	0.00	1,049,321.00	467,503.87	581,817.13	N/A	N/A	193,100.24	18.40% *
	TOTAL Account 391	6,297,811.29		0.00	6,297,811.29	4,044,148.24	2,253,663.05			558,318.42	8.87%
	TRANSPORTATION EQUIPMENT										
392.1	Transportation Equipment (Trailers)	113,614.30	0%	0.00	113,614.30	152,128.67	-38,514.37	24-L1	12.6	0.00	0.00% (1)
392.2	Transportation Equipment (Cars & Trucks)	5,326,632.43	0%	0.00	5,326,632.43	3,135,598.94	2,191,033.49	8-R2	4.5	486,896.33	9.14%
	TOTAL Account 392	5,440,246.73		0.00	5,440,246.73	3,287,727.61	2,152,519.12			486,896.33	8.95%
393.0	Stores Equipment	45,012.16	0%	0.00	45,012.16	16,459.85	28,552.31	N/A	N/A	1,494.05	3.32% *
	TOOLS, SHOP & GARAGE EQ.										
394.1	Tools, Shop & Garage Equip. (Non-Unitized)	412,820.47	0%	0.00	412,820.47	161,007.16	251,813.31	N/A	N/A	27,719.23	6.71% *
394.3	Vehicle Maintenance Equipment	179,785.84	0%	0.00	179,785.84	80,709.96	99,075.88	N/A	N/A	9,591.43	5.33% *
394.4	Vehicle Refueling Equipment	612,112.44	0%	0.00	612,112.44	575,399.33	36,713.11	N/A	N/A	20,101.35	3.28% *
	TOTAL Account 394	1,204,718.75		0.00	1,204,718.75	817,116.45	387,602.30			57,412.01	4.77%
396.2	Power Operated Equipment	53,432.48	0%	0.00	53,432.48	7,669.90	45,762.58	10-R2	4.7	9,736.72	18.22%
	COMMUNICATION EQUIPMENT										
397.1	Radio Communication Equip. (Fixed)	379,772.93	0%	0.00	379,772.93	233,451.80	146,321.13	N/A	N/A	17,844.86	4.70% *
397.2	Radio Communication Equip. (Mobile)	612,124.91	0%	0.00	612,124.91	466,747.57	145,377.34	N/A	N/A	25,251.65	4.13% *
397.3	General Telephone Communication Equip.	496,688.56	0%	0.00	496,688.56	368,104.63	128,583.93	N/A	N/A	38,662.59	7.78% *
397.5	Supervisory & Telemetering Equip.	41,918.98	0%	0.00	41,918.98	39,621.09	2,297.89	N/A	N/A	1,777.12	4.24% *

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Montana-Dakota Utilities Company
Common Plant
390.00 STRUCTURES & IMPROVEMENTS

Forecasted Future Net Salvage
Based Upon Experienced Net Salvage 1968 - 2008

Year	Orginal Cost Of Retirements	Gross Salvage Amount	Gross Salvage %	Cost of Removal Amount	Cost of Removal %	Net Salvage Amount	Net Salvage %
Annual Activity							
1968	4,755.66	662.00	13.92%	40.08	0.84%	621.92	13.08%
1969	23,146.27	350.00	1.51%	978.69	4.23%	(628.69)	-2.72%
1970	9,535.95	5,550.94	58.21%	1,401.83	14.70%	4,149.11	43.51%
1971	55.50	816.00	1470.27%	1,457.69	2626.47%	(641.69)	-1156.20%
1972	89,020.14	20,850.79	23.42%	100.23	0.11%	20,750.56	23.31%
1973	823.15	556.00	67.55%	0.00	0.00%	556.00	67.55%
1974	6,649.36	0.00	0.00%	2,380.69	35.80%	(2,380.69)	-35.80%
1975	0.00	0.00	0.00%	0.00	0.00%	0.00	0.00%
1976	698.69	0.00	0.00%	17.84	2.55%	(17.84)	-2.55%
1977	33,563.08	10.00	0.03%	7,368.10	21.95%	(7,358.10)	-21.92%
1978	5,945.18	166.75	2.80%	470.81	7.92%	(304.06)	-5.11%
1979	361.83	-2.15	-0.59%	28.73	7.94%	(30.88)	-8.53%
1980	36,428.79	46,043.00	126.39%	0.00	0.00%	46,043.00	126.39%
1981	386.16	0.00	0.00%	0.00	0.00%	0.00	0.00%
1982	2,390.36	-35,198.49	-1472.52%	0.00	0.00%	(35,198.49)	-1472.52%
1983	151,268.18	52,055.19	34.41%	17,106.40	11.31%	34,948.79	23.10%
1984	0.00	239.87	0.00%	0.00	0.00%	239.87	0.00%
1985	29,321.00	0.00	0.00%	0.00	0.00%	0.00	0.00%
1986	353,205.79	462.87	0.13%	23,017.27	6.52%	(22,554.40)	-6.39%
1987	114,668.89	6.60	0.01%	178,550.90	155.71%	(178,544.30)	-155.70%
1988	1,065.81	20.00	1.88%	44,427.72	4168.45%	(44,407.72)	-4166.57%
1989	2,907.81	0.00	0.00%	1,361.75	46.83%	(1,361.75)	-46.83%
1990	1,179.28	0.00	0.00%	4,183.53	354.75%	(4,183.53)	-354.75%
1991	11,317.67	0.00	0.00%	21,000.00	185.55%	(21,000.00)	-185.55%
1992	6,400.00	0.00	0.00%	59,485.65	929.46%	(59,485.65)	-929.46%
1993	66,938.07	5,500.00	8.22%	11,015.00	16.46%	(5,515.00)	-8.24%
1994	76,339.95	52.50	0.07%	3,348.28	4.39%	(3,295.78)	-4.32%
1995	249,269.07	188,096.00	75.46%	48,516.38	19.46%	139,579.62	56.00%

Montana-Dakota Utilities Company
Common Plant
390.00 STRUCTURES & IMPROVEMENTS

Forecasted Future Net Salvage
Based Upon Experienced Net Salvage 1968 - 2008

Year	Orginal Cost Of Retirements	Gross Salvage Amount	Gross Salvage %	Cost of Removal Amount	Cost of Removal %	Net Salvage Amount	Net Salvage %
Annual Activity							
1996	174,572.37	26,753.21	15.32%	22,545.80	12.91%	4,207.41	2.41%
1997	97,788.56	45,363.50	46.39%	4,264.75	4.36%	41,098.75	42.03%
1998	255,811.74	0.00	0.00%	40,398.90	15.79%	(40,398.90)	-15.79%
1999	303,792.23	30,685.00	10.10%	12,226.33	4.02%	18,458.67	6.08%
2000	172,070.45	10,283.75	5.98%	30,934.95	17.98%	(20,651.20)	-12.00%
2001	109,759.98	0.00	0.00%	14,718.75	13.41%	(14,718.75)	-13.41%
2002	110,036.20	0.00	0.00%	29,201.73	26.54%	(29,201.73)	-26.54%
2003	16,416.00	0.00	0.00%	0.00	0.00%	0.00	0.00%
2004	1,053,662.14	639,099.00	60.66%	26,474.19	2.51%	612,624.81	58.14%
2005	-32,272.79	0.00	0.00%	225.00	0.00%	(225.00)	0.00%
2006	381,881.81	330,000.00	86.41%	9,972.50	2.61%	320,027.50	83.80%
2007	95,847.37	111,000.00	115.81%	14,204.68	14.82%	96,795.32	100.99%
2008	26,948.70	0.00	0.00%	2,070.30	7.68%	(2,070.30)	-7.68%

Montana-Dakota Utilities Company
Common Plant
390.00 STRUCTURES & IMPROVEMENTS

Forecasted Future Net Salvage
Based Upon Experienced Net Salvage 1968 - 2008

Year	Orginal Cost Of Retirements	Gross Salvage		Cost of Removal		Net Salvage	
		Amount	%	Amount	%	Amount	%
Three - Year Rolling Bands							
1968 - 1970	37,437.88	6,562.94	17.53%	2,420.60	6.47%	4,142.34	11.06%
1969 - 1971	32,737.72	6,716.94	20.52%	3,838.21	11.72%	2,878.73	8.79%
1970 - 1972	98,611.59	27,217.73	27.60%	2,959.75	3.00%	24,257.98	24.60%
1971 - 1973	89,898.79	22,222.79	24.72%	1,557.92	1.73%	20,664.87	22.99%
1972 - 1974	96,492.65	21,406.79	22.18%	2,480.92	2.57%	18,925.87	19.61%
1973 - 1975	7,472.51	556.00	7.44%	2,380.69	31.86%	(1,824.69)	-24.42%
1974 - 1976	7,348.05	0.00	0.00%	2,398.53	32.64%	(2,398.53)	-32.64%
1975 - 1977	34,261.77	10.00	0.03%	7,385.94	21.56%	(7,375.94)	-21.53%
1976 - 1978	40,206.95	176.75	0.44%	7,856.75	19.54%	(7,680.00)	-19.10%
1977 - 1979	39,870.09	174.60	0.44%	7,867.64	19.73%	(7,693.04)	-19.30%
1978 - 1980	42,735.80	46,207.60	108.12%	499.54	1.17%	45,708.06	106.95%
1979 - 1981	37,176.78	46,040.85	123.84%	28.73	0.08%	46,012.12	123.77%
1980 - 1982	39,205.31	10,844.51	27.66%	0.00	0.00%	10,844.51	27.66%
1981 - 1983	154,044.70	16,856.70	10.94%	17,106.40	11.10%	(249.70)	-0.16%
1982 - 1984	153,658.54	17,096.57	11.13%	17,106.40	11.13%	(9.83)	-0.01%
1983 - 1985	180,589.18	52,295.06	28.96%	17,106.40	9.47%	35,188.66	19.49%
1984 - 1986	382,526.79	702.74	0.18%	23,017.27	6.02%	(22,314.53)	-5.83%
1985 - 1987	497,195.68	469.47	0.09%	201,568.17	40.54%	(201,098.70)	-40.45%
1986 - 1988	468,940.49	489.47	0.10%	245,995.89	52.46%	(245,506.42)	-52.35%
1987 - 1989	118,642.51	26.60	0.02%	224,340.37	189.09%	(224,313.77)	-189.07%
1988 - 1990	5,152.90	20.00	0.39%	49,973.00	969.80%	(49,953.00)	-969.42%
1989 - 1991	15,404.76	0.00	0.00%	26,545.28	172.32%	(26,545.28)	-172.32%
1990 - 1992	18,896.95	0.00	0.00%	84,669.18	448.06%	(84,669.18)	-448.06%
1991 - 1993	84,655.74	5,500.00	6.50%	91,500.65	108.09%	(86,000.65)	-101.59%
1992 - 1994	149,678.02	5,552.50	3.71%	73,848.93	49.34%	(68,296.43)	-45.63%
1993 - 1995	392,547.09	193,648.50	49.33%	62,879.66	16.02%	130,768.84	33.31%
1994 - 1996	500,181.39	214,901.71	42.96%	74,410.46	14.88%	140,491.25	28.09%
1995 - 1997	521,630.00	260,212.71	49.88%	75,326.93	14.44%	184,885.78	35.44%

Montana-Dakota Utilities Company
Common Plant
390.00 STRUCTURES & IMPROVEMENTS

Forecasted Future Net Salvage
Based Upon Experienced Net Salvage 1968 - 2008

Year	Orginal Cost Of Retirements	Gross Salvage		Cost of Removal		Net Salvage	
		Amount	%	Amount	%	Amount	%
Three - Year Rolling Bands							
1996 - 1998	528,172.67	72,116.71	13.65%	67,209.45	12.72%	4,907.26	0.93%
1997 - 1999	657,392.53	76,048.50	11.57%	56,889.98	8.65%	19,158.52	2.91%
1998 - 2000	731,674.42	40,968.75	5.60%	83,560.18	11.42%	(42,591.43)	-5.82%
1999 - 2001	585,622.66	40,968.75	7.00%	57,880.03	9.88%	(16,911.28)	-2.89%
2000 - 2002	391,866.63	10,283.75	2.62%	74,855.43	19.10%	(64,571.68)	-16.48%
2001 - 2003	236,212.18	0.00	0.00%	43,920.48	18.59%	(43,920.48)	-18.59%
2002 - 2004	1,180,114.34	639,099.00	54.16%	55,675.92	4.72%	583,423.08	49.44%
2003 - 2005	1,037,805.35	639,099.00	61.58%	26,699.19	2.57%	612,399.81	59.01%
2004 - 2006	1,403,271.16	969,099.00	69.06%	36,671.69	2.61%	932,427.31	66.45%
2005 - 2007	445,456.39	441,000.00	99.00%	24,402.18	5.48%	416,597.82	93.52%
2006 - 2008	504,677.88	441,000.00	87.38%	26,247.48	5.20%	414,752.52	82.18%

Montana-Dakota Utilities Company
Common Plant
390.00 STRUCTURES & IMPROVEMENTS

Forecasted Future Net Salvage
Based Upon Experienced Net Salvage 1968 - 2008

Year	Orginal Cost Of Retirements	Gross Salvage Amount	Gross Salvage %	Cost of Removal Amount	Cost of Removal %	Net Salvage Amount	Net Salvage %
Three - Year Rolling Bands							
1968 - 2008	4,043,956.40	1,479,422.33	36.58	633,495.45	15.67	845,926.88	20.92

Trend Analysis (End Year) 2008

***Based Upon Three - Year Rolling Averages**

Annual Inflation Rate	2.75%
Average Service Life (ASL)	35.0
Average Retirement Age (Yrs)	8.4
Years To ASL	26.6
Inflation Factor At 2.75% to ASL	2.06

Gross Salvage Linear Trend Analysis

1989-2008	20 - Year Trend	67.87%
1994-2008	15 - Year Trend	70.21%
1999-2008	10 - Year Trend	102.38%
2004-2008	5 - Year Trend	105.40%

Forcasted

Gross Salvage (Five Year Trend)	105.40%
Cost Of Removal	32.22%
Net Salvage	73.18%

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MONTANA-DAKOTA UTILITIES CO.
MONTANA CONSUMER COUNSEL
DATA REQUEST
DATED JANUARY 11, 2013
DOCKET NO. D2012.9.100

MCC-148 RE: ACCOUNT 390 COMMON
WITNESS: ROBINSON

Please provide a detailed description (e.g., physical location, type of construction, square feet, when built, etc.) for each of the 10 largest investments in Account 390 – General Structures Common Plant. For each of the 10 largest investments, identify whether the investment is owned or leased.

Response:

Please see Attachment A.

Montana-Dakota Utilities Co.
MCC-148 Ten Largest General Plant Structures by Investment
Common 390 Account - All Owned
As of December 31, 2012

Building	Location	390 Account Balance	Type of Construction	Year Built	Size (Sq. Ft)	Current Use
Billings Office	Billings, MT	$4,341,473.19	Steel with brick exterior	2007	32,680	Construction and maintenance warehouse and shop primarily supporting the Billing's District's operations and the main operations office for the Rocky Mountain Region
MDU General Office	Bismarck, ND	5,309,559.38	Steel with precast exterior	1968	65,224	Main administrative and operations office for Montana-Dakota Utilities Co.
Bismarck Service Center	Bismarck, ND	4,456,772.65	Steel with brick/ metal exterior	1984	101,767	Construction and maintenance warehouse, shop, and office primarily supporting the Bismarck District's operations
MDU Resources Corporate Office	Bismarck, ND	5,470,791.60	Steel with precast exterior	2005	90,752	Main administrative office for MDU Resources Group, Inc. Amount presented represents Montana-Dakota Utilities Co's 13% ownership
Glendive District Office & Service Center	Glendive, MT	1,529,677.39	Steel with EIFS/ metal exterior	1995	25,124	Construction and maintenance warehouse, shop, and office primarily supporting the Glendive District's operations
Sheridan District Office	Sheridan, WY	1,117,566.19	Wood stud with EIFS/ stone veneer exterior	2004	6,250	Main operations office for the Sheridan District
Sheridan Service Center	Sheridan, WY	855,683.80	Steel with metal exterior	1979	18,425	Construction and maintenance warehouse and shop primarily supporting the Sheridan District's operations
Badlands Region Office & Service Center	Dickinson, ND	2,152,318.31	Steel with brick/ metal exterior	1982	33,800	Construction and maintenance warehouse and shop primarily supporting the Dickinson District's operations and the main operations office for the Badlands Region
Williston Employee Trailer Park	Williston, ND	2,072,792.09	Vinyl Siding	2012	20,660	Land improvements/10 Mobile Homes & one 4-Plex @ Employee Mobile Home Park MDU employee and contractor housing
Aircraft Hangar	Bismarck, ND	714,588.22	Steel with metal exterior	2009	14,975	Maintenance and hangar for corporate aircraft
Total		$28,021,222.82				
Total Other Structures & Improvements		$ 7,008,416.49				
Total 390 Account-Common		$35,029,639.31				

Response No. MCC-148
Attachment A
Page 1 of 1

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MONTANA-DAKOTA UTILITIES CO.
MONTANA CONSUMER COUNSEL
DATA REQUEST
DATED FEBRUARY 4, 2013
DOCKET NO. D2012.9.100

MCC-185 RE: ACCOUNT 390 – COMMON PLANT
WITNESS: ROBINSON

As it relates to Account 390 – Common Plant, please identify what retired and the reason for retirement corresponding to the $998,763 level of retirement set forth on page 5-2 of the Common Plant Depreciation Study in Exhibit_(EMR-2) for the age interval 3.5-4.5. The response should further specifically demonstrate why retirements of such magnitude at such an early age are indicative of the existing plant in service.

Response:

The overwhelming majority (99 plus percent) of the $998,763 is related to the investment in the MDU Resources Group, Inc. Corporate office building that was bought and sold within a relatively short time period (6 years – bought in 1994 and sold to MDU Resources in 2001). At the time, it was decided to create a separate company under MDU Resources to hold the assets of the building and its contents. Montana-Dakota originally had on its books100 percent of the MDU Resources Corporate office building and its contents. When the new company, Future Source, was formed, Montana-Dakota sold the MDU Resources Corporate office building and its contents to Future Source at net book value.

MONTANA-DAKOTA UTILITIES CO.
MONTANA CONSUMER COUNSEL
DATA REQUEST
DATED FEBRUARY 4, 2013
DOCKET NO. D2012.9.100

MCC-186 RE: ACCOUNT 390 – COMMON PLANT
WITNESS: ROBINSON

As it relates to Account 390 – Common Plant, please identify what retired and the reason for retirement corresponding to the $1,803,313 level of retirement set forth on page 5-2 of the Common Plant Depreciation Study in Exhibit_(EMR-2) for the age interval 6.5-7.5. The response should further specifically demonstrate why retirements of such magnitude at such an early age are indicative of the existing plant in service.

Response:

The overwhelming majority (99 plus percent) of the $1,803,313 is related to the investment in the MDU Resources Group, Inc. Corporate office building that was bought and sold within a relatively short time period (6 years – bought in 1994 and sold to MDU Resources in 2001). At the time, it was decided to create a separate company under MDU Resources to hold the assets of the building and its contents. Montana-Dakota originally had on its books100 percent of the MDU Resources Corporate office building and its contents. When the new company, Future Source, was formed, Montana-Dakota sold the MDU Resources Corporate office building and its contents to Future Source at net book value.

MONTANA-DAKOTA UTILITIES CO.
MONTANA CONSUMER COUNSEL
DATA REQUEST
DATED FEBRUARY 4, 2013
DOCKET NO. D2012.9.100

MCC-187 RE: ACCOUNT 391.10
WITNESS: ROBINSON

Regarding the assumed 15R3 life-curve combination for common plant Account 391.10 – Office Furniture and Equipment as set forth on page 2-8 of the Common Plant Depreciation Study at Table 7, please provide all support and justification of the assumed 15R3 life-curve combination.

Response:

In accordance with general industry practice, the Company has been using general plant amortization for its general plant accounts including Accounts 391.1, 391.2, 391.3, 391.4, 391.5, 393, 394.1, 394.3, 394.4, 397.1, 397.2, 397.3, 397.5, 394.8, and 398 since the early 2000's. Each of the various plant accounts contain only modest levels of individual investments which are comprised of larger quantities of small investment amounts that are difficult to track unit retirements. At the time of moving to general plant amortization, the available historical data along with general industry lives were assessed in developing the general plant amortization periods. Subsequent to moving to the general plant amortization procedure, retirements occur only when the property achieves the age equal to the general plant amortization period. Accordingly, specific life related retirement data no longer exists for the property group.

BEFORE THE MONTANA PUBLIC SERVICE COMMISSION

In the Matter of the Application of MONTANA-DAKOTA UTILITIES CO., a Division of MDU Resources Group, Inc., for Authority to Establish Increased Rates for Natural Gas Service	)))))	Docket No. D2012.9.__

DIRECT TESTIMONY AND EXHIBITS

OF

EARL M. ROBINSON

On The Subject of Depreciation

DEPRECIATION

1 compiled through December 31, 2008, which contains detailed vintage
2 level information, was used to develop observed life tables. The
3 development of the observed life tables from the historical information was
4 completed by grouping like aged investments within each property
5 category and identifying the level of retirements that occur through each
6 successive age to develop the applicable observed life tables. The
7 resulting observed lives were then fitted to standard Iowa Curves to
8 estimate each property group's historically achieved average service life.
9 Likewise, the net salvage database was used as a basis to identify
10 historical experience and trends and to determine each property group's
11 recommended net salvage factors. This was accomplished by preparing
12 various three year rolling band analyses of salvage components as well as
13 a forecast based on the Company's historical salvage experience.
14 **Q9. In the preparation of the depreciation study, have you utilized**
15 **information from additional sources when estimating service life and**
16 **salvage parameters?**
17 **A.** Yes. In addition to the historical data obtained from the Company's books
18 and records, information was obtained from Company personnel relative
19 to current operations and future expectations with respect to depreciation.
20 Discussions were held with Company planning and operations
21 management. In addition, physical inspections were also conducted of
22 various representative sites of the Company's operating property.

identical service lives, but have lives which are dispersed over a range of time. Utilizing group depreciation allows for a uniform application of depreciation rates to groups of similar property in lieu of performing extensive depreciation calculations on an item-by-item basis. The Broad Group approach is a recognized common group depreciation procedure.

The Broad Group Procedure recovers the investment within the asset group over the average service life of the property group. Given that there is dispersion within each property group, there are variations of retirement ages for the many investments within each property group. That is, some properties retire early (before average service life) while others retire at older ages (after average service life). This dispersion of retirement ages defines the survival pattern experienced by the applicable property group.

Q18. What factors influence the determination of the recommended annual depreciation rates included in your depreciation reports?

A. The depreciation rates reflect four principal factors: (1) the plant in service by vintage, (2) the book depreciation reserve, (3) the future net salvage, and (4) the composite remaining life for the property group. Factors considered in arriving at the service life are the average age, realized life and the survival characteristics of the property. The net salvage estimate is influenced by both past experience and future estimates of the cost of removal and gross salvage amounts.

1 cost of the plant when first placed into service. This information, along
2 with knowledge about the average age of the historical retirements that
3 have occurred to date, allows an estimation of the level of retirement cost
4 that will be experienced by the Company at the end of each property
5 group's useful life. The study methodology utilized has been extensively
6 set forth in depreciation textbooks and has been the accepted practice by
7 depreciation professionals for many decades. Furthermore, the cost of
8 removal analysis is the current standard practice used for mass assets by
9 essentially all depreciation professionals in estimating future net salvage
10 for the purpose of identifying the applicable depreciation rate for a
11 property group. There is a direct relationship between the installation of
12 specific plant and its corresponding removal. The installation is its
13 beginning of life cost while the removal is its end of life cost. Also, it is
14 important to note that Average Remaining Life depreciation rates
15 incorporate future net salvage which is typically more representative of
16 recent versus long-term historical average net salvage.

17 The Company's historical net salvage experience was analyzed to
18 identify the historical net salvage factor for each applicable property group
19 and is included in Section 7 of the study. This analysis routinely finds that
20 historical retirements have occurred at average ages significantly shorter
21 than the property group's average service life. The occurrence of
22 historical retirements at an age which is significantly younger than the
23 average service life of the property category demonstrates that the

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2-21-2013

U.S. Department Of Labor
Bureau of Labor Statistics
Washington, D.C. 20212

Consumer Price Index

All Urban Consumers - (CPI-U)

U.S. city average

All items

1982-84=100

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Avg.	Percent change Dec-Dec	Avg-Avg
1913	9.8	9.8	9.8	9.8	9.7	9.8	9.9	9.9	10.0	10.0	10.1	10.0	9.9		
1914	10.0	9.9	9.9	9.8	9.9	9.9	10.0	10.2	10.2	10.1	10.2	10.1	10.0	1.0	1.0
1915	10.1	10.0	9.9	10.0	10.1	10.1	10.1	10.1	10.1	10.2	10.3	10.3	10.1	2.0	1.0
1916	10.4	10.4	10.5	10.6	10.7	10.8	10.8	10.9	11.1	11.3	11.5	11.6	10.9	12.6	7.9
1917	11.7	12.0	12.0	12.6	12.8	13.0	12.8	13.0	13.3	13.5	13.5	13.7	12.8	18.1	17.4
1918	14.0	14.1	14.0	14.2	14.5	14.7	15.1	15.4	15.7	16.0	16.3	16.5	15.1	20.4	18.0
1919	16.5	16.2	16.4	16.7	16.9	16.9	17.4	17.7	17.8	18.1	18.5	18.9	17.3	14.5	14.6
1920	19.3	19.5	19.7	20.3	20.6	20.9	20.8	20.3	20.0	19.9	19.8	19.4	20.0	2.6	15.6
1921	19.0	18.4	18.3	18.1	17.7	17.6	17.7	17.7	17.5	17.5	17.4	17.3	17.9	-10.8	-10.5
1922	16.9	16.9	16.7	16.7	16.7	16.7	16.8	16.6	16.6	16.7	16.8	16.9	16.8	-2.3	-6.1
1923	16.8	16.8	16.8	16.9	16.9	17.0	17.2	17.1	17.2	17.3	17.3	17.3	17.1	2.4	1.8
1924	17.3	17.2	17.1	17.0	17.0	17.0	17.1	17.0	17.1	17.2	17.2	17.3	17.1	0.0	0.0
1925	17.3	17.2	17.3	17.2	17.3	17.5	17.7	17.7	17.7	17.7	18.0	17.9	17.5	3.5	2.3
1926	17.9	17.9	17.8	17.9	17.8	17.7	17.5	17.4	17.5	17.6	17.7	17.7	17.7	-1.1	1.1
1927	17.5	17.4	17.3	17.3	17.4	17.6	17.3	17.2	17.3	17.4	17.3	17.3	17.4	-2.3	-1.7
1928	17.3	17.1	17.1	17.1	17.2	17.1	17.1	17.1	17.3	17.2	17.2	17.1	17.1	-1.2	-1.7
1929	17.1	17.1	17.0	16.9	17.0	17.1	17.3	17.3	17.3	17.3	17.3	17.2	17.1	0.6	0.0
1930	17.1	17.0	16.9	17.0	16.9	16.8	16.6	16.5	16.6	16.5	16.4	16.1	16.7	-6.4	-2.3
1931	15.9	15.7	15.6	15.5	15.3	15.1	15.1	15.1	15.0	14.9	14.7	14.6	15.2	-9.3	-9.0
1932	14.3	14.1	14.0	13.9	13.7	13.6	13.6	13.5	13.4	13.3	13.2	13.1	13.7	-10.3	-9.9
1933	12.9	12.7	12.6	12.6	12.6	12.7	13.1	13.2	13.2	13.2	13.2	13.2	13.0	0.8	-5.1
1934	13.2	13.3	13.3	13.3	13.3	13.4	13.4	13.4	13.6	13.5	13.5	13.4	13.4	1.5	3.1
1935	13.6	13.7	13.7	13.8	13.8	13.7	13.7	13.7	13.7	13.7	13.8	13.8	13.7	3.0	2.2
1936	13.8	13.8	13.7	13.7	13.7	13.8	13.9	14.0	14.0	14.0	14.0	14.0	13.9	1.4	1.5
1937	14.1	14.1	14.2	14.3	14.4	14.4	14.5	14.5	14.6	14.6	14.5	14.4	14.4	2.9	3.6
1938	14.2	14.1	14.1	14.2	14.1	14.1	14.1	14.1	14.1	14.0	14.0	14.0	14.1	-2.8	-2.1
1939	14.0	13.9	13.9	13.8	13.8	13.8	13.8	13.8	14.1	14.0	14.0	14.0	13.9	0.0	-1.4
1940	13.9	14.0	14.0	14.0	14.0	14.1	14.0	14.0	14.0	14.0	14.0	14.1	14.0	0.7	0.7
1941	14.1	14.1	14.2	14.3	14.4	14.7	14.7	14.9	15.1	15.3	15.4	15.5	14.7	9.9	5.0
1942	15.7	15.8	16.0	16.1	16.3	16.3	16.4	16.5	16.5	16.7	16.8	16.9	16.3	9.0	10.9
1943	16.9	16.9	17.2	17.4	17.5	17.5	17.4	17.3	17.4	17.4	17.4	17.4	17.3	3.0	6.1
1944	17.4	17.4	17.4	17.5	17.5	17.6	17.7	17.7	17.7	17.7	17.7	17.8	17.6	2.3	1.7
1945	17.8	17.8	17.8	17.8	17.9	18.1	18.1	18.1	18.1	18.1	18.1	18.2	18.0	2.2	2.3
1946	18.2	18.1	18.3	18.4	18.5	18.7	19.8	20.2	20.4	20.8	21.3	21.5	19.5	18.1	8.3
1947	21.5	21.5	21.9	21.9	21.9	22.0	22.2	22.5	23.0	23.0	23.1	23.4	22.3	8.8	14.4
1948	23.7	23.5	23.4	23.8	23.9	24.1	24.4	24.5	24.5	24.4	24.2	24.1	24.1	3.0	8.1
1949	24.0	23.8	23.8	23.9	23.8	23.9	23.7	23.8	23.9	23.7	23.8	23.6	23.8	-2.1	-1.2
1950	23.5	23.5	23.6	23.6	23.7	23.8	24.1	24.3	24.4	24.6	24.7	25.0	24.1	5.9	1.3
1951	25.4	25.7	25.8	25.8	25.9	25.9	25.9	25.9	26.1	26.2	26.4	26.5	26.0	6.0	7.9
1952	26.5	26.3	26.3	26.4	26.4	26.5	26.7	26.7	26.7	26.7	26.7	26.7	26.5	0.8	1.9
1953	26.6	26.5	26.6	26.6	26.7	26.8	26.8	26.9	26.9	27.0	26.9	26.9	26.7	0.7	0.8
1954	26.9	26.9	26.9	26.8	26.9	26.9	26.9	26.9	26.8	26.8	26.8	26.7	26.9	-0.7	0.7
1955	26.7	26.7	26.7	26.7	26.7	26.7	26.8	26.8	26.9	26.9	26.9	26.8	26.8	0.4	-0.4
1956	26.8	26.8	26.8	26.9	27.0	27.2	27.4	27.3	27.4	27.5	27.5	27.6	27.2	3.0	1.5
1957	27.6	27.7	27.8	27.9	28.0	28.1	28.3	28.3	28.3	28.3	28.4	28.4	28.1	2.9	3.3
1958	28.6	28.6	28.8	28.9	28.9	28.9	29.0	28.9	28.9	28.9	29.0	28.9	28.9	1.8	2.8
1959	29.0	28.9	28.9	29.0	29.0	29.1	29.2	29.2	29.3	29.4	29.4	29.4	29.1	1.7	0.7
1960	29.3	29.4	29.4	29.5	29.5	29.6	29.6	29.6	29.6	29.8	29.8	29.8	29.6	1.4	1.7
1961	29.8	29.8	29.8	29.8	29.8	29.8	30.0	29.9	30.0	30.0	30.0	30.0	29.9	0.7	1.0
1962	30.0	30.1	30.1	30.2	30.2	30.2	30.3	30.3	30.4	30.4	30.4	30.4	30.2	1.3	1.0
1963	30.4	30.4	30.5	30.5	30.5	30.6	30.7	30.7	30.7	30.8	30.8	30.9	30.6	1.6	1.3
1964	30.9	30.9	30.9	30.9	30.9	31.0	31.1	31.0	31.1	31.1	31.2	31.2	31.0	1.0	1.3
1965	31.2	31.2	31.3	31.4	31.4	31.6	31.6	31.6	31.6	31.7	31.7	31.8	31.5	1.9	1.6
1966	31.8	32.0	32.1	32.3	32.3	32.4	32.5	32.7	32.7	32.9	32.9	32.9	32.4	3.5	2.9
1967	32.9	32.9	33.0	33.1	33.2	33.3	33.4	33.5	33.6	33.7	33.8	33.9	33.4	3.0	3.1
1968	34.1	34.2	34.3	34.4	34.5	34.7	34.9	35.0	35.1	35.3	35.4	35.5	34.8	4.7	4.2
1969	35.6	35.8	36.1	36.3	36.4	36.6	36.8	37.0	37.1	37.3	37.5	37.7	36.7	6.2	5.5
1970	37.8	38.0	38.2	38.5	38.6	38.8	39.0	39.0	39.2	39.4	39.6	39.8	38.8	5.6	5.7
1971	39.8	39.9	40.0	40.1	40.3	40.6	40.7	40.8	40.8	40.9	40.9	41.1	40.5	3.3	4.4
1972	41.1	41.3	41.4	41.5	41.6	41.7	41.9	42.0	42.1	42.3	42.4	42.5	41.8	3.4	3.2

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1973	42.6	42.9	43.3	43.6	43.9	44.2	44.3	45.1	45.2	45.6	45.9	46.2	44.4	8.7	6.2
1974	46.6	47.2	47.8	48.0	48.6	49.0	49.4	50.0	50.6	51.1	51.5	51.9	49.3	12.3	11.0
1975	52.1	52.5	52.7	52.9	53.2	53.6	54.2	54.3	54.6	54.9	55.3	55.5	53.8	6.9	9.1
1976	55.6	55.8	55.9	56.1	56.5	56.8	57.1	57.4	57.6	57.9	58.0	58.2	56.9	4.9	5.8
1977	58.5	59.1	59.5	60.0	60.3	60.7	61.0	61.2	61.4	61.6	61.9	62.1	60.6	6.7	6.5
1978	62.5	62.9	63.4	63.9	64.5	65.2	65.7	66.0	66.5	67.1	67.4	67.7	65.2	9.0	7.6
1979	68.3	69.1	69.8	70.6	71.5	72.3	73.1	73.8	74.6	75.2	75.9	76.7	72.6	13.3	11.3
1980	77.8	78.9	80.1	81.0	81.8	82.7	82.7	83.3	84.0	84.8	85.5	86.3	82.4	12.5	13.5
1981	87.0	87.9	88.5	89.1	89.8	90.6	91.6	92.3	93.2	93.4	93.7	94.0	90.9	8.9	10.3
1982	94.3	94.6	94.5	94.9	95.8	97.0	97.5	97.7	97.9	98.2	98.0	97.6	96.5	3.8	6.2
1983	97.8	97.9	97.9	98.6	99.2	99.5	99.9	100.2	100.7	101.0	101.2	101.3	99.6	3.8	3.2
1984	101.9	102.4	102.6	103.1	103.4	103.7	104.1	104.5	105.0	105.3	105.3	105.3	103.9	3.9	4.3
1985	105.5	106.0	106.4	106.9	107.3	107.6	107.8	108.0	108.3	108.7	109.0	109.3	107.6	3.8	3.6
1986	109.6	109.3	108.8	108.6	108.9	109.5	109.5	109.7	110.2	110.3	110.4	110.5	109.6	1.1	1.9
1987	111.2	111.6	112.1	112.7	113.1	113.5	113.8	114.4	115.0	115.3	115.4	115.4	113.6	4.4	3.6
1988	115.7	116.0	116.5	117.1	117.5	118.0	118.5	119.0	119.8	120.2	120.3	120.5	118.3	4.4	4.1
1989	121.1	121.6	122.3	123.1	123.8	124.1	124.4	124.6	125.0	125.6	125.9	126.1	124.0	4.6	4.8
1990	127.4	128.0	128.7	128.9	129.2	129.9	130.4	131.6	132.7	133.5	133.8	133.8	130.7	6.1	5.4
1991	134.6	134.8	135.0	135.2	135.6	136.0	136.2	136.6	137.2	137.4	137.8	137.9	136.2	3.1	4.2
1992	138.1	138.6	139.3	139.5	139.7	140.2	140.5	140.9	141.3	141.8	142.0	141.9	140.3	2.9	3.0
1993	142.6	143.1	143.6	144.0	144.2	144.4	144.4	144.8	145.1	145.7	145.8	145.8	144.5	2.7	3.0
1994	146.2	146.7	147.2	147.4	147.5	148.0	148.4	149.0	149.4	149.5	149.7	149.7	148.2	2.7	2.6
1995	150.3	150.9	151.4	151.9	152.2	152.5	152.5	152.9	153.2	153.7	153.6	153.5	152.4	2.5	2.8
1996	154.4	154.9	155.7	156.3	156.6	156.7	157.0	157.3	157.8	158.3	158.6	158.6	156.9	3.3	3.0
1997	159.1	159.6	160.0	160.2	160.1	160.3	160.5	160.8	161.2	161.6	161.5	161.3	160.5	1.7	2.3
1998	161.6	161.9	162.2	162.5	162.8	163.0	163.2	163.4	163.6	164.0	164.0	163.9	163.0	1.6	1.6
1999	164.3	164.5	165.0	166.2	166.2	166.2	166.7	167.1	167.9	168.2	168.3	168.3	166.6	2.7	2.2
2000	168.8	169.8	171.2	171.3	171.5	172.4	172.8	172.8	173.7	174.0	174.1	174.0	172.2	3.4	3.4
2001	175.1	175.8	176.2	176.9	177.7	178.0	177.5	177.5	178.3	177.7	177.4	176.7	177.1	1.6	2.8
2002	177.1	177.8	178.8	179.8	179.8	179.9	180.1	180.7	181.0	181.3	181.3	180.9	179.9	2.4	1.6
2003	181.7	183.1	184.2	183.8	183.5	183.7	183.9	184.6	185.2	185.0	184.5	184.3	184.0	1.9	2.3
2004	185.2	186.2	187.4	188.0	189.1	189.7	189.4	189.5	189.9	190.9	191.0	190.3	188.9	3.3	2.7
2005	190.7	191.8	193.3	194.6	194.4	194.5	195.4	196.4	198.8	199.2	197.6	196.8	195.3	3.4	3.4
2006	198.3	198.7	199.8	201.5	202.5	202.9	203.5	203.9	202.9	201.8	201.5	201.8	201.6	2.5	3.2
2007	202.416	203.499	205.352	206.686	207.949	208.352	208.299	207.917	208.490	208.936	210.177	210.036	207.342	4.1	2.8
2008	211.080	211.693	213.528	214.823	216.632	218.815	219.964	219.086	218.783	216.573	212.425	210.228	215.303	0.1	3.8
2009	211.143	212.193	212.709	213.240	213.856	215.693	215.351	215.834	215.969	216.177	216.330	215.949	214.537	2.7	-0.4
2010	216.687	216.741	217.631	218.009	218.178	217.965	218.011	218.312	218.439	218.711	218.803	219.179	218.056	1.5	1.6
2011	220.223	221.309	223.467	224.906	225.964	225.722	225.922	226.545	226.889	226.421	226.230	225.672	224.939	3.0	3.2
2012	226.665	227.663	229.392	230.085	229.815	229.478	229.104	230.379	231.407	231.317	230.221	229.601	229.594	1.7	2.1
2013	230.280														

MONTANA-DAKOTA UTILITIES CO.
MONTANA CONSUMER COUNSEL
DATA REQUEST
DATED JANUARY 11, 2013
DOCKET NO. D2012.9.100

MCC-143 RE: NET SALVAGE
WITNESS: ROBINSON

Please provide a detailed narrative explaining specifically how annual inflation built into forecasted net salvage amounts was employed in the development of the final proposed net salvage parameters for accounts 376 and 380.

Response:

The net salvage forecast analysis is an additional tool used to provide information about the level of net salvage anticipated to occur relative to property over its life. The historical component of net salvage is what has transpired for only the smaller portion of the Company's property that has been retired to date. Such retirements have routinely occurred at ages far younger than the average service of the various property groups. Accordingly, the experienced historical net salvage likely significantly understates the overall net salvage that will be experienced as the property groups continue to age.

The net salvage estimate gives consideration to the overall average, recent experience, and forecast analysis. The estimation process is one of gradualism towards more future looking calculations which is more representative of the future net salvage that can be anticipated at end of life of the property group.

MONTANA-DAKOTA UTILITIES CO.
MONTANA CONSUMER COUNSEL
DATA REQUEST
DATED JANUARY 11, 2013
DOCKET NO. D2012.9.100

MCC-149 RE: ACCOUNT 390 COMMON
WITNESS: ROBINSON

Please identify each time in the last 20 years when the Company retired one of its general office structure in Account 390 Common Plant, or terminated a lease and moved to a new location. For each such instance, identify the dollar level of retirements, a description of what was retired, along with corresponding cost of removal and net salvage.

Response:

Please see Attachment A.

Please see Revised Attachment A for the updated retirements for Account 390. Montana-Dakota inadvertently misstated the salvage on the Schuchart Building in its original response.

Montana-Dakota Utilities Co.
MCC-149 Ten Largest General Plant Structures Retirements
Common 390 Account
As of December 31, 2012

Building	Location	Year Retired	390 Account Balance	Cost of Removal	Salvage
Schuchart Building	Bismarck, ND	07/31/01	3,302,689.44	0.00	(3,028,920.86)
Billings Office Building	Billings, MT	12/31/06	368,352.37	4,000.00	(330,000.00)
Bismarck Dist. Office Building	Bismarck. ND	11/30/09	534,298.00	38,904.00	(526,443.80)
Sheridan Office Building	Sheridan, WY	12/31/04	983,302.83	4,500.00	(638,829.00)
Forsyth Office Building	Forsyth, MT	05/31/96	139,236.18	627.00	(67,504.37)
Gettysburg Office Building	Gettysburg, SD	05/31/96	21,826.80	99.64	(7,533.00)
Glendive Warehouse	Glendive, MT	11/30/99	311,956.52	3,088.93	(23,000.00)
Glendive Office	Glendive, MT	12/31/95	147,380.00	562.00	(51,715.84)
Hebron Office	Hebron, ND	12/31/95	15,391.18	520.00	(13,010.00)
Ray Office	Ray, ND	09/30/99	44,257.16	0.00	(5,000.00)
Terry Office	Terry, MT	12/31/95	37,836.34	259.00	(19,401.10)
	Total		5,906,526.82	52,560.57	(4,711,357.97)

Revised Response No. MCC-149
Attachment A
Page 1 of 1

000053

MONTANA-DAKOTA UTILITIES CO.
MONTANA CONSUMER COUNSEL
DATA REQUEST
DATED JANUARY 11, 2013
DOCKET NO. D2012.9.100

MCC-149 RE: ACCOUNT 390 COMMON
WITNESS: ROBINSON

Please identify each time in the last 20 years when the Company retired one of its general office structure in Account 390 Common Plant, or terminated a lease and moved to a new location. For each such instance, identify the dollar level of retirements, a description of what was retired, along with corresponding cost of removal and net salvage.

Response:

Please see Attachment A.

Montana-Dakota Utilities Co.
MCC-149 Ten Largest General Plant Structures Retirements
Common 390 Account
As of December 31, 2012

Building	Location	Year Retired	390 Account Balance	Cost of Removal	Salvage
Schuchart Building	Bismarck, ND	07/31/01	3,302,689.44	0.00	(4,593,548.51)
Billings Office Building	Billings, MT	12/31/06	368,352.37	4,000.00	(330,000.00)
Bismarck Dist. Office Building	Bismarck. ND	11/30/09	534,298.00	38,904.00	(526,443.80)
Sheridan Office Building	Sheridan, WY	12/31/04	983,302.83	4,500.00	(638,829.00)
Forsyth Office Building	Forsyth, MT	05/31/96	139,236.18	627.00	(67,504.37)
Gettysburg Office Building	Gettysburg, SD	05/31/96	21,826.80	99.64	(7,533.00)
Glendive Warehouse	Glendive, MT	11/30/99	311,956.52	3,088.93	(23,000.00)
Glendive Office	Glendive, MT	12/31/95	147,380.00	562.00	(51,715.84)
Hebron Office	Hebron, ND	12/31/95	15,391.18	520.00	(13,010.00)
Ray Office	Ray, ND	09/30/99	44,257.16	0.00	(5,000.00)
Terry Office	Terry, MT	12/31/95	37,836.34	259.00	(19,401.10)
	Total		5,906,526.82	52,560.57	(6,275,985.62)

Response No. MCC-149
Attachment A
Page 1 of 1

000060

COMPANY : MDU
ACCOUNT : 376.1 - DISTRIBUTION MAINS - STEEL
INPUT BY: JP

DOCKET NO.:40824

DATE : 22-Feb-13

CO'S MODEL			CITIES' MODEL	
CURVE :	R		CURVE :	R
CURVE # :	4		CURVE # :	2.5
ASL :	47		ASL :	60
BALANCE :	41,975,049		BALANCE :	41,975,049
RESERVE :	36,466,143	ALLOCATED ALG THEO =>	RESERVE :	24,454,158
SALVAGE :	(50.00)		SALVAGE :	(50.00)
REM LF. :	22.30		REM. LF. :	36.70
DEPR EXP. :	1,188,181	(138,805)	DEPR EXP. :	1,049,376
DEPR RATI :	2.83%	-0.33%	DEPR RATI :	2.50%

000061

ACCOUNT : 376.1 - DISTRIBUTION MAINS - STEEL
CURVE R2.5 60

YEAR	AGE (YEARS)	ADDITIONS	SURVIVORS	PROBABLE LIFE FACTOR	PROBABLE LIFE	REMAINING LIFE	DOLLAR PER YEAR
2011	0.5		4120958.34	100.0458	60.03	59.53	245,310,348
2010	1.5		513100.14	100.1410	60.08	58.58	30,059,768
2009	2.5		368109.51	100.2413	60.14	57.64	21,219,599
2008	3.5		1561295.64	100.3463	60.21	56.71	88,537,641
2007	4.5		1103475.58	100.4580	60.27	55.77	61,546,130
2006	5.5		1137902.51	100.5752	60.35	54.85	62,408,377
2005	6.5		177935.15	100.6985	60.42	53.92	9,594,103
2004	7.5		112871.05	100.8290	60.50	53.00	5,981,872
2003	8.5		415155.29	100.9652	60.58	52.08	21,620,914
2002	9.5		411147.59	101.1093	60.67	51.17	21,036,613
2001	10.5		263997.66	101.2605	60.76	50.26	13,267,546
2000	11.5		103532.09	101.4185	60.85	49.35	5,109,423
1999	12.5		160286.25	101.5852	60.95	48.45	7,766,045
1998	13.5		93201.40	101.7595	61.06	47.56	4,432,258
1997	14.5		385968.63	101.9420	61.17	46.67	18,011,303
1996	15.5		1067025.48	102.1337	61.28	45.78	49,764,244
1995	16.5		632954.05	102.3345	61.40	44.90	29,420,080
1994	17.5		545918.18	102.5437	61.53	44.03	24,034,703
1993	18.5		442123.14	102.7637	61.66	43.16	19,081,239
1992	19.5		444873.54	102.9925	61.80	42.30	18,816,149
1991	20.5		568793.49	103.2317	61.94	41.44	23,570,233
1990	21.5		344343.54	103.4809	62.09	40.59	13,976,358
1989	22.5		1209008.32	103.7415	62.24	39.74	48,051,915
1988	23.5		786387.51	104.0118	62.41	38.91	30,673,872
1987	24.5		320731.56	104.2943	62.58	38.08	12,212,357
1986	25.5		965584.46	104.5880	62.75	37.25	35,970,725
1985	26.5		1208817.07	104.8923	62.94	36.44	44,043,733
1984	27.5		1021359.93	105.2090	63.13	35.63	36,386,359
1983	28.5		838852.11	105.5365	63.32	34.82	29,211,431
1982	29.5		692815.95	105.8790	63.53	34.03	23,574,725
1981	30.5		356063.94	106.2332	63.74	33.24	11,835,530
1980	31.5		399931.83	106.6000	63.96	32.46	12,949,327
1979	32.5		719735.33	106.9790	64.19	31.69	22,805,541
1978	33.5		56815	107.3723	64.42	30.92	1,756,913
1977	34.5		441083.34	107.7790	64.67	30.17	13,306,338
1976	35.5		904926.77	108.1990	64.92	29.42	26,618,918
1975	36.5		819581.51	108.6322	65.18	28.88	23,507,892
1974	37.5		777937.31	109.0815	65.45	27.95	21,742,492
1973	38.5		3208435.77	109.5443	65.73	27.23	87,300,344
1972	39.5		938031.03	110.0227	66.01	26.51	24,870,580
1971	40.5		1040350.26	110.5165	66.31	25.81	26,851,594
1970	41.5		846189.44	111.0252	66.62	25.12	21,252,132
1969	42.5		599081.61	111.5510	66.93	24.43	14,635,439
1968	43.5		840851.87	112.0930	67.25	23.76	19,975,109
1967	44.5		826387.63	112.6522	67.59	23.09	19,082,369
1966	45.5		863732.22	113.2288	67.94	22.44	19,379,819
1965	46.5		927542.70	113.8240	68.29	21.79	20,215,237
1964	47.5		630728.86	114.4368	68.66	21.16	13,347,543
1963	48.5		720787.84	115.0702	69.04	20.54	14,806,496
1962	49.5		546461.29	115.7225	69.43	19.93	10,692,866
1961	50.5		391106.28	116.3948	69.84	19.34	7,562,783
1960	51.5		314770.47	117.0890	70.25	18.75	5,903,017
1959	52.5		538098.79	117.8040	70.68	18.18	9,783,927
1958	53.5		731467.72	118.5403	71.12	17.62	12,891,533
1957	54.5		74257.30	119.3003	71.58	17.08	1,268,330
1956	55.5		270639.75	120.0830	72.05	16.55	4,479,034
1955	56.5		296702.94	120.8882	72.53	16.03	4,757,009
1954	57.5		476863.48	121.7173	73.03	15.53	7,402,775
1953	58.5		218884.19	122.5710	73.54	15.04	3,292,587
1952	59.5		46827.51	123.4483	74.07	14.57	682,230
1951	60.5		39544.48	124.3500	74.61	14.11	557,973
1950	61.5		34507.81	125.2765	75.17	13.67	471,580
1949	62.5		24144.41	126.2257	75.74	13.24	319,575
1948	63.5		0.00	127.2008	76.32	12.82	0
1947	64.5		0.00	128.1990	76.92	12.42	0
1946	65.5		0.00	129.2207	77.53	12.03	0
1945	66.5		0.00	130.2648	78.16	11.66	0
1944	67.5		0.00	131.3320	78.80	11.30	0
1943	68.5		923.00	132.4202	79.45	10.95	10,109
1942	69.5		2306.00	133.5285	80.12	10.62	24,483
1941	70.5		1424.68	134.6575	80.79	10.29	14,668
1940	71.5		4246.91	135.8040	81.48	9.98	42,394
1939	72.5		2005.57	136.9690	82.18	9.68	19,417
1938	73.5		418.47	138.1495	82.89	9.39	3,929
1937	74.5		450.01	139.3455	83.61	9.11	4,098
1936	75.5		655.15	140.5538	84.33	8.83	5,786
1935	76.5		703.03	141.7760	85.07	8.57	6,022
1934	77.5		493.63	143.0078	85.80	8.30	4,099
1933	78.5		253.98	144.2495	86.55	8.05	2,044
1932	79.5		111.24	145.5000	87.30	7.80	888
1931	80.5		37.89	146.7573	88.05	7.55	296
1930	81.5		7.90	148.0223	88.81	7.31	58
1929	82.5		0.46	149.2925	89.58	7.08	3
1928	83.5		0.00	150.5680	90.34	6.84	0
1927	84.5		0.00001	151.8468	91.11	6.61	0
1926	85.5		0.00001	153.1340	91.88	6.38	0
1925	86.5		0.00001	154.4233	92.65	6.15	0
1924	87.5		0.00001	155.7175	93.43	5.93	0
1923	88.5		0.00001	157.0145	94.21	5.71	0
1922	89.5		0.00001	158.3152	94.99	5.49	0
1921	90.5		0.00001	159.6185	95.77	5.27	0
1920	91.5		0.00001	160.9225	96.55	5.05	0
1919	92.5		0.00001	162.2262	97.34	4.84	0
1918	93.5		0.00001	163.5270	98.12	4.62	0
1917	94.5		0.00001	164.8215	98.89	4.39	0
1916	95.5		0.00001	166.1076	99.66	4.16	0
1915	96.5		0.00001	167.3820	100.43	3.93	0
1914	97.5		0.00001	168.6410	101.18	3.68	0
1913	98.5		0.00001	169.8832	101.93	3.43	0
1912	99.5		0.00001	171.1090	102.67	3.17	0
1911	100.5		0.00001	172.3215	103.39	2.89	0
1910	101.5		0.00001	173.5288	104.12	2.62	0
1909	102.5		0.00001	174.7388	104.84	2.34	0
1908	103.5		755.55	175.9535	105.57	2.07	1,566
1907	104.5		469.74	177.1735	106.30	1.80	847
		**********	41,975,049				1,540,336,628
							36.70

COMPANY : MDU
ACCOUNT : 376.1 - DISTRIBUTION MAINS - STEEL
INPUT BY: JP

DOCKET NO.:40824

DATE : 22-Feb-13

CO'S MODEL			CITIES' MODEL	
CURVE :	R		CURVE :	s
CURVE # :	4		CURVE # :	0.5
ASL :	47		ASL :	68
BALANCE :	41,975,049		BALANCE :	41,975,049
RESERVE :	36,466,143	ALLOCATED ALG THEO =>	RESERVE :	17,032,652
SALVAGE :	(50.00)		SALVAGE :	(50.00)
REM LF. :	22.30		REM. LF. :	49.60
DEPR EXP. :	1,188,181	(262,261)	DEPR EXP. :	925,920
DEPR RATI :	2.83%	-0.62%	DEPR RATI :	2.21%

000063

ACCOUNT : 376.1 - DISTRIBUTION MAINS - STEEL
CURVE s0.5 68

YEAR	AGE (YEARS)	ADDITIONS	SURVIVORS	PROBABLE LIFE FACTOR	PROBABLE LIFE	REMAINING LIFE	DOLLAR PER YEAR
2011	0.5		4120958.34	100.0074	68.01	67.51	278,185,293
2010	1.5		513100.14	100.0436	68.03	66.53	34,136,376
2009	2.5		368109.61	100.1081	68.07	65.57	24,137,743
2008	3.5		1561295.64	100.1911	68.13	64.63	100,906,508
2007	4.5		1103475.68	100.2988	68.20	63.70	70,294,903
2006	5.5		1137802.51	100.4258	68.29	62.79	71,448,251
2005	6.5		177935.15	100.5748	68.39	61.89	11,012,559
2004	7.5		112871.05	100.7416	68.50	61.00	6,885,622
2003	8.5		415155.29	100.9290	68.63	60.13	24,964,002
2002	9.5		411147.69	101.1338	68.77	59.27	24,399,129
2001	10.5		263997.66	101.3581	68.92	58.42	15,423,678
2000	11.5		103532.09	101.5993	69.09	57.59	5,962,154
1999	12.5		160286.25	101.8594	69.26	56.76	9,098,546
1998	13.5		93201.40	102.1359	69.45	55.95	5,214,644
1997	14.5		365968.63	102.4300	69.65	55.15	21,287,089
1996	15.5		1087025.48	102.7407	69.86	54.36	58,094,727
1995	16.5		632954.05	103.0679	70.09	53.59	33,917,577
1994	17.5		545918.18	103.4113	70.32	52.82	28,835,213
1993	18.5		442123.14	103.7709	70.56	52.06	23,018,788
1992	19.5		444873.54	104.1462	70.82	51.32	22,830,652
1991	20.5		568783.49	104.5361	71.08	50.58	28,772,180
1990	21.5		344343.54	104.9413	71.36	49.86	17,189,003
1989	22.5		1209008.32	105.3609	71.65	49.15	59,417,173
1988	23.5		786387.51	105.7956	71.94	48.44	38,190,311
1987	24.5		320731.56	106.2442	72.25	47.75	15,313,662
1986	25.5		965584.46	256.7070	174.56	149.06	143,930,753
1985	26.5		1205817.07	116.0060	78.88	52.38	63,322,746
1984	27.5		1021359.93	107.6727	73.22	45.72	46,693,941
1983	28.5		838852.11	108.1746	73.56	45.06	37,797,636
1982	29.5		692815.95	108.6901	73.91	44.41	30,767,456
1981	30.5		356063.94	109.2179	74.27	43.77	15,584,271
1980	31.5		398931.83	109.7584	74.64	43.14	17,208,196
1979	32.5		719735.33	110.3102	75.01	42.51	30,596,611
1978	33.5		56815	110.8747	75.39	41.89	2,380,253
1977	34.5		441083.34	111.4497	75.79	41.29	18,210,479
1976	35.5		804826.77	112.0364	76.18	40.68	36,812,642
1975	36.5		819681.51	112.6347	76.59	40.09	32,862,327
1974	37.5		777837.31	113.2426	77.00	39.50	30,732,398
1973	38.5		3206435.77	113.8619	77.43	38.93	124,813,975
1972	39.5		936031.03	114.4913	77.85	38.35	35,977,317
1971	40.5		1040360.26	115.1318	78.29	37.79	39,314,798
1970	41.5		845169.44	115.7801	78.73	37.23	31,504,056
1969	42.5		599081.81	116.4400	79.18	36.68	21,973,108
1968	43.5		840851.87	117.1086	79.63	36.13	30,383,207
1967	44.5		826387.63	117.7857	80.09	35.59	29,415,242
1966	45.5		863732.22	118.4736	80.56	35.06	30,284,231
1965	46.5		927542.70	119.1694	81.04	34.54	32,032,854
1964	47.5		630728.66	119.8734	81.51	34.01	21,453,554
1963	48.5		720787.84	120.5869	82.00	33.50	24,145,730
1962	49.5		545461.29	121.3077	82.49	32.99	18,027,343
1961	50.5		391106.28	122.0371	82.99	32.49	12,705,174
1960	51.5		314770.47	122.7739	83.49	31.99	10,069,318
1959	52.5		538098.79	123.5190	83.99	31.49	16,945,302
1958	53.5		731467.72	124.2717	84.50	31.00	22,678,981
1957	54.5		74257.30	125.0315	85.02	30.52	2,266,437
1956	55.5		270638.75	125.7986	85.54	30.04	8,130,852
1955	56.5		295702.94	126.5718	86.07	29.57	8,773,150
1954	57.5		476663.48	127.3534	86.60	29.10	13,871,060
1953	58.5		218884.19	128.1409	87.14	28.64	6,257,920
1952	59.5		46827.51	128.9355	87.68	28.18	1,319,418
1951	60.5		39544.48	129.7350	88.22	27.72	1,096,191
1950	61.5		34507.61	130.5431	88.77	27.27	941,004
1949	62.5		24144.41	131.3561	89.32	26.82	647,605
1948	63.5		0.00	132.1757	89.88	26.38	0
1947	64.5		0.00	133.0004	90.44	25.94	0
1946	65.5		0.00	133.8314	91.01	25.51	0
1945	66.5		0.00	134.6676	91.57	25.07	0
1944	67.5		0.00	135.5092	92.15	24.65	0
1943	68.5		923.00	136.3563	92.72	24.22	22,357
1942	69.5		2306.00	137.2088	93.30	23.80	54,887
1941	70.5		1424.88	138.0661	93.88	23.38	33,321
1940	71.5		4246.91	138.9286	94.47	22.97	97,558
1939	72.5		2005.57	139.7960	95.06	22.56	45,248
1938	73.5		418.47	140.6676	95.65	22.15	9,271
1937	74.5		450.01	141.5446	96.25	21.75	9,788
1936	75.5		655.15	142.4257	96.85	21.35	13,987
1935	76.5		703.03	143.3115	97.45	20.95	14,730
1934	77.5		493.63	144.2012	98.06	20.56	10,147
1933	78.5		253.98	145.0951	98.66	20.16	5,121
1932	79.5		111.24	145.9931	99.28	19.78	2,200
1931	80.5		37.89	146.8951	99.89	19.39	735
1930	81.5		7.90	147.8013	100.50	19.00	150
1929	82.5		0.46	148.7106	101.12	18.62	9
1928	83.5		0.00	149.6239	101.74	18.24	0
1927	84.5		0.00001	150.5414	102.37	17.87	0
1926	85.5		0.00001	151.4613	102.99	17.49	0
1925	86.5		0.00001	152.3855	103.62	17.12	0
1924	87.5		0.00001	153.3119	104.25	16.75	0
1923	88.5		0.00001	154.2422	104.88	16.38	0
1922	89.5		0.00001	155.1758	105.52	16.02	0
1921	90.5		0.00001	156.1123	106.16	15.66	0
1920	91.5		0.00001	157.0511	106.79	15.29	0
1919	92.5		0.00001	157.9929	107.44	14.94	0
1918	93.5		0.00001	158.9375	108.08	14.58	0
1917	94.5		0.00001	159.8850	108.72	14.22	0
1916	95.5		0.00001	160.8344	109.37	13.87	0
1915	96.5		0.00001	161.7868	110.02	13.52	0
1914	97.5		0.00001	162.7415	110.66	13.16	0
1913	98.5		0.00001	163.6983	111.31	12.81	0
1912	99.5		0.00001	164.6573	111.97	12.47	0
1911	100.5		0.00001	165.6184	112.62	12.12	0
1910	101.5		0.00001	166.5806	113.27	11.77	0
1909	102.5		0.00001	167.5454	113.93	11.43	0
1908	103.5		755.55	168.5125	114.59	11.09	8,378
1907	104.5		469.74	169.4801	115.25	10.75	5,048
		**********	41,975,049				2,062,156,462
							49.60

COMPANY : MDU
ACCOUNT : 376.2 - DISTRIBUTION MAINS - PLASTIC
INPUT BY: JP

DOCKET NO.:40824

DATE : 22-Feb-13

CO'S MODEL			CITIES' MODEL	
CURVE :	R		CURVE :	R
CURVE # :	4		CURVE # :	2.5
ASL :	47		ASL :	60
BALANCE :	63,935,959		BALANCE :	63,935,959
RESERVE :	30,608,794	ALLOCATED ALG THEO =>	RESERVE :	20,064,684
SALVAGE :	(50.00)		SALVAGE :	(50.00)
REM LF. :	33.40		REM. LF. :	47.45
DEPR EXP. :	1,954,944	(356,545)	DEPR EXP. :	1,598,399
DEPR RATI :	3.06%	-0.56%	DEPR RATI :	2.50%

000065

ACCOUNT : 376.2 - DISTRIBUTION MAINS - PLASTIC
CURVE R2.5 60

YEAR	AGE (YEARS)	ADDITIONS	SURVIVORS	PROBABLE LIFE FACTOR	PROBABLE LIFE	REMAINING LIFE	DOLLAR PER YEAR
2008	0.5		3230998.08	100.0458	60.03	59.53	192,333,238
2007	1.5		3274264.95	100.1410	60.08	58.58	191,821,502
2006	2.5		3378408.81	100.2413	60.14	57.64	194,747,700
2005	3.5		3699727.95	100.3463	60.21	56.71	209,803,433
2004	4.5		2466222.75	100.4580	60.27	55.77	137,553,081
2003	5.5		3159607.85	100.5752	60.35	54.85	173,289,008
2002	6.5		1642908.92	100.6985	60.42	53.92	88,584,170
2001	7.5		1599263.67	100.8290	60.50	53.00	84,597,835
2000	8.5		1465621.71	100.9652	60.58	52.08	76,328,260
1999	9.5		1002858.81	101.1093	60.67	51.17	51,311,873
1998	10.5		1434972.07	101.2605	60.76	50.26	72,116,367
1997	11.5		1961601.15	101.4185	60.85	49.35	98,807,175
1996	12.5		2326335.52	101.5852	60.95	48.45	112,713,515
1995	13.5		1280540.60	101.7595	61.06	47.56	59,945,691
1994	14.5		4144868.16	101.9420	61.17	46.67	193,421,102
1993	15.5		6716425.25	102.1337	61.28	45.78	307,479,291
1992	16.5		1909825.75	102.3345	61.40	44.90	85,752,513
1991	17.5		1258329.77	102.5437	61.53	44.03	55,399,478
1990	18.5		900428.29	102.7637	61.66	43.16	38,850,884
1989	19.5		616172.76	102.9925	61.80	42.30	26,081,335
1988	20.5		798772.36	103.2317	61.94	41.44	33,100,328
1987	21.5		1245600.97	103.4808	62.09	40.59	50,557,075
1986	22.5		1207695.76	103.7415	62.24	39.74	47,999,747
1985	23.5		1266384.82	104.0116	62.41	38.91	49,271,361
1984	24.5		1247938.59	104.2943	62.58	38.08	47,517,259
1983	25.5		1178844.50	104.5890	62.75	37.25	43,915,258
1982	26.5		1140141.23	104.8923	62.94	36.44	41,541,502
1981	27.5		1106155.39	105.2090	63.13	35.63	39,407,228
1980	28.5		1499614.40	105.5385	63.32	34.82	52,221,222
1979	29.5		1099370.09	105.8790	63.53	34.03	37,408,705
1978	30.5		523726.09	106.2332	63.74	33.24	17,408,603
1977	31.5		318479.60	106.6000	63.96	32.46	10,337,848
1976	32.5		652826.63	106.9790	64.19	31.69	20,686,379
1975	33.5		893346.54	107.3723	64.42	30.92	27,625,312
1974	34.5		65675.19	107.7790	64.67	30.17	1,981,250
1973	35.5		297850.57	108.1980	64.92	29.42	8,785,348
1972	36.5		1284061.62	108.6322	65.18	28.68	37,112,781
1971	37.5		142625.39	109.0815	65.45	27.95	3,986,223
1970	38.5		375086.60	109.5443	65.73	27.23	10,212,333
1969	39.5		135279.43	110.0227	66.01	26.51	3,586,745
			63,935,959				3,033,570,157
							47.45

COMPANY : MDU
ACCOUNT : 376.2 - DISTRIBUTION MAINS - PLASTIC
INPUT BY: JP

DOCKET NO.:40824

DATE : 22-Feb-13

CO'S MODEL			CITIES' MODEL	
CURVE :	R		CURVE :	R
CURVE # :	4		CURVE # :	2.5
ASL :	47		ASL :	67
BALANCE :	63,935,959		BALANCE :	63,935,959
RESERVE :	30,608,794	ALLOCATED ALG THEO =>	RESERVE :	18,086,808
SALVAGE :	(50.00)		SALVAGE :	(50.00)
REM LF. :	33.40		REM. LF. :	54.36
DEPR EXP. :	1,954,944	(523,542)	DEPR EXP. :	1,431,402
DEPR RATI :	3.06%	-0.82%	DEPR RATI :	2.24%

000067

ACCOUNT : 376.2 - DISTRIBUTION MAINS - PLASTIC
CURVE R2.5 67

YEAR	AGE (YEARS)	ADDITIONS	SURVIVORS	PROBABLE LIFE FACTOR	PROBABLE LIFE	REMAINING LIFE	DOLLAR PER YEAR
2008	0.5		3230998.08	100.0410	67.03	66.53	214,950,225
2007	1.5		3274264.95	100.1259	67.08	65.58	214,740,440
2006	2.5		3378408.81	100.2146	67.14	64.64	218,393,150
2005	3.5		3599727.95	100.3073	67.21	63.71	235,694,536
2004	4.5		2458222.75	100.4050	67.27	62.77	154,808,131
2003	5.5		3159607.85	100.5068	67.34	61.84	195,388,822
2002	6.5		1842908.92	100.6142	67.41	60.91	100,072,080
2001	7.5		1596263.87	100.7261	67.49	59.99	95,754,299
2000	8.5		1465621.71	100.8439	67.57	59.07	86,567,577
1999	9.5		1002958.81	100.9662	67.65	58.15	58,313,602
1998	10.5		1434972.07	101.0951	67.73	57.23	82,126,790
1997	11.5		1961601.15	101.2293	67.82	56.32	110,484,458
1996	12.5		2326335.52	101.3694	67.92	55.42	128,919,675
1995	13.5		1260540.60	101.5161	68.02	54.52	68,719,341
1994	14.5		4144888.16	101.6687	68.12	53.62	222,239,790
1993	15.5		6716425.25	101.8278	68.22	52.72	354,120,902
1992	16.5		1909825.75	101.9945	68.34	51.84	98,999,281
1991	17.5		1258329.77	102.1673	68.45	50.95	64,114,557
1990	18.5		900428.29	102.3483	68.57	50.07	45,087,452
1989	19.5		616172.76	102.5356	68.70	49.20	30,314,985
1988	20.5		798772.36	102.7320	68.83	48.33	38,605,020
1987	21.5		1245900.97	102.9346	68.97	47.47	59,123,945
1986	22.5		1207695.76	103.1468	69.11	46.61	56,288,731
1985	23.5		1266384.82	103.3663	69.26	45.76	57,943,944
1984	24.5		1247938.59	103.5945	69.41	44.91	58,042,801
1983	25.5		1178844.50	103.8307	69.57	44.07	51,947,657
1982	26.5		1140141.23	104.0762	69.73	43.23	49,299,525
1981	27.5		1106155.39	104.3308	69.90	42.40	46,902,825
1980	28.5		1499614.40	104.5947	70.08	41.58	62,351,657
1979	29.5		1099370.09	104.8666	70.26	40.76	44,811,017
1978	30.5		523726.09	105.1493	70.45	39.95	20,922,873
1977	31.5		318479.60	105.4410	70.65	39.15	12,467,034
1976	32.5		652828.63	105.7430	70.85	38.35	25,034,465
1975	33.5		893346.54	106.0540	71.06	37.56	33,550,683
1974	34.5		65875.19	106.3769	71.27	36.77	2,415,041
1973	35.5		297950.57	106.7087	71.49	35.99	10,724,671
1972	36.5		1294061.62	107.0518	71.72	35.22	45,582,906
1971	37.5		142625.39	107.4049	71.96	34.46	4,915,053
1970	38.5		375086.60	107.7697	72.21	33.71	12,642,568
1969	39.5		135279.43	108.1437	72.46	32.96	4,458,308
		63,635,659					3,475,631,837
							54.36

COMPANY : MDU
ACCOUNT : 376.4 - DISTRIBUTION MAINS - MANHOLES
INPUT BY: JP

DOCKET NO.:40824

DATE : 22-Feb-13

CO'S MODEL			CITIES' MODEL	
CURVE :	R		CURVE :	R
CURVE # :	4		CURVE # :	2.5
ASL :	47		ASL :	60
BALANCE :	69,919		BALANCE :	69,919
RESERVE :	55,146	ALLOCATED ALG THEO =>	RESERVE :	36,018
SALVAGE :	(50.00)		SALVAGE :	(50.00)
REM LF. :	24.60		REM. LF. :	39.39
DEPR EXP. :	2,022	(274)	DEPR EXP. :	1,748
DEPR RATI :	2.89%	-0.39%	DEPR RATI :	2.50%

000069

ACCOUNT : 376.4 - DISTRIBUTION MAINS - MANHOLES
CURVE R2.5 60

YEAR	AGE (YEARS)	ADDITIONS	SURVIVORS	PROBABLE LIFE FACTOR	PROBABLE LIFE	REMAINING LIFE	DOLLAR PER YEAR
2008	0.5		0.00	100.0458	60.03	59.53	0
2007	1.5		0.00	100.1410	60.08	58.58	0
2006	2.5		0.00	100.2413	60.14	57.64	0
2005	3.5		0.00	100.3463	60.21	56.71	0
2004	4.5		0.00	100.4580	60.27	55.77	0
2003	5.5		0.00	100.5762	60.35	54.85	0
2002	6.5		0.00	100.6985	60.42	53.92	0
2001	7.5		0.00	100.8290	60.50	53.00	0
2000	8.5		0.00	100.9652	60.58	52.08	0
1999	9.5		0.00	101.1093	60.67	51.17	0
1998	10.5		0.00	101.2605	60.76	50.26	0
1997	11.5		0.00	101.4185	60.85	49.35	0
1996	12.5		3287.49	101.5852	60.95	48.45	159,283
1995	13.5		2299.05	101.7595	61.06	47.56	109,333
1994	14.5		0.00	101.9420	61.17	46.67	0
1993	15.5		4344.30	102.1337	61.28	45.78	198,883
1992	16.5		0.00	102.3345	61.40	44.90	0
1991	17.5		1140.52	102.5437	61.53	44.03	50,213
1990	18.5		9279.86	102.7637	61.66	43.16	400,502
1989	19.5		0.00	102.9925	61.80	42.30	0
1988	20.5		3739.38	103.2317	61.94	41.44	154,958
1987	21.5		3512.13	103.4808	62.09	40.59	142,652
1986	22.5		1716.97	103.7415	62.24	39.74	68,241
1985	23.5		5397.11	104.0118	62.41	38.91	209,886
1984	24.5		2852.00	104.2943	62.58	38.08	112,402
1983	25.5		4593.08	104.5890	62.75	37.25	171,105
1982	26.5		10590.76	104.8923	62.94	36.44	385,679
1981	27.5		4708.73	105.2090	63.13	35.63	167,750
1980	28.5		7430.06	105.5385	63.32	34.82	258,738
1979	29.5		1211.43	105.8790	63.53	34.03	41,222
1978	30.5		3706.52	106.2332	63.74	33.24	123,204
1977	31.5		0.00	106.6000	63.96	32.46	0
1976	32.5		0.00	106.9790	64.19	31.69	0
1975	33.5		0.00	107.3723	64.42	30.92	0
1974	34.5		0.00	107.7790	64.67	30.17	0
1973	35.5		0.00	108.1980	64.92	29.42	0
1972	36.5		0.00	108.6322	65.18	28.68	0
1971	37.5		0.00	109.0815	65.45	27.95	0
1970	38.5		0.00	109.5443	65.73	27.23	0
1969	39.5		0.00	110.0227	66.01	26.51	0
1968	40.5		0.00	110.5165	66.31	25.81	0
1967	41.5		0.00	111.0252	66.62	25.12	0
1966	42.5		0.00	111.5510	66.93	24.43	0
1965	43.5		0.00	112.0930	67.26	23.76	0
1964	44.5		0.00	112.6522	67.59	23.09	0
1963	45.5		0.00	113.2286	67.94	22.44	0
1962	46.5		0.00	113.8240	68.29	21.79	0
1961	47.5		0.00	114.4368	68.66	21.16	0
1960	48.5		9.90	115.0702	69.04	20.54	203
							0
			69,919				2,754,452
							39.39

COMPANY : MDU DOCKET NO.:40824
ACCOUNT : 376.5 - DISTRIBUTION MAINS - BRIDGES/RIVER
INPUT BY: JP DATE : 22-Feb-13

CO'S MODEL			CITIES' MODEL	
CURVE :	R		CURVE :	R
CURVE # :	4		CURVE # :	2.5
ASL :	47		ASL :	60
BALANCE :	19,818		BALANCE :	19,818
RESERVE :	6,023	ALLOCATED ALG THEO =>	RESERVE :	3,989
SALVAGE :	(50.00)		SALVAGE :	(50.00)
REM LF. :	38.30		REM. LF. :	51.95
DEPR EXP. :	619	(123)	DEPR EXP. :	495
DEPR RATI :	3.12%	-0.62%	DEPR RATI :	2.50%

000071

ACCOUNT : 376.5 - DISTRIBUTION MAINS - BRIDGES/RIVER
CURVE R2.5 60

YEAR	AGE (YEARS)	ADDITIONS	SURVIVORS	PROBABLE LIFE FACTOR	PROBABLE LIFE	REMAINING LIFE	DOLLAR PER YEAR
2008	0.5		0.00	100.0458	60.03	59.53	0
2007	1.5		0.00	100.1410	60.08	58.58	0
2006	2.5		6514.77	100.2413	60.14	57.64	375,543
2005	3.5		0.00	100.3463	60.21	56.71	0
2004	4.5		0.00	100.4580	60.27	55.77	0
2003	5.5		0.00	100.5752	60.35	54.85	0
2002	6.5		2617.45	100.6985	60.42	53.92	141,131
2001	7.5		0.00	100.8290	60.50	53.00	0
2000	8.5		0.00	100.9652	60.58	52.08	0
1999	9.5		0.00	101.1093	60.67	51.17	0
1998	10.5		1723.00	101.2605	60.76	50.26	86,592
1997	11.5		0.00	101.4185	60.85	49.35	0
1996	12.5		39.60	101.5852	60.95	48.45	1,919
1995	13.5		8923.21	101.7595	61.06	47.56	424,349
			19,818				1,029,533
							51.95

COMPANY : MDU
ACCOUNT : 390 - COMMON STRUCTURES & IMPROVMT.
INPUT BY: JP

DOCKET NO.:40824

DATE : 22-Feb-13

CO'S MODEL			CITIES' MODEL	
CURVE :	R		CURVE :	R
CURVE # :	1		CURVE # :	1
ASL :	35		ASL :	55
BALANCE :	26,865,571		BALANCE :	26,865,571
RESERVE :	9,843,802	ALLOCATED ALG THEO =>	RESERVE :	7,499,574
SALVAGE :	0.00		SALVAGE :	(50.00)
REM LF. :	25.20		REM. LF. :	44.76
DEPR EXP. :	675,467	57,230	DEPR EXP. :	732,697
DEPR RATI :	2.51%	0.21%	DEPR RATI :	2.73%

000073

ACCOUNT : 390 - COMMON STRUCTURES & IMPROVMT.
CURVE R1 55

YEAR	AGE (YEARS)	ADDITIONS	SURVIVORS	PROBABLE LIFE FACTOR	PROBABLE LIFE	REMAINING LIFE	DOLLAR PER YEAR
2008	0.5		298058.63	100.2364	55.13	54.63	16,282,943
2007	1.5		4703481.21	100.7091	55.39	53.89	253,470,602
2006	2.5		43081.84	101.1918	55.66	53.16	2,290,037
2005	3.5		3529351.33	101.6782	55.92	52.42	185,019,185
2004	4.5		1262380.59	102.1791	56.20	51.70	65,263,183
2003	5.5		267482.71	102.6800	56.47	50.97	13,634,654
2002	6.5		433470.02	103.1891	56.75	50.25	21,783,602
2001	7.5		267033.59	103.7082	57.04	49.54	13,228,710
2000	8.5		720315.20	104.2318	57.33	48.83	35,171,190
1999	9.5		261325.27	104.7618	57.62	48.12	12,574,711
1998	10.5		261211.63	105.2973	57.91	47.41	12,384,958
1997	11.5		650004.46	105.8427	58.21	46.71	30,363,984
1996	12.5		328408.43	106.3882	58.51	46.01	15,111,221
1995	13.5		1242406.73	106.9436	58.82	45.32	56,304,631
1994	14.5		2292791.36	107.5027	59.13	44.63	102,319,254
1993	15.5		301888.43	108.0684	59.44	43.94	13,263,921
1992	16.5		163550.50	108.6400	59.75	43.25	7,074,319
1991	17.5		70702.10	109.2118	60.07	42.57	3,009,541
1990	18.5		3459.76	109.7936	60.39	41.89	144,917
1989	19.5		26601.63	110.3755	60.71	41.21	1,096,160
1988	20.5		4844.35	110.9673	61.03	40.53	196,351
1987	21.5		0.00001	111.5600	61.36	39.86	0
1986	22.5		465866.01	112.1600	61.69	39.19	18,257,141
1985	23.5		538049.67	112.7700	62.02	38.52	20,727,556
1984	24.5		3123696.11	113.3855	62.36	37.86	116,269,362
1983	25.5		464701.29	114.0036	62.70	37.20	16,403,677
1982	26.5		1752465.62	114.6336	63.05	36.55	64,049,990
1981	27.5		186300.70	115.2700	63.40	35.90	6,687,916
1980	28.5		243249.46	115.9145	63.75	35.25	8,575,273
1979	29.5		528255.41	116.5691	64.11	34.61	18,284,505
1978	30.5		8332.24	117.2282	64.46	33.98	283,092
1977	31.5		300253.37	117.9009	64.85	33.35	10,012,099
1976	32.5		41609.38	118.5745	65.22	32.72	1,361,292
1975	33.5		0.00001	119.2655	65.60	32.10	0
1974	34.5		16413.39	119.9636	65.98	31.48	516,694
1973	35.5		75575.41	120.6727	66.37	30.87	2,333,013
1972	36.5		423317.91	121.3955	66.77	30.27	12,812,775
1971	37.5		18619.63	122.1227	67.17	29.67	552,398
1970	38.5		5744.59	122.8600	67.57	29.07	167,012
1969	39.5		74569.26	123.6155	67.99	28.49	2,124,261
1968	40.5		1009471.80	124.3773	68.41	27.91	28,171,834
1967	41.5		161052.17	125.1555	68.84	27.34	4,402,442
1966	42.5		152339.84	125.9400	69.27	26.77	4,077,680
1965	43.5		3850.31	126.7309	69.70	26.20	100,886
1964	44.5		18963.94	127.5400	70.15	25.65	486,881
1963	45.5		5458.13	128.3645	70.60	25.10	137,002
1962	46.5		9511.94	129.1909	71.06	24.56	236,021
1961	47.5		1232.59	130.0373	71.52	24.02	29,607
1960	48.5		2078.30	130.8955	71.99	23.49	48,624
1959	49.5		413.04	131.7600	72.47	22.97	9,487
1958	50.5		1338.02	132.6327	72.95	22.45	30,036
1957	51.5		11218.58	133.5218	73.44	21.94	246,102
1956	52.5		24602.68	134.4273	73.94	21.44	527,359
1955	53.5		18414.07	135.3364	74.44	20.94	385,499
1954	54.5		863.89	136.2573	74.94	20.44	17,659
1953	55.5		3494.96	137.1936	75.46	19.96	69,747
1952	56.5		12250.98	138.1362	75.98	19.48	238,600
			26,865,571				1,202,622,046
							44.76

Age Interval	Exposures	Retirements	Ret Ratio	Survivors	OLT
0	23146946	0	0	1	100
0.5	18792882	15452.13	0.0008222	0.9991778	100
1.5	18383361	8022.88	0.0004364	0.9995636	99.917777
2.5	17826128	9599.99	0.0005385	0.9994615	99.87417
3.5	16389391	9578.85	0.0005845	0.9994155	99.820385
4.5	15290560	47263.34	0.003091	0.996909	99.762044
5.5	14237712	10895.47	0.0007653	0.9992347	99.453678
6.5	14049887	12998.11	0.0009251	0.9990749	99.377571
7.5	13898558	39300.77	0.0028277	0.9971723	99.285633
8.5	13550418	6901.97	0.0005094	0.9994906	99.004884
9.5	13031510	88529.58	0.0067935	0.9932065	98.954456
10.5	12771536	4588.06	0.0003592	0.9996408	98.282208
11.5	12608435	64195.64	0.0050915	0.9949085	98.246901
12.5	12420453	32457.65	0.0026132	0.9973868	97.746679
13.5	12252524	104456.13	0.0085253	0.9914747	97.491243
14.5	11443573	71504.49	0.0062484	0.9937516	96.660104
15.5	10268566	14625.43	0.0014243	0.9985757	96.056129
16.5	9621920.2	31647.88	0.0032891	0.9967109	95.919317
17.5	9117561.7	18518.56	0.0020311	0.9979689	95.603824
18.5	8635362.4	58717.65	0.0067997	0.9932003	95.409645
19.5	8236826.4	25850.05	0.0031384	0.9968616	94.76089
20.5	7667430.8	56480.85	0.0073663	0.9926337	94.463497
21.5	7213321.9	21760.15	0.0030167	0.9969833	93.767648
22.5	6034948.7	10049.97	0.0016653	0.9983347	93.484782
23.5	5279682.9	3851.87	0.0007296	0.9992704	93.329103
24.5	4974583.1	9735.72	0.0019571	0.9980429	93.261013
25.5	4180727.3	929.23	0.0002223	0.9997777	93.078493
26.5	3029916.8	6996.34	0.0023091	0.9976909	93.057804
27.5	2084867.7	0	0	1	92.842926
28.5	1320149.3	37002.55	0.0280291	0.9719709	92.842926
29.5	699843.37	0	0	1	90.240626
30.5	360308.08	0	0	1	90.240626

Age Interval	Exposures	Retirements	Ret Ratio	Survivors	OLT
0	65343947	3359.94	0.0000514	0.9999486	100
0.5	61581190	40251.19	0.0006536	0.9993464	99.994858
1.5	58104872	55351.7	0.0009526	0.9990474	99.929499
2.5	54187061	46753.5	0.0008628	0.9991372	99.834304
3.5	51359074	105437.2	0.0020529	0.9979471	99.748165
4.5	48811515	48473.16	0.0009931	0.9990069	99.543388
5.5	46033423	51762.97	0.0011245	0.9988755	99.444535
6.5	44205596	49395.8	0.0011174	0.9988826	99.332713
7.5	42434794	48113.06	0.0011338	0.9988662	99.221717
8.5	40918662	35471.44	0.0008669	0.9991331	99.109219
9.5	39825966	64796.03	0.001627	0.998373	99.023303
10.5	38299435	45439.16	0.0011864	0.9988136	98.862194
11.5	36280937	36580.51	0.0010083	0.9989917	98.744902
12.5	33929527	25074.69	0.000739	0.999261	98.645342
13.5	32494637	172637.6	0.0053128	0.9946872	98.572441
14.5	28267136	82632.5	0.0029233	0.9970767	98.048745
15.5	21535961	14935.92	0.0006935	0.9993065	97.762122
16.5	19603487	22648.5	0.0011553	0.9988447	97.694321
17.5	18307185	37972.72	0.0020742	0.9979258	97.581452
18.5	17374768	31988.75	0.0018411	0.9981589	97.379048
19.5	16740627	17968.11	0.0010733	0.9989267	97.199763
20.5	15902876	38978.01	0.002451	0.997549	97.095437
21.5	14642468	14807.48	0.0010113	0.9989887	96.857455
22.5	13416879	17892.98	0.0013336	0.9986664	96.759506
23.5	12101682	48812.23	0.0040335	0.9959665	96.630466
24.5	10820702	33042.01	0.0030536	0.9969464	96.240706
25.5	9625827.8	16029.25	0.0016652	0.9983348	95.946827
26.5	8466445.1	19241.43	0.0022727	0.9977273	95.787053
27.5	7352838.7	7451.05	0.0010134	0.9989866	95.56936
28.5	5848991.7	4232.58	0.0007236	0.9992764	95.472515
29.5	4735392.3	14229.34	0.0030049	0.9969951	95.403427
30.5	4209904.7	1761.5	0.0004184	0.9995816	95.11675
31.5	3889807.6	1617.47	0.0004158	0.9995842	95.076951
32.5	3235101.3	1879.66	0.000581	0.999419	95.037416
33.5	2177479.9	164274.92	0.0754427	0.9245573	94.982197
34.5	2110391.8	1412.85	0.0006695	0.9993305	87.816485
35.5	1812086	355.25	0.000196	0.999804	87.757695
36.5	517761.97	262.38	0.0005068	0.9994932	87.74049
37.5	375086.6	49.98	0.0001332	0.9998668	87.696027

	Ret	NS	NS%
1995	85394	132758	155.47%
1996	190887	195985	102.67%
1997	147018	167593	113.99%
1998	156868	232674	148.32%
1999	129801	205972	158.68%
2000	134394	200261	149.01%
2001	123831	203197	164.09%
2002	95019	198438	208.84%
2003	163649	267037	163.18%
2004	184932	371150	200.70%
2005	91049	257858	283.21%
2006	107042	265723	248.24%
2007	173206	367329	212.08%
2008	112618	322277	286.17%
Total	1895708	3388252	178.73%

Life

376 P	376 S	380 P	380 S	Utility	Year
45R4	54R3	37R5	38R2	Gt Plains	2011
50R4	36L4	50R3	50R3	PSE&G	2008
45R3	65R3	40S2	55R4	Cascade NG	2008
45S2	45R3	40R3	47R3/38L3	Northern UT NH	2006
60R3	75L2	45R2	50L1	NY State	2008
60R4	67R2.5	44L3	35R0.5	Rochester G&E	2008
50.8	57	42.7	45.8	R Average	

Net Salvage

376 P	376 S	380 P	380 S		
-55	-55	-75	-75	Gt Plains	2011
-75	-75	-125	-125	PSE&G	2008
-30	-20/-70	-160	-160	Cascade NG	2008
-25	-25	-85	-85	Northern UT NH	2006
-15	-100	-55	-45	NY State	2008
-70	-70	-30	-25	Rochester G&E	2008
		-88	-86	R Average	

NET SALVAGE ONLY

LIFE ONLY

MONTANA-DAKOTA UTILITIES, CO.
GAS PLANT DEPRECIATION EXPENSE
PERIOD ENDING DECEMBER 31, 2008

No.	Account Description	Balance 12/31/2008	Net Salvage %	Net Salvage $	Reserve 12/31/2008	Net Depreciable	Remaining Life	Depreciation Accrual	Depreciation Rate
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
376.1	Mains - Steel	$41,975,049	-50%	$ (20,987,524.73)	$36,466,143	$26,496,431	36.90	$718,060	1.71%
376.2	Mains - Plastic	$63,935,959	-50%	$ (31,967,979.40)	$30,608,794	$65,295,144	47.45	$1,376,083	2.15%
376.3	Mains - Valves	$447,328	-50%	$ (223,664.05)	$257,220	$413,772	26.16	$15,817	3.54%
376.4	Mains - Manholes	$69,919	-50%	$ (34,959.65)	$55,146	$49,733	39.39	$1,263	1.81%
376.5	Mains - Bridge/River Cx	$19,818	-50%	$ (9,909.02)	$6,023	$23,704	51.95	$456	2.30%
Total 376		$106,448,074		$ (53,224,036.83)	$67,393,326	$92,278,784		$2,111,679	1.98%
380.1	Services - Steel	$7,285,188	-200%	$ (14,570,375.74)	$12,429,968	$9,425,595	13.43	$701,831	9.63%
380.2	Services - Plastic	$42,690,273	-200%	$ (85,380,546.46)	$30,149,319	$97,921,501	29.00	$3,376,603	7.91%
380.3	Farm/Fuel Lines	$248,640	-200%	$ (497,280.36)	$256,290	$489,630	17.96	$27,262	10.96%
Total 380		$50,224,101		$ (100,448,202.56)	$42,835,578	$107,836,726		$4,105,697	8.17%
381	Meters	$55,172,050	-15%	$ (8,275,807.54)	$16,541,851	$46,906,007	24.19	$1,939,066	3.51%
Others	Remaining Accounts	$39,980,869	14%	$ 5,574,093.50	$20,321,636	$14,085,139	13.76	$1,023,825	
Total		$251,825,094		$ (156,373,953.42)	$147,092,391	$261,106,656		$9,180,268	
	MDU Request							$10,224,058	
	MCC Adjustment							**$ (1,043,789.54)**	

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NET SALVAGE ONLY

MONTANA-DAKOTA UTILITIES, CO.
GAS PLANT DEPRECIATION EXPENSE
PERIOD ENDING DECEMBER 31, 2008

No.	Account Description	Balance 12/31/2008	Net Salvage %	Net Salvage $	Reserve 12/31/2008	Net Depreciable	Remaining Life	Depreciation Accrual	Depreciation Rate
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
376.1	Mains - Steel	$41,975,049	-30%	$ (12,592,514.84)	$36,466,143	$18,101,421	22.36	$809,545	1.93%
376.2	Mains - Plastic	$63,935,959	-30%	$ (19,180,787.64)	$30,608,794	$52,507,952	33.45	$1,569,744	2.46%
376.3	Mains - Valves	$447,328	-30%	$ (134,198.43)	$257,220	$324,306	26.16	$12,397	2.77%
376.4	Mains - Manholes	$69,919	-30%	$ (20,975.79)	$55,146	$35,749	24.63	$1,451	2.08%
376.5	Mains - Bridge/River Cx	$19,818	-30%	$ (5,945.41)	$6,023	$19,741	38.35	$515	2.60%
Total 376		$106,448,074		$ (31,934,422.10)	$67,393,326	$70,989,169		$2,393,652	2.25%
380.1	Services - Steel	$7,285,188	-175%	$ (12,749,078.77)	$12,429,968	$7,604,299	13.43	$566,217	7.77%
380.2	Services - Plastic	$42,690,273	-175%	$ (74,707,978.15)	$30,149,319	$87,248,932	29.00	$3,008,584	7.05%
380.3	Farm/Fuel Lines	$248,640	-175%	$ (435,120.32)	$256,290	$427,470	17.96	$23,801	9.57%
Total 380		$50,224,101		$ (87,892,177.24)	$42,835,578	$95,280,701		$3,598,602	7.17%
381	Meters	$55,172,050	-5%	$ (2,758,602.51)	$16,541,851	$41,388,802	24.19	$1,710,988	3.10%
Others	Remaining Accounts	$39,980,869	14%	$ 5,574,093.50	$20,321,636	$14,085,139	13.76	$1,023,825	
Total		$251,825,094		$ (117,011,108.35)	$147,092,391	$221,743,811		$8,727,068	
	MDU Request							$10,224,058	
	MCC Adjustment							**$ (1,496,989.12)**	

000080

MDU-014

Attachment

D2012.9.100

Business Strategy Review, 2000, Volume 11 Issue 2, pp 1-18

Risk and Return in the 20th and 21st Centuries

Elroy Dimson, Paul Marsh and Mike Staunton

The single most important contemporary issue in finance is the equity risk premium. This drives future equity returns, and is the key determinant of the cost of capital. The risk premium – the expected reward for bearing the risk of investing in equities, rather than in low-risk investments such as bills or bonds – is usually estimated from historical data. This article starts by summarising new evidence on historical returns in twelve major world markets from the authors' recent book, "The Millennium Book: A Century of Investment Returns". The authors show that the historical equity risk premium has been lower than previously believed, and argue that the future risk premium is likely to be lower still. They discuss what this implies for the cost of capital, stock market values, and companies' target rates of return. They suggest that many companies are seeking too high a rate of return and thus run the risk of under-investing.

Today, investors have more cause than ever to ask where the markets are heading. What returns can be expected from equities? How might bonds be expected to perform? What are the risks of stock market investment? And what are the rewards? Companies also need answers to these questions, to understand what returns their shareholders and bondholders require, and to ensure they raise and use capital to best effect. Similarly, these are crucial issues for governments, since market returns provide the yardsticks for judging the worth of public sector projects, and for raising and managing government debt. Regulators, too, need to know the cost of capital in order to set 'fair' rates of return for regulated industries.

The recent equity bull run has few, if any, parallels in the 20th century. This makes a long-term perspective on market returns more important than ever before. Measuring what has happened in the past is the starting point for assessing the future. Interpretation of the data and being able to apply it to a modern-day canvas are just as important. But without good quality, consistent data the whole process falls at the first hurdle. In this article we use new indices which we compiled for our recent book, *The Millennium Book: A Century of Investment Returns*. These indices measure the returns on equities, long-term government bonds, treasury bills (short-term risk-free deposits) and inflation in twelve countries over the entire 20th century. Taken together, these twelve countries make up 90% of today's world market capitalisation. Our new indices are more representative than those used

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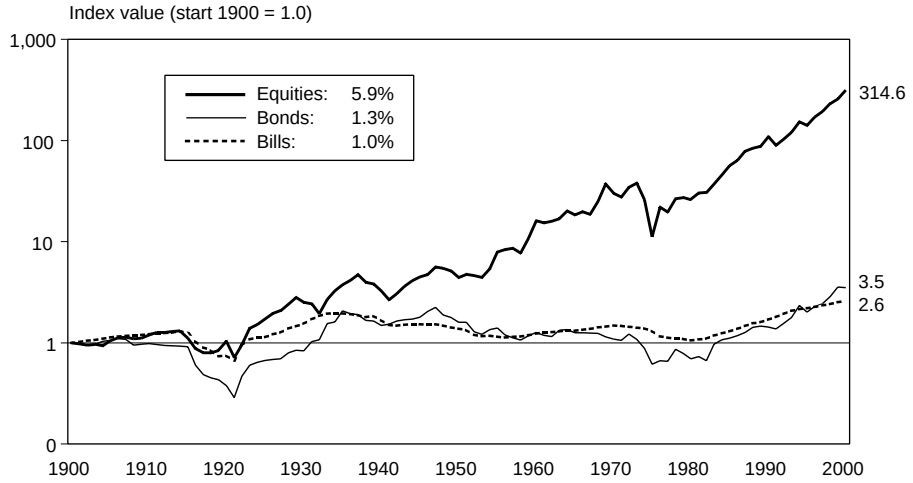
Figure 1
Real returns on UK equities, bonds and bills, 1900-2000



Source: Dimson, Marsh and Staunton (ABN AMRO/LBS)

in any previous study, and cover a longer time span for a larger number of countries.

The article starts by summarising the main findings about long-term investment returns based on our new index series. These findings challenge some of the accepted beliefs about long-term returns. One notable conclusion is that for much of the 20th century, the risks of equity investment were higher and the rewards lower than is suggested either by past studies or by recent market performance statistics.

Using the findings from *The Millennium Book*, we then focus on the all-important issue of the equity risk premium. We explain why the size of the risk premium is the single most important contemporary issue in finance. We use *The Millennium Book* data to show what the historical risk premium has been in different world markets, and that this, too, has been lower than previously estimated.

We then turn to the future and discuss what the historical risk premium tells us about the future risk premium, and hence the cost of capital. Finally, we speculate about likely future market returns, whether current stock market valuations can be justified, and whether companies are setting excessively high target rates of return, and hence may be under-investing.

Main Findings of *The Millennium Book*

The key findings of the research published in *The Millennium Book* were:

- Equities were the best performing asset class in all twelve countries.
- Equities had highest risk.
- Inflation was a major force in the 20th century.
- Bonds proved a disappointing investment over the 20th century.
- Although equities performed best, equity returns were lower than previous studies have suggested.

Our research approach is summarised in the Appendix.

Equities were the best performers

In every country, equities proved to be the best performing investment over the 20th century. In the UK, £1 invested in the equity market at the end of 1899 would have grown to £16,946 by the start of 2000, before investors' taxes and dealing costs, and with dividends reinvested. This represents an annualised return of 10.2%. Over this same period, UK inflation averaged 4.1%, and so in real terms, equities provided an annualised real return of 5.9%. Figure 1 compares the inflation-adjusted performance of equities with that of bonds and bills. It shows that £1 invested in equities at the start of the 20th century grew to nearly £315 in terms of equivalent purchasing power (ie, a real return of 5.9% pa) by the start of 2000. This compares with just £3.5 for bonds (a real return of 1.3% pa) and £2.6 for bills (a real return of 1.0% pa).

Figure 2 shows annualised real equity and real bond returns over the 20th century for all twelve countries

in our study. There are noticeable variations across countries, with some national markets having provided strikingly good real equity returns, while others turned in more modest results. The worst performing equity market was Italy, with a real return of 2.7% pa, while the best was Sweden, with a real return of 8.2% pa. The average real return across all twelve markets was 5.6%, as shown by the left-hand bar of the paired bars labelled 'AVG' in figure 2.

Figure 2 shows that, despite the variation across countries, equity market returns were ahead of inflation in all twelve countries, including those that experienced major dislocations from wars and economic turmoil. Similarly, figure 2 shows that equities outperformed bonds by a considerable margin in every country.

Equities had highest risk

Although equities gave the highest return in every country, the returns from shares were far more volatile, and hence riskier, than for bonds or short-term deposits. Indeed, equity investors have at times faced large losses. In October 1987, US shares fell 23% in one day, and the crash echoed around the world with even larger one-day losses in some markets. Following the legendary Wall Street Crash in 1929, shares fell 60% in real terms over 1929-31. More recently, in 1973-74, UK investors suffered a still greater loss of 71% in real terms. But the largest losses recorded in our study were in Germany and Japan at the end of World War II, with real returns of –91% in Germany (1945-48), and –97% in Japan (1944-47).

The risk of an investment is usually measured by its volatility (standard deviation) of returns. Assuming investment returns are approximately normally distributed, an investment with a standard deviation of 10% would be one where, in about one year in six, the return was likely to underperform expectations by 10% or more, and vice versa. The volatility (standard deviation) of real equity returns in the UK over the 20th century was 20% pa. This compares with a 14.6% standard deviation for UK bonds and 6.6% for bills. This ranking was common across the world. In every country, equities proved more volatile than bonds, while bonds were more risky than bills.

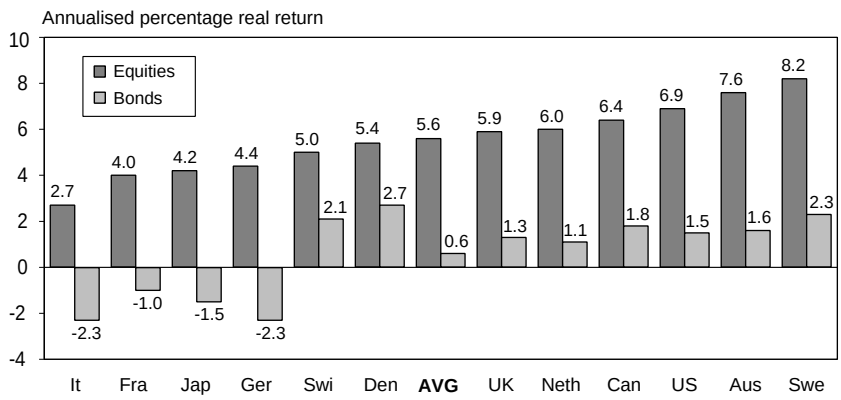
During the 20th century, the UK stock market was less volatile than most others. The average volatility (standard deviation) for the twelve countries was 23%. Germany, Japan and Italy had the highest volatilities; only Australia and Canada were lower than the UK.

Inflation was a major force in the 20th century

UK inflation averaged 4.1% pa over the 20th century. £1 in 1900 had the same purchasing power as £54 today. But while the UK may view itself as having been afflicted by inflation, it was in fact slightly below average for the 20th century taken as a whole. The average inflation rate for all twelve countries was 4.8% pa.

This average figure, however, hides considerable variation across countries. The extreme case was German hyperinflation in 1922/3, which ran at an annual percentage rate in the billions. Three other countries experienced very high inflation around the end of World War II: 344% in Italy in 1944, 317% in Japan in 1946, and 74% in France in 1946.

Figure 2
Real returns on world equity and bond markets, 1900-2000



Source: Dimson, Marsh and Staunton (ABN AMRO/LBS)

All countries also experienced deflation at some time during the 1920s and early 1930s. UK retail prices rose from £1 in 1900 to £3.13 in 1920, then fell to £1.66 by 1933, and did not regain their 1920 level until 1952.

Inflation and a number of other variables in our study have shown some tendency to regress towards the mean. For example, after being the highest inflation country in the first half-century, Germany enjoyed the lowest rate (2.8%) in the second half (see figure 3). In contrast, the UK had low inflation (2.0%) in the first half century, because the years of higher inflation were partially offset by the deflationary period in the twenties and early thirties. However, in the second half-century, it had the second-highest inflation (after Italy): 6.2% pa from 1950-99, peaking at 25% in 1975.

Bonds proved a disappointing investment

High and unexpected levels of inflation ensured that the 20th century was not the century for bond investors. In the UK, long-term government bonds (gilts) provided a disappointing return of 5.4% pa, or just 1.3% after inflation of 4.1% pa. Risk-free short-dated treasury bills returned 5.1%, or just 1.0% pa in real terms (see figure 1 above).

UK bill and bond returns were around the median of the twelve countries in our study. Four countries – Germany, Japan, Italy and France – experienced negative real returns on both bonds and bills over the 20th century taken as a whole.

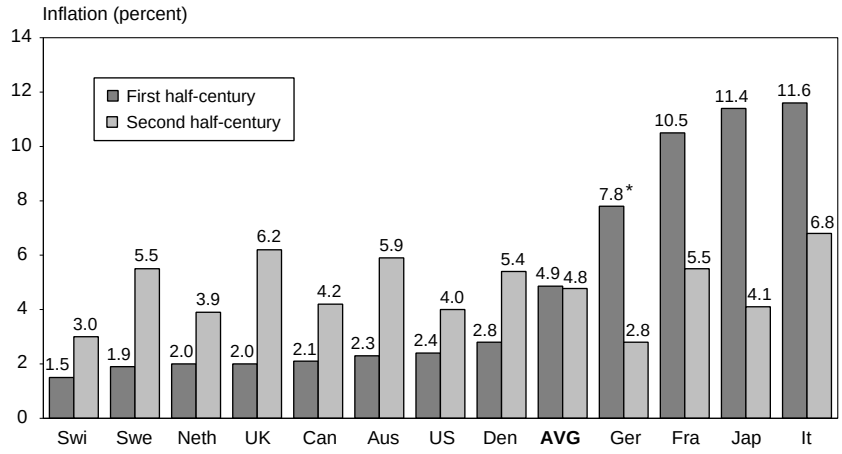
Across all 12 countries, the average real bond return was 0.6% pa, while the bond maturity premium (the difference between long-bond returns and the short-term interest rate) was also 0.6%. Since investment in long bonds is much riskier than investment in short-term deposits, especially at times of high or uncertain inflation, a maturity premium of just 0.6% appears low for the incremental risks involved. It seems highly likely, therefore, that in many markets the returns on bonds fell short of investors' expectations because inflation proved to be higher and more volatile than expected.

The most extreme example of this was naturally during a period of hyperinflation. In 1922/3, German investors who held bonds or even short-term deposits lost everything, reminding us that, although we normally regard government bills as risk-free, and bonds as lower risk than equities, there can be extreme circumstances where this ceases to be true. Over 1922/3, *The Millennium Book* reveals that the real return on German equities was 13%.

Interestingly, the four countries which experienced the lowest bond returns due to high inflation during the first half of the 20th century – Germany, Japan, Italy and France – were amongst the best-performing bond markets over the most recent 50 years (see figure 4). For these countries, bond prices at the mid-point of the century had reflected an expectation of continuing debasement of the domestic currency. Post-war control of inflation typically provided a boost to bond market returns.

Financial market returns thus reflect the turbulence of the 20th century. Through the lens of the markets, we can see the decimating impact of wars and their aftermath, inflation, high interest rates, stock market

Figure 3
International inflation: first *versus* second half of 20th century



Source: Dimson, Marsh and Staunton (ABN AMRO/LBS)

* Excludes 1922-3

crashes and the great depression. These events have impacted not only on investment returns, but also on the volatility of the financial markets.

Equity returns were lower than previously believed

Although equities performed best in every country, equity returns over the 20th century proved somewhat lower than has previously been believed. There are two main reasons for this. First, several previous studies have over-estimated equity returns by placing reliance on indices constructed using hindsight. Second, most previous studies have focussed on data that was easy to collect, typically taken from the second half-century, when equities performed especially well.

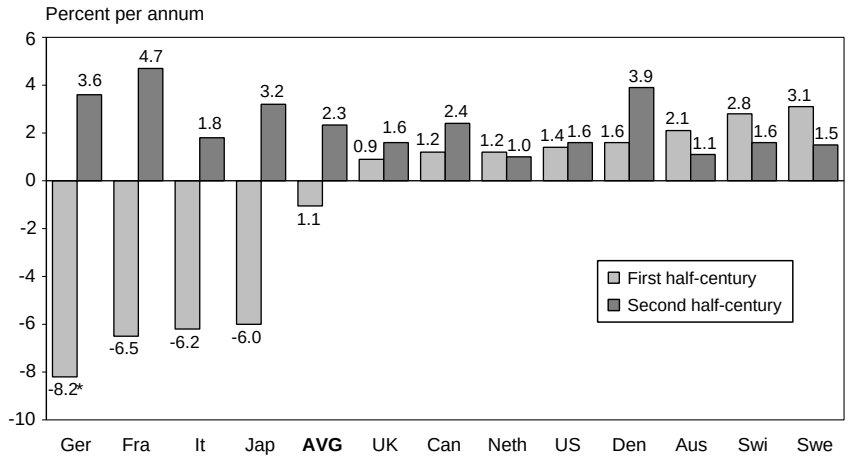
Focusing first on the problem of hindsight, we have taken great pains in *The Millennium Book* to avoid hindsight in the construction of our new indices. Previous research, however, is not always hindsight free. Some researchers have compiled indices based only on surviving or successful companies or industries, and this has led them to overstate equity performance. Within the British stock market one illustration is the omission, from a standard equity index back-history, of the entire railway sector, which in 1900 represented over one third of the entire value of the UK equity market. At the start of the 20th century, investors could not have known that railway stocks were destined to disappear from the market.

In the UK, the standard reference work on long-run UK equity returns has been the BZW equity index (see Barclays Capital, 1999, and CSFB, 1999), which covers the period from 1919 onwards. This went live in 1955, and provides unbiased estimates of equity returns from 1955 onwards, though with narrower market coverage than our *Millennium Book* indices. For the period 1919-54, however, the BZW equity index is based on a reconstructed backhistory, which included companies that were subsequently incorporated into a large-company index. It was thus constructed with hindsight, since an investor back in 1919 would clearly not have known which companies were destined to be successful, ie, to grow large. This use of hindsight, coupled with other problems in index construction, led to the BZW equity index overstating equity returns by 2.34% pa over the period 1919-54.

The second and even more pervasive reason why previous studies have documented higher returns than *The Millennium Book* is their reliance on easy data. Again, we can illustrate this for UK returns. The BZW index starts after the end of World War I, whereas we select 1900 as the common base date for all our indices. By omitting years of turmoil early in the 20th century, while including the post-war recovery, equity market returns are flattered in the BZW and other studies. The effect of starting the BZW history in 1919 rather than 1900 is to add an additional 2.62% pa to the pre-1955 real return on UK equities. Since post-WWI equity returns are more readily available than older data, the differential performance of the BZW index arose from a focus on data that is relatively easy to obtain.

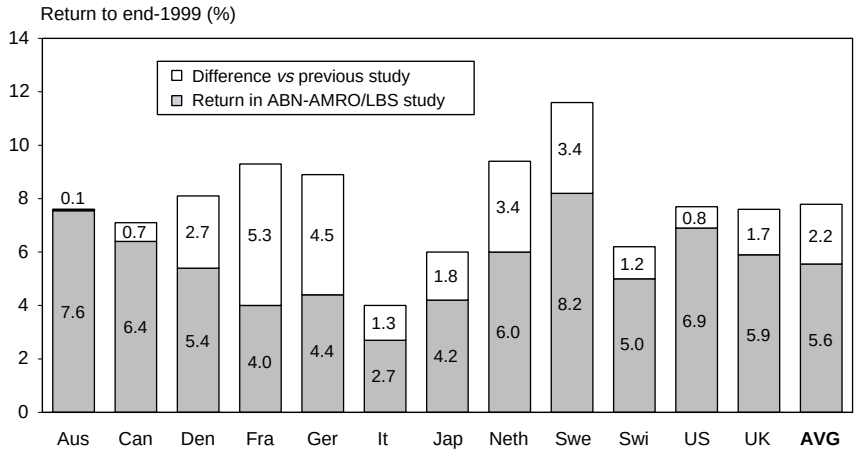
This problem is quite prevalent. Most studies are based on records that are relatively accessible. By avoiding

Figure 4
Real bond returns: first *versus* second half of 20th century



Source: Dimson, Marsh and Staunton (ABN AMRO/LBS) * Excludes 1922-3

Figure 5
This study *versus* previous research: easy data bias



Source: Dimson, Marsh and Staunton (ABN AMRO/LBS)

inaccessible, controversial or infrequently-published data, periods of poor market performance are often omitted. This tends to give rise to over-estimates of long-run rates of return. Easy data generally exclude periods with breaks in trading activity or times which are regarded as otherwise unusual, such as periods of unrest and economic upheaval, and wars and their aftermath. Easily available data also typically relates to more recent time periods, when equities have performed especially strongly. This is true of the BZW studies for other countries (France, Germany and the Netherlands) and of the Ibbotson studies of the equity risk premium in other countries (Ibbotson Associates, 1999), all of which span far less than the full century examined in *The Millennium Book*.

Compared to estimates over the periods spanned by other studies, our 100-year estimates of equity returns and equity risk premia are markedly lower. In figure 5 we review twelve studies which, despite covering periods that are sometimes as brief as thirty years, might hitherto have been taken as the standard reference for each country. These references generate a misleading impression of 20th century investment performance. They cover intervals during which equity returns exceed the actual returns for the century by, on average, 2.2% per year.

The Equity Risk Premium and Why It Matters

The equity risk premium is the difference between the return on equities and the return on a risk-free asset, typically treasury bills, but sometimes government bonds. The risk premium is important because it represents the reward for, or price of, bearing risk. Investors do not knowingly take on risk unless there is some expected compensation for their risk exposure. For taking on the risks of the equity market, this compensation takes the form of the equity risk premium. To measure this premium, and establish the price of risk, we need to look at the markets where equity risk is traded, namely the world's leading stock markets.

The risk premium matters because it is central to projecting future investment returns, calculating a company's cost of equity capital, valuing companies and shares, appraising investment projects and determining fair rates of return for regulated utilities. *The Millennium Book* provides extensive direct evidence on the equity risk premium, and this is undoubtedly the most important variable documented in the study. Many finance professionals and financial economists regard the equity risk premium as the single most important number in finance.

By definition, an unbiased estimate of the risk premium required by investors tells us what returns we can expect from the equity market in the future, relative to bills or bonds. A low (high) risk premium automatically implies low (high) future returns from equities. If this were not the case, then the highly competitive conditions prevailing in the world's leading stock markets would ensure that share prices rapidly rose (fell) until promised returns were aligned with required returns.

By combining the risk premium estimate with a forecast of future market volatility, we can also infer

the price of risk, ie, the additional percentage return investors require per unit of market volatility. The price of risk, coupled with estimates of future market returns, provide crucial inputs to investors' asset allocation choices, namely how to allocate funds between stocks, bonds, bills and other asset classes. The risk premium is thus central, either explicitly or implicitly, to asset allocation decisions made by investment professionals, individuals and firms.

At the same time, the equity risk premium is of fundamental importance to company managers and regulators. To company managers, the cost of capital is central to setting minimum target rates of return for proposed investment projects. Finally, many utilities and other companies face a situation where part or all of their business is subject to price or rate-of-return regulation. This is designed to ensure that the firms in question do not abuse their market power, and earn an unfairly-high rate of return. The benchmark for judging whether returns are excessive should be the company's cost of capital, which in turn, depends on the equity risk premium.

Measuring the Risk Premium

The equity risk premium is typically measured in one of two ways. The first uses treasury bills (short-term, default-free, fixed-income government securities) as the risk-free or 'safe' benchmark. The second measures the risk premium relative to long-term government bonds. Of these two, only treasury bills can really be considered risk-free, and even here hyperinflation can cause bill investors to experience large losses in real terms. Long-term government bonds are generally appreciably more risky than bills, since bond prices are sensitive both to changes in real interest rates and to inflationary expectations. Since bonds are riskier than bills, we would expect the equity risk premium relative to bonds to be lower than the premium relative to bills.

Long-term bonds nevertheless have one advantage as a benchmark in that long-bond prices reflect not only today's short-term interest rate, but also future expected interest rates. Thus for valuing shares or projects where the cash flows extend many years into the future, the promised return on long bonds will encapsulate the expected sequence of returns on short-

The Risk Premium and Share Valuation

The risk premium is crucial for valuing shares. It has long been recognised that the value of a share is the present value of the discounted stream of cash flows to the shareholder. This statement can be translated into a dividend discount (or dividend growth) valuation model. Alternatively, it may be reformulated as a model that values the portion of the company's free cash flows which is attributable to shareholders.

All these valuation models require a discount rate, which by definition is the shareholders' required return. This required return will be the risk-free rate plus a premium for risk, where the latter will be the equity risk premium for the market, adjusted for the risk of the share in question. If the Capital Asset Pricing Model is being used to determine discount rates, the risk adjustment will depend on the share's systematic risk, or beta – a measure of the extent to which a share's performance fluctuates with the market. UK share betas are published in the London Business School *Risk Measurement Service*. But whichever pricing or valuation model is used, the size of the equity risk premium will, explicitly or implicitly, play a central role.

Just as the external valuation of a company's shares should be driven by the shareholders' required rate of return (the 'cost of equity capital'), so should internal valuations within the company. When reviewing new projects and investments, acquisitions and divestments, or whether existing businesses are providing an adequate return, the benchmark used by managers should be the return required in the capital markets.

The required return on a company's investments should reflect not only the costs of borrowing money, but the cost of equity capital (see, eg, Brealey and Myers 2000, chapters 7-9, for further details on calculating the cost of capital). Projects that fail to cover the cost of capital should not be undertaken, while those that exceed it will be value enhancing. Once again, therefore, the equity risk premium is vital, since if managers over-estimate the required premium, and hence their cost of capital, this will lead to under-investment, and vice versa. Shareholders will be worse off whenever the premium is under- or over-estimated.

dated bills over the remaining term of the bond. The corresponding disadvantage is that long-bond prices will also encapsulate a maturity risk premium, the magnitude of which is hard to measure.

We cannot observe directly what risk premium investors expect for the future. But we can measure the historical risk premium, and if the measurement interval is long enough, we can use this as a starting point for inferences about what investors might expect. We measure the risk premium by taking the geometric difference between the equity return and the risk-free return. The formula for the equity risk premium is *1 + Equity rate of return* divided by *1 + Riskless return*, minus *1*. For example, if shares with a one-year return of 21% are being evaluated relative to treasury bills yielding 10%, the equity risk premium would be 10%. This is because $(1 + {}^{21}/_{100})$ divided by $(1 + {}^{10}/_{100})$ is equal to $(1 + {}^{10}/_{100})$.

The equity risk premium, measured relative to bill or bond returns, is a ratio. It is hence unaffected by whether returns are computed in dollars or (say) French francs, or whether returns are computed in nominal or real (inflation-adjusted) terms.

The range of premia that are encountered over investment periods of a single year is very broad, reflecting the fact that year-to-year equity returns are volatile. In the US, for example, the one-year equity risk premium relative to treasury bills varied over the 20th century between –45% (in 1931) and +55% (in 1933). No one would suggest on the basis of these observations that investors required a risk premium of either –45% or +55%! The outcomes for these two years simply represent one particularly disappointing, and one especially good, year for equities. To infer investors' expectations for the risk premium requires one to look at realised premia over investment horizons that are much longer than a year, and conventional wisdom suggests one should select the longest period possible.

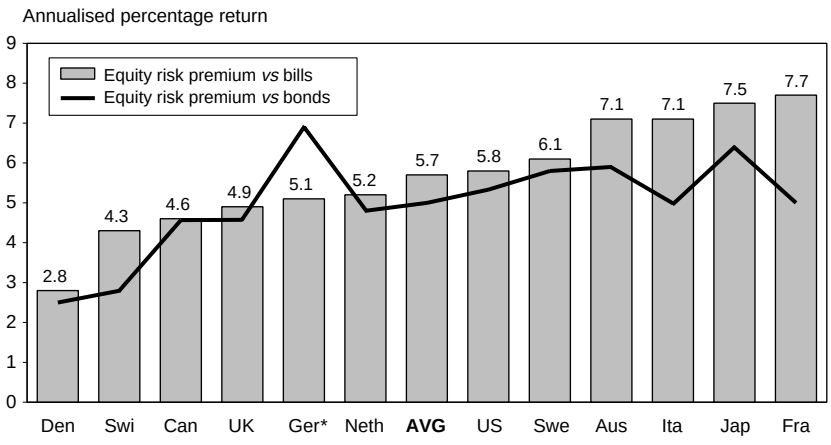
Evidence on the Historical Risk Premium

The twelve countries' equity risk premia over the entire 20th century are shown in figure 6 below. The bars in figure 6 show the risk premium relative to treasury bills, while the line plot shows the premium relative to long bonds. In the case of Germany, the risk premium figures are based on data for 98 years, since we have excluded the hyperinflationary years of 1922/3 when bills and bonds returned –100% in real terms.

While the equity risk premium has clearly varied across countries, the century-long averages fall within a fairly narrow range. Figure 6 shows that, relative to bills, the equity risk premium averaged 5.7%, and ranged from a high of 7.7% for France down to 4.3% for Switzerland, the only outlier being Denmark at 2.8%. We find that the equity risk premium for the US is remarkably close to the middle of the distribution of equity premia, whether the latter are estimated relative to bills or bonds. In particular, the 100-year US equity risk premium relative to bills of 5.8%, was very close to the mean of 5.7% for the twelve countries. The UK experience was also close to the mean, with a 100-year equity risk premium of 4.9%.

The line plot in figure 6 shows the equity risk premium relative to long-term government bonds. As can be seen, this was generally lower than the premium

Figure 6
Annualised equity risk premia relative to bills and bonds



Source: Dimson, Marsh and Staunton (ABN AMRO/LBS) * Excludes 1922-3

relative to bills. This is because, over the century as a whole, the return on government bonds exceeded the return on treasury bills. The average risk premium relative to bonds across the twelve countries was 5.0%, ranging from a high of 6.9% for Germany to a low of 2.5% for Denmark. Once again, the risk premia of 5.3% for the US and 4.6% for the UK are close to the mean for all twelve countries.

As we noted above, the evidence suggests that bond returns over the 20th century proved lower than investors' expectations because of unexpectedly high rates of inflation. If bond performance had been in line with expectations, realised bond returns would have been higher, and equity risk premia would have been lower. This suggests that the historical risk premia relative to bonds, shown in figure 6, are likely to overstate investors' expectations.

Furthermore, the unanticipated losses experienced during the century's worst inflation episodes afflicted bondholders more than shareholders. The risk premia reported in figure 6 are therefore subject to a further caveat in relation to those countries that experienced the worst real bond returns. Germany's appearance at the top of the league table of risk premia relative to bonds is thus attributable much more to the disappointing return on bonds, than to the good performance of German equities (even after excluding 1922/3). This is borne out by the fact that figure 6 shows that Germany was the only country in which the risk premium relative to bonds exceeded the risk premium relative to bills.

The Risk Premium and the Cost of Capital

The risk premia reported above were computed as geometric means. This has intuitive appeal from an investment perspective, since, when past performance is being considered, the geometric mean summarises the annualised rate of return over a historical period. The geometric mean of n returns is the nth root of (*1+the first return*) x (*1+the second return*) x … x (*1+the* n^{th} *return*), minus *1*. When decisions are being taken on a forward-looking basis, however, the arithmetic mean is the appropriate measure, since it represents the mean of all the returns that may possibly occur over the investment holding period. The arithmetic mean of n returns is the sum of all n returns, divided by n.

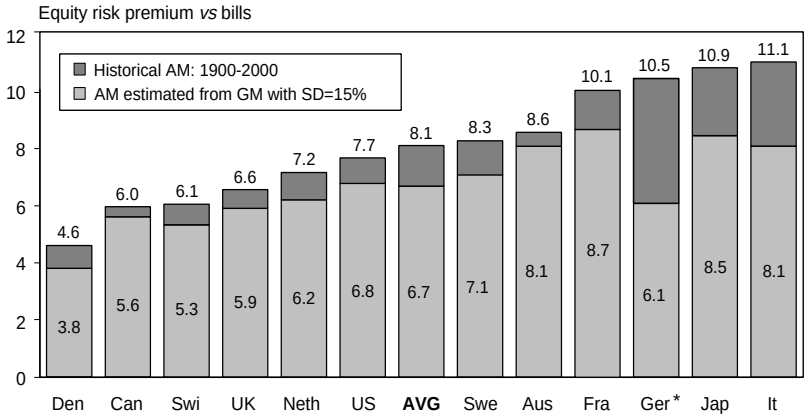
The arithmetic mean of a sequence of different returns is always larger than the geometric mean. To understand this, consider successive returns of +25% in one year, followed by –20% in the following year. The arithmetic mean of these two returns is 2½% (ie, 25 minus 20, divided by 2). The geometric mean of these two rates is zero (since $(1 + {}^{25}/_{100}) \times (1 - {}^{20}/_{100}) - 1 = 0$). The more volatile or risky the sequence of returns, the greater will be the difference between the two means. For very risky investments, the arithmetic mean return can be much higher than the geometric mean.

As we saw above, one of the key uses of the equity risk premium is to determine investors' required returns, and hence the cost of capital for use as the discount rate in valuing shares and in project appraisal. For discounting uncertain future cash flows it is necessary to use the expected risk premium. The expected premium is the arithmetic mean of the one-year premia. In figure 7 (overleaf), the full height of the bars shows the historical arithmetic mean risk premium relative to bills over the last 100 years for each of the twelve countries. The average figure is 8.1%, while the figures for the US and UK are 7.7% and 6.6% respectively. As we would expect, the arithmetic mean risk premium is noticeably higher than the geometric mean premia recorded in figure 6 above. Furthermore, the arithmetic mean is at its largest, both in absolute terms and relative to the geometric mean, for the four countries which experienced the greatest turmoil and hence volatility of returns over the 20th century (see the right-most four bars of figure 7).

The historical arithmetic means in figure 7 are thus clearly influenced by the periods of extreme volatility during the 20th century. All market analysts agree, however, that repetition of certain types of historical event is so implausible that the past must be interpreted with care. Extreme hyperinflation is widely regarded as something that will not again afflict major economies; and a world war would be of a different nature if it were to happen in the future. (If there were another world war, the good news is that we would never again need to concern ourselves with the risk premium.)

We are thus likely to obtain more plausible estimates of the expected future arithmetic risk premium if we adjust the historical estimates in figure 7 downwards to reflect today's best guesses about future equity market volatility levels. The approach we follow here is to take the historical geometric means from figure 6

Figure 7
Arithmetic equity risk premia



Note: AM = Arithmetic Mean; GM = Geometric Mean; SD = Standard Deviation * Excludes 1922-3

Source: Dimson, Marsh and Staunton (ABN AMRO/LBS)

as given; that is, we treat them as unbiased estimates of the future geometric mean. We then recalculate the arithmetic means, assuming an illustrative, but more plausible, estimate of early 21st century levels of volatility. To do this, we use the result that with lognormally distributed returns, the geometric and arithmetic means are linked by the standard deviation (or volatility) of returns. (Some statistical assumptions that underpin our calculations, but are glossed over here, are discussed in Cooper 1996 and Dimson and Marsh 2001.) For illustrative purposes only, we have assumed a current volatility level of 15% for all twelve markets.

The resultant arithmetic mean risk premia are shown by the lower part of the bars in figure 7. The premia range from 3.8% for Denmark to 8.7% for France, with a mean of 6.7%. The figure for the US is 6.8%, and that for the UK is 5.9%. Note that even when we use 100 years of data, the standard errors around these risk premia estimates are very high, ranging from 1.7% (for Australia and Canada) to 3.6% (for Germany). The standard error for both the US and the UK is 2%. This means that while the figure of 5.9% for the UK remains our best estimate, we can be only 68% confident that the true mean lies within one standard error of this, ie, within the range 5.9 ± 2%, namely between 3.9% and 7.9%. These high standard errors are the reason why conventional wisdom prescribes that the longest possible series of stock market data should be used to estimate risk premia.

We should sound a cautionary note. Even *The Millennium Book's* estimates of long-run returns – which use the longest-run series and most accurate data available to date – may still be slightly upward biased. This is because our study is restricted to the twelve countries for which total returns can currently be estimated. We omit markets that at some point failed to survive – Russia, Argentina, China, Poland and so on. Some of these experienced returns of –100%, and their exclusion will inflate our estimates, which are based only on surviving markets. Mostly, though, these markets were small, so their omission probably has only a minor impact in market capitalisation weighted terms. Our study also excludes some markets which existed in 1900 and still exist today (eg, Spain), but where a full century of data has so far eluded us. Our research thus suffers from some element of the survivorship and easy data bias to which we referred earlier. This may mean that even our global average historical risk premium is slightly upward biased, though hopefully this is mitigated by the large proportion of world market capitalisation covered by our twelve markets. The important qualitative point is that, insofar as our research too may suffer from data biases, it is in the direction of over-estimating the equity risk premium, not under-estimating it.

To obtain a cost-of-capital estimate for use in discounting future cash flows, we require a forecast of the future arithmetic risk premium. For those who believe that estimates based on a long-run series of historical returns are a good guide to future risk premia, and who are prepared to accept that our data are relatively free of survivorship and easy data bias, then the numbers illustrated in the lower bars of figure 7 are the relevant numbers to employ. This indicates

that for the twelve countries in our sample, the average risk premium (for typical risk equities, in a typical risk market) would be 6.7%. Hence, the current cost of equity would be the current risk-free rate of interest, plus a premium of 6.7%.

What This Means for the Future

The key remaining question is whether this 6.7% global average historical risk premium should be used as our best estimate of the future risk premium. In a recent paper, Goyal and Welch (1999) specifically state that "in the absence of any variable known to robustly predict the equity premium out of sample, the [finance] profession should assume that no variable can predict the equity premium better than its own past average". Certainly, many leading textbooks advocate the use of the arithmetic mean of historical equity premia; these include Brealey and Myers (2000) and Bodie, Kane and Marcus (1999).

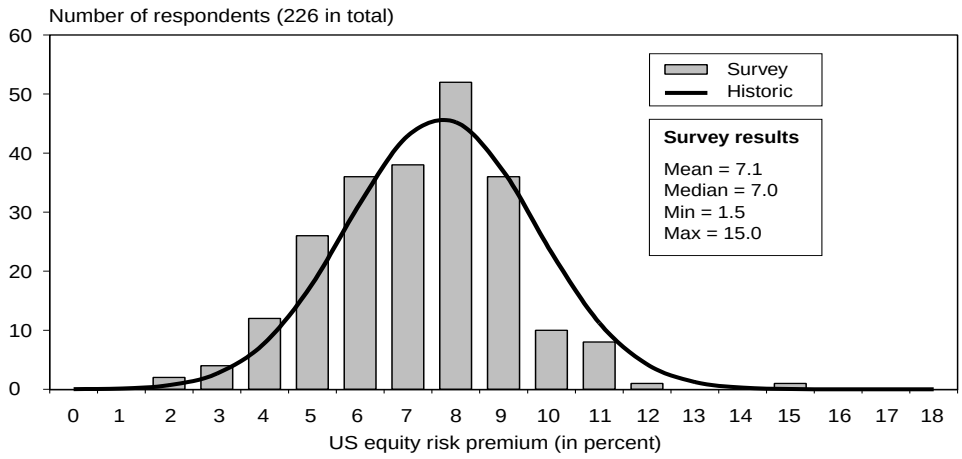
A recent survey by Ivo Welch (2000) casts light on whether academic finance professionals do, in fact, extrapolate from the historical record into the future. Rather than looking at a cross-section of countries, Welch studies the opinions of 226 financial economists who were asked to forecast the arithmetic equity risk premium in the US over a number of time horizons. He finds that the consensus forecast of the arithmetic 30-year equity premium is about 7%. The consensus is that a pessimistic outcome (with a 5% probability of occurrence) would be an equity premium of 2–3%; the consensus regarding an optimistic outcome is for a 12–13% equity premium.

The bars in figure 8 represent the distribution from the Welch survey, while the curved line represents the normal distribution based on the historic mean (7.7%) and associated standard error (2.0%) using the century of observations for the US equity risk premium. An important aspect is the similar spread in both distributions. The uncertainty across financial experts about the risk premium is as large as the uncertainty that arises from statistical analysis of historical returns.

Most respondents to the Welch survey would have regarded the Ibbotson *1999 Yearbook* as the definitive study of the historical US risk premium. The survey mean was lower than the Ibbotson benchmark, and since survey respondents claimed to revise their risk premium forecasts downwards when the equity market rises, this difference may well be explained by the recent strong performance of the market. Consistent with this, the survey respondents also perceived the profession's consensus to be higher than it really was, ie, they thought the mean was ½ to 1% higher than the 7% figure shown in figure 8.

These survey figures represent what is being taught in the world's leading business schools and economics departments. As such, they will also be widely used by finance professionals and corporate executives. Similarly, they will be cited by regulators and used in rate-of-return regulation disputes. Their influence will thus extend from the classroom to the boardroom, the dealing room, and the courtroom.

Figure 8
Views of financial economists *versus* historical results



Source: Welch (2000)

Whether a mean of 7% is correct is quite another matter. As noted above (see figure 5), our new estimate of the annualised 1900-1999 US premium is nearly one percentage point lower than the Ibbotson estimate, which was for 1926-1999. To the extent that survey respondents were calibrating their forecasts relative to the Ibbotson benchmark, these same respondents might now wish to lower their estimates of the equity risk premium to figures based on the new estimates from *The Millennium Book*. This assumes, of course, that they are still content to use historical means as the anchor for their future forecasts.

Interpreting History to Estimate Future Risk Premia

Clearly, history can be no more than a starting point for predicting the equity risk premium. Financial economists may be reluctant to diverge markedly from the historical mean. Decision-makers, on the other hand, cannot rely merely on the average premium observed from past observations. They correctly wish to go beyond using only the past, and to identify the market's implicit expectation for future performance.

There are coherent arguments in favour of going beyond raw historical estimates of the risk premium. First, the whole notion of using the achieved risk premium to forecast the required risk premium depends on having a long enough time period to iron out good and bad luck. Even with a century of data, standard errors are still high.

Second, the equity risk premium could change over time. This might be because the underlying business risk of equities has fluctuated, as the world or the corporate sector became riskier or safer. Or it might be because the risks faced by investors have been transformed, as enhanced diversification opportunities became available, both domestically and internationally. Alternatively, it might be a consequence of systematic changes in investors' levels of risk aversion.

Third, we must take account of the fact that stock market outcomes are influenced by many factors. Some of those that were important in the past may be non-repeatable. If so, projections of the future risk premium should deviate from extrapolations based on the past. The financial history of our twelve stock markets has been so variable over time that it is worthwhile exploring this argument further.

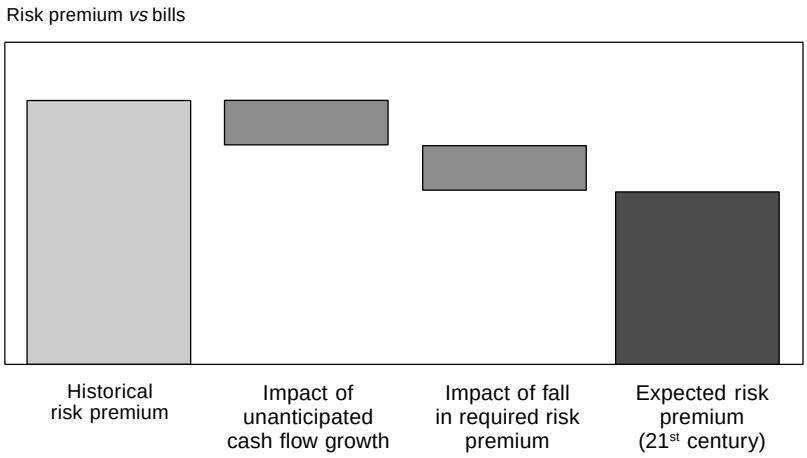
A comparison between the first and second halves of the 20th century makes the point. Over the first half-century the US equity risk premium had an arithmetic average of 6.5%, whereas the second half-century gave rise to a 9.0% risk premium relative to treasury bills. This pattern is common to most of the twelve countries we study in *The Millennium Book*. (The exceptions are Australia, Canada and Italy – and Germany because of its interwar hyperinflation.) The cross-sectional mean for all countries (excluding Germany) in the first half-century was an arithmetic average risk premium of 6.5%, as compared to 9.3% for the twelve-country mean in the second half-century.

The large risk premia achieved during the second half of the 20th century are attributable to two factors. First, there was unprecedented growth in productivity and efficiency, as well as improvements in management and corporate governance, and there was also extensive technological change. As Europe, North America and the Asia-Pacific region emerged from the turmoil of World War II, expectations for improvement were limited to what could be imagined. Reality exceeded investors' expectations. Corporate cash flows grew faster than investors had anticipated. This higher growth is now known to the market, and built into today's higher stock prices.

Second, stock prices have almost certainly also risen because of a fall in the required rate of return, due to diminished investment risk. The economic and political lessons of the 20th century have surely been learned, international trade and investment flows have increased, and the Cold War has ended, leading to a more secure business environment. A further factor that may have lowered required returns is that investors now have much more opportunity to diversify, both domestically and internationally, than they had a century ago. Diversification allows investors to lower their risk exposure without detriment to expected return. Transaction costs are also lower now than a century ago. Factors such as these, which have led to a reduction in the required risk premium, have contributed further to the upward re-rating of share prices.

To convert from a pure historical estimate of the risk premium into a forward-looking projection, we need to reverse-engineer the factors that have driven up stock markets over the last 100 years. This is illustrated conceptually in figure 9. The left-hand bar in figure 9

Figure 9
Historical and expected geometric risk premia



portrays the historical risk premium on the equity market. This includes the impact of unanticipated growth in cash flows and of falls in the required risk premium. We therefore deduct the impact of these two factors. What remains is an indication of the risk premium demanded by investors today (see the right-hand bar in figure 9). The key qualitative point is that it is lower than the raw historical risk premium.

One final point. The use of historical averages as estimates of current required returns implies that France has a very high equity risk premium, while Denmark's risk premium is very low. There may, of course, be differences in risk between markets, but this is unlikely to account for cross-sectional differences in historical premia. Indeed, much of the cross-country variation in historical equity premia is attributable to country-specific historical events that will not recur. When making future projections there is therefore a strong case, particularly given the increasingly global nature of capital markets, for taking a global, rather than a country-by-country, approach to determining the cost of capital.

What Returns Can We Expect over the 21st Century?

The arguments above all lean in one direction, namely that the historical risk premium is likely to exaggerate investors' current required equity risk premium. This has important implications. The bad news is that some investors may have observed these high past returns and assumed they would continue, when in reality they were due to a gradual re-rating that may now be complete. Returns will certainly not persist at the annual level of 16% that was recently cited as the expectation of British private investors (Gallup poll, reported in the *Financial Times* on 15 November 1999). Nor is the premium likely to be as high as the 9.5% arithmetic mean reported in the Ibbotson Associates *2000 Yearbook*. As Siegel (1998) and Shiller (2000) point out, future stock market returns are likely to be lower than many investors are expecting.

If investors continue to require a relatively low risk premium in future, then equities can be expected to outperform risk-free investments, though by a lower margin than over the 20th century. If instead required rates of return rise, share prices will fall, and thus equities will underperform. Perversely, only if the expected equity risk premium is now at a permanently lower level can today's high stock prices be justified.

Readers may now be pondering what our view is of the long-term prospects for equities. As academics, and with investment track records like our own, we are naturally reluctant to forecast investment returns. However, three trends seem likely. First, and uncontroversially, in the 21st century, investment in equities will remain risky. This is because business itself is risky, and because the new century will bring its own forms of turmoil and volatility. Our second prediction follows from our first. If equities remain risky, as must certainly be the case, equity investors should continue to expect a positive risk premium. This implies that, when investors look back 100 years from now, equities should prove to have been the best-performing asset class over the 21st century. Our third prediction is that the risk premium will turn out to be

lower than it has been during the 20th century, even when it is calculated, as in this study, to include the turbulent earlier half of the 20th century.

These are long-term forecasts, the accuracy of which should not be judged for a further one hundred years. Even then, note that with 200 observations the standard error associated with estimates based on historic data will still be of the order of 1.5%.

Are Companies Under-investing?

It has become clear that the current level of the equity risk premium is unlikely to be as high as was considered reasonable in the mid-1990s. The arithmetic mean of 8½% recommended by Ross, Westerfield and Jaffe (1993), the 8-9% suggested (with caveats) by Brealey and Myers (2000), the 7½% recommended by Weston, Chung and Sui (1997), and a similar figure inferred from the Copeland, Koller and Murrin (1995) geometric mean of 5-6%, all look excessive. The market is almost certainly building lower risk premia than this into stock prices.

At the same time, real interest rates have declined. For example, the real yield on UK index-linked government bonds has fallen from well over 4% a few years ago to around 2% today. To compute the expected return on equity investment, we have to add the risk premium to the real interest rate. Since both components have declined, it follows that in real terms, the required rate of return on equity capital is markedly lower than it was. With lower inflation and lower real interest rates, the expected return on conventional bonds has also fallen. So the required return on debt capital is also lower than it was.

The cost of capital has thus fallen substantially in recent years. Moreover, as we show in *The Millennium Book*, most countries share the experience we describe. Many companies, however, are still living in the past. They are seeking a required rate of return on new investment which is simply too high. By ignoring the worldwide fall in the costs of both debt and equity capital, there is a danger that these companies are under-investing, or are waiting too long before embarking on important projects.

Cancellation or deferral of worthwhile projects erodes the competitive position of established companies. The biggest losers are likely to be those firms that risk being overtaken by new competitors who are in a position to exploit new technologies and innovative processes. These losers will experience downgrading of their market ratings and erosion of their share prices. Ironically, this stock market reaction may be misinterpreted as an increase in the cost of capital, and contribute to a vicious circle of continuing under-investment and loss of shareholder value.

Is mis-estimation of the cost of capital the only explanation for the woes of 'old economy' companies? Of course not: it is not that simple. Markets have risen because of lower required rates of return. But they have also responded to a benevolent economic environment and the emergence of new technologies. To share in the improved profits outlook, it has been necessary to be doing the right thing. This means investing in worthwhile projects, rather than simply expanding through projects that fail to cover the cost of capital.

Some companies have been overtaken by the fast pace of change in the economy, and are not in a position to benefit from today's low cost of capital by investing in worthwhile projects. While these firms should be looking for profitable new investments, they may well conclude that the best they can do is to return excess funds to their shareholders. These shareholders then have the option of investing their money in other shares that do offer the normal return from equity investment.

To make the right decision, it is important that managers have insight into the returns that can be expected from investing in the capital market. History can be misleading as a guide to the future, and undoubtedly needs to be interpreted with care. Nevertheless, financial market history provides a starting point. By understanding the capital markets, managers can be empowered to focus on investments that add to the market value of their company.

Elroy Dimson is Professor of Finance and Chair of the Accounting Subject Area; Paul Marsh is Esmée Fairbairn Professor of Finance and Academic Director of the Masters in Finance and Corporate Finance Evening Programmes; Dr Mike Staunton is Director of the London Share Price Database; all at London Business School.

Appendix: The Research Approach

Prior to publication of *The Millennium Book*, there was a paucity of reliable, comparable evidence on long-run rates of return in the world's major markets over the 20th century. The US was the exception, since for many years high quality data had been available, at least from 1926 to date. However, America has had a remarkably successful economy, and it would have been dangerous to extrapolate the future from the US experience.

The Millennium Book sought to fill the gap in our knowledge about long-term rates of return. For the UK, this was achieved by constructing an entire new family of equity and bond indices from 1900-2000 especially for the study. For the eleven other markets, we assembled and linked together the best quality indices and returns data available from previous academic studies and other sources.

For our own home market, the UK, there was until now no satisfactory record of long-run equity performance. We therefore used the London Business School Share Price Database to construct an index, starting in 1955, of the total return from investing in the entire UK equity market. This index is described in our forthcoming article in the *Journal of Business* (2001). From 1900 onwards, we constructed an index of the performance of the largest 100 companies. This involved a process of painstaking financial archaeology, collecting original data on share prices, dividends, and other data from archives in the City of London. By linking these two indices together, we have compiled an authoritative record of UK equity performance over the last 100 years. Similarly, for government bonds, we constructed a new returns index from 1900-2000, which tracks the returns on perpetuals until 1954, and thereafter on a portfolio of bonds with an average maturity of 20 years.

The eleven other markets covered are the US and Canada; Denmark, France, Germany, Italy, the Netherlands, Sweden and Switzerland; and Australia and Japan. In each country, we cover the same asset classes: equities, bonds and bills; and inflation. To span the century, for each asset class, we typically needed to link several different studies/index series.

Unlike most previous long-term studies of global markets, all our investment returns include reinvested income as well as capital gains. Many early equity indices measure just capital gains, ignoring dividends, while many early bond indices record just yields, ignoring price movements. Furthermore, our database is more comprehensive and accurate than previous research, spans a longer period, and the common start-date of 1900 aids international comparisons. In contrast, one of the most frequently cited previous studies, Jorion and Goetzmann (1999), identified only four non-Anglo Saxon markets with pre-1970 dividends, and none of these index series started before the 1920s. Finally, as noted above, we have taken pains to avoid any hindsight.

Capital market returns

For each asset class within each country, we have computed a series of annual nominal returns, calculated in local currency, for each calendar year from 1900 to 1999. From these, we compute the annualised (geometric mean) rate of return over the full century, and over any chosen sub-period. These annualised rates are the returns that investors would have earned before personal taxes and dealing costs. When compounded up, they indicate the terminal wealth that would have been generated by the initial investment.

Inflation was a major force in all countries during the 20th century. In addition to nominal returns, we therefore also calculate real, or inflation-adjusted, returns. The real return is defined as *1 + Nominal rate of return* divided by *1 + Inflation rate*, minus *1*. Because real returns are measured in constant purchasing power, they provide a far more meaningful measure of investment performance. Furthermore, real returns can readily be compared across different countries, since they have no obvious currency numeraire.

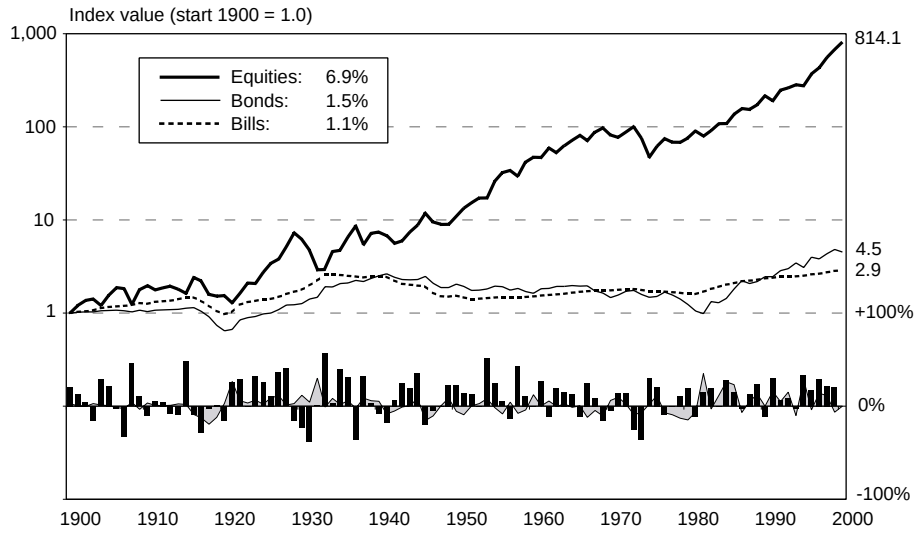
The nature of our underlying returns data is illustrated in the two-page box which shows summary data taken from the second half of *The Millennium Book*. While the first part of the book deals mainly with international comparisons, the second part contains a separate chapter for each country, describing the data sources, and presenting summary charts and statistics of returns data. The data shown overleaf is extracted from the chapter covering the US. A similar template is used for all twelve countries.

Long-run Rates of Return in the United States

In this box we illustrate the process of compiling a long-term performance record for each market. We follow the same procedure – adapting it slightly – for each of our twelve countries. We cover the three main asset categories – equities, government bonds and treasury bills – and inflation. Out of 48 asset/country combinations, 44 have a complete century-long record, while four have an unbroken history that covers nearly ninety years.

For all assets and markets we compile estimates of capital appreciation, income and total return, including reinvested dividends. Occasionally, as for the UK, our research involved assembling a new index from underlying stock price data. But for most countries, we simply identified the highest quality and most authoritative research studies over a sequence of time periods. The least troublesome market, from this point of view, was the US. We use the Schwert (1990) equity market returns for the first 26 years of the 20th century, which we link to the University of Chicago's index of all New York Stock Exchange

Figure 10
Real returns on US equities, bonds and bills, 1900-2000



Source: Dimson, Marsh and Staunton (ABN AMRO/LBS)

Table 1
Distribution of US asset returns, 1900-2000

Return % pa	Asset	Arithmetic mean	Geometric mean	Minimum return	Maximum return	Standard deviation
Nominal return	Equities	12.2	10.3	-43.9	57.6	20.0
	Bonds	5.0	4.7	-9.2	40.4	8.1
	Bills	4.3	4.3	0.0	15.2	2.8
	Inflation	3.3	3.2	-10.8	20.4	5.0
Real return	Equities	8.9	6.9	-38.1	56.4	20.3
	Bonds	2.0	1.5	-19.3	35.2	9.9
	Bills	1.2	1.1	-15.0	20.0	4.9

Source: Dimson, Marsh and Staunton (ABN AMRO/LBS)

Table 2
US real rates of return over various periods, 1900-2000

	From 1 January									
To	**1900**	**1910**	**1920**	**1930**	**1940**	**1950**	**1960**	**1970**	**1980**	**1990**
1 Jan					**Real return on equities**					
1910	7.1									
1920	2.2	-2.5								
1930	6.2	5.8	14.9							
1940	5.1	4.5	8.2	1.9						
1950	4.9	4.4	6.8	2.9	4.0					
1960	6.6	6.5	8.9	7.0	9.7	15.7				
1970	6.5	6.4	8.3	6.7	8.3	10.5	5.6			
1980	5.6	5.3	6.7	5.2	6.0	6.7	2.4	-0.7		
1990	6.1	6.0	7.3	6.1	7.0	7.7	5.2	5.0	11.0	
2000	6.9	6.9	8.2	7.2	8.1	9.0	7.4	8.0	12.6	14.2
1 Jan					**Real return on bonds**					
1910	0.3									
1920	-2.2	-4.6								
1930	0.8	1.0	7.0							
1940	2.3	3.0	7.0	7.1						
1950	1.4	1.7	3.9	2.4	-2.0					
1960	0.8	0.9	2.3	0.8	-2.1	-2.2				
1970	0.5	0.6	1.7	0.4	-1.8	-1.6	-1.0			
1980	0.3	0.3	1.1	-0.1	-1.8	-1.7	-1.4	-1.7		
1990	1.0	1.1	1.9	1.1	0.0	0.5	1.4	2.6	7.2	
2000	1.5	1.7	2.5	1.8	1.0	1.6	2.6	3.8	6.7	6.3
1 Jan					**Real return on bills**					
1910	2.3									
1920	-0.1	-2.5								
1930	1.9	1.8	6.2							
1940	2.3	2.3	4.8	3.4						
1950	0.9	0.5	1.5	-0.7	-4.6					
1960	0.7	0.4	1.1	-0.5	-2.4	-0.2				
1970	0.8	0.6	1.2	0.0	-1.1	0.6	1.5			
1980	0.6	0.4	0.8	-0.2	-1.1	0.1	0.3	-0.9		
1990	1.0	0.8	1.3	0.5	-0.1	1.1	1.5	1.5	3.9	
2000	1.1	0.9	1.4	0.7	0.2	1.3	1.6	1.7	3.0	2.0
1 Jan					**Inflation**					
1910	2.4									
1920	4.8	7.3								
1930	2.9	3.1	-0.9							
1940	1.6	1.4	-1.5	-2.0						
1950	2.4	2.4	0.7	1.6	5.4					
1960	2.3	2.3	1.1	1.8	3.8	2.2				
1970	2.4	2.4	1.4	2.0	3.4	2.4	2.5			
1980	3.0	3.1	2.4	3.0	4.3	4.0	4.9	7.4		
1990	3.2	3.3	2.7	3.4	4.5	4.3	5.0	6.2	5.1	
2000	3.2	3.3	2.8	3.3	4.2	4.0	4.5	5.1	4.0	2.9

Source: Dimson, Marsh and Staunton (ABN AMRO/LBS)

stocks (1926-61) and their index of all NYSE, American and Nasdaq stocks (1962-70), and to the Wilshire 5000 index (1971-1999). We follow a similar procedure for assembling the bond, bill and inflation indices.

Inflation-adjusted returns are more comparable across countries, so we focus here on the real returns on US asset categories. Figure 10 shows the cumulative real return from an investment of one dollar in each of equities, long-term government bonds, and short-dated treasury bills made at the end of 1899 and held throughout the 20th century. The bar chart in the lower section of figure 10 displays the year-by-year real returns on US equities and government bonds.

Table 1 summarises the data represented in figure 10, listing the arithmetic and geometric means and the standard deviation of annual returns, and the minimum and maximum returns experienced in the US over the entire 20th century. The returns are shown both in nominal terms (upper panel) and in real, inflation-adjusted terms (lower panel).

Table 2 lists annualised real returns over all possible intervals of duration 10, 9…1 decades, from an initial investment made in 1900, 1910…1990. This table covers equity, bond and bill returns, as well as inflation. The top panel of table 2 reveals the good fortune experienced over recent decades by equity investors. Look at the bottom row of the top panel. The entries towards the right-hand side show that over 1990-2000 the annualised real equity return was 14.2%, as compared to lower levels over longer intervals, such as the 12.6% recorded for 1980-2000, 8.0% over 1970-2000, and 7.4% over 1960-2000. The body of the same panel reveals that the preceding thirty years gave rise to an annualised real return on equities of 7.0% (1930-1960), while the first thirty years of the century yielded real returns of only 6.2% (1900-1930). By taking a long-term perspective, we mitigate the problem of drawing inferences from recent experience that may be unrepresentative of the future.

Figure 10 shows real returns on US assets. The upper section shows the cumulative real returns from an investment of $1 in each of equities, long-term government bonds, and short-dated treasury bills made at the end of 1899 and held throughout the 20th century. The lower section comprises a bar chart of the year-by-year real returns on US equities and government bonds.

It can be seen immediately from both the triangles and the table in the box that, for the US market, the annualised real return on equities over the 20th century was 6.9% per annum. A real return of 6.9% pa on an initial investment of $1 held over 100 years would have resulted in real terminal wealth of $814.1 as shown in figure 10. Real bond and bill returns were a much lower, 1.5% and 1.1% respectively, while inflation averaged 3.2%. Note, however, that the variability (standard deviation) of equity returns has been twice that of bonds, which in turn had twice the variability of bills.

As noted above, the history of US stocks, bonds, bills and inflation has hitherto been far better documented than in any other country, while researchers have been concerned that the US results may be non-typical since the US has been such a successful economy. A major contribution of *The Millennium Book* is that we have been able to assemble comparable 100-year series for the same asset classes for eleven other countries. We can now set this alongside the US data and make international comparisons that help set the US experience in perspective.

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MDU-015

Attachment

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DIVIDEND YIELDS AND EXPECTED STOCK RETURNS*

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The power of dividend yields to forecast stock returns, measured by regression R^2, increases with the return horizon. We offer a two-part explanation. (1) High autocorrelation causes the variance of expected returns to grow faster than the return horizon. (2) The growth of the variance of unexpected returns with the return horizon is attenuated by a discount-rate effect – shocks to expected returns generate opposite shocks to current prices. We estimate that, on average, the future price increases implied by higher expected returns are just offset by the decline in the current price. Thus, time-varying expected returns generate 'temporary' components of prices.

1. Introduction

There is much evidence that stock returns are predictable. The common conclusion, usually from tests on monthly data, is that the predictable component of returns, or equivalently, the variation through time of expected returns, is a small fraction (usually less than 3%) of return variances. See, for example, Fama and Schwert (1977), Fama (1981), Keim and Stambaugh (1986), and French, Schwert, and Stambaugh (1987). Recently, however, Fama and French (1987a) find that portfolio returns for holding periods beyond a year have strong negative autocorrelation. They show that under some assumptions about the nature of the price process, the autocorrelations imply that time-varying expected returns explain 25–40% of three- to five-year return variances. Using variance-ratio tests, Poterba and Summers (1987) also estimate that long-horizon stock returns have large predictable components.

Univariate tests on long-horizon returns are imprecise. Although their point estimates suggest strong predictability, Poterba and Summers (1987) cannot reject the hypothesis that stock prices are random walks, even with variance ratios estimated on returns from 1871 to 1985. Fama and French (1987a) find reliable negative autocorrelation in tests on long-horizon returns for the

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1926–1985 period, but subperiod results suggest that the autocorrelation is largely due to the 1926–1940 period. Because sample sizes for long-horizon returns are small, however, it is impossible to make reliable inferences about changes in their time-series properties.

We use dividend/price ratios (D/P), henceforth called dividend yields, to forecast returns on the value- and equal-weighted portfolios of New York Stock Exchange (NYSE) stocks for return horizons (holding periods) from one month to four years. Our tests confirm existing evidence that the predictable (expected) component of returns is a small fraction of short-horizon return variances. Regressions of returns on yields typically explain less than 5% of monthly or quarterly return variances. More interesting, our results add statistical power to the evidence that the predictable component of returns is a larger fraction of the variation of long-horizon returns. Regressions of returns on D/P often explain more than 25% of the variances of two- to four-year returns. In contrast to the univariate tests of Fama and French (1987a) and Poterba and Summers (1987), regressions of returns on yields provide reliable evidence of forecast power for subperiods as well as for the 1927–1986 sample period.

The hypothesis that D/P forecasts returns has a long tradition among practitioners and academics [for example, Dow (1920) and Ball (1978)]. The intuition of the 'efficient markets' version of the hypothesis is that stock prices are low relative to dividends when discount rates and expected returns are high, and vice versa, so that D/P varies with expected returns. There is also evidence, primarily for annual returns, that supports the hypothesis. See, for example, Rozeff (1984), Shiller (1984), Flood, Hodrick, and Kaplan (1986), and Campbell and Shiller (1987). Thus, neither the hypothesis nor the evidence that D/P forecasts returns is new. What we offer are (a) evidence that forecast power increases with the return horizon, (b) an economic story to explain this result, and (c) evidence consistent with the explanation.

Part of the story for why the predictable component of returns becomes more important for longer return horizons is easy to document. If expected returns have strong positive autocorrelation, rational forecasts of one-year returns one to four years ahead are highly correlated. As a consequence, the variance of expected returns grows faster with the return horizon than the variance of unexpected returns – the variation of expected returns becomes a larger fraction of the variation of returns. Our results, like those of others, indicate that expected returns are highly autocorrelated.

The second part of the story for forecast power that increases with the return horizon is more interesting. It starts from the observation that residual variances for regressions of returns on yields (the unexpected returns estimated from the regressions) increase less than in proportion to the return horizon. Our explanation centers on what we call the discount-rate effect, that is, the offsetting adjustment of current prices triggered by shocks to discount rates and expected returns. We find that estimated shocks to expected returns

are indeed associated with opposite shocks to prices. The cumulative price effect of these shocks is roughly zero; on average, the expected future price increases implied by higher expected returns are offset by the immediate decline in the current price.

These results are consistent with models [for example, Summers (1986)] in which time-varying expected returns generate mean-reverting components of prices. The interesting economic question, motivated but unresolved by our results, is whether the predictability of returns implied by such temporary price components is driven by rational economic behavior (the investment opportunities of firms and the tastes of investors for current versus risky future consumption) – or by animal spirits.

2. Dividend yields

Consider a discrete-time perfect-certainty model in which $D(t)$, the dividend per share for the time period from $t-1$ to t, grows at the constant rate g, and the market interest rate that relates the stream of future dividends to the stock price $P(t-1)$ at time $t-1$ is the constant r. In this model, the price $P(t-1)$ is

$$P(t-1) = \frac{D(t)}{1+r}\left(1 + \frac{1+g}{1+r} + \frac{(1+g)^2}{(1+r)^2} + \cdots\right) = \frac{D(t)}{r-g}. \tag{1}$$

The dividend yield is the interest rate less the dividend growth rate,

$$\frac{D(t)}{P(t-1)} = r - g. \tag{2}$$

In the certainty model, the interest rate r is the discount rate for dividends and the period-by-period return on the stock. The transition from certainty to a model that (a) accommodates uncertain future dividends and discount rates and (b) shows the correspondence between discount rates and time-varying expected returns is difficult. See Campbell and Shiller (1987) and Poterba and Summers (1987). The direct relation between the dividend yield and the interest rate in the certainty model (2) suffices, however, to illustrate that yields are likely to capture variation in expected returns.

3. Variables for the basic regressions

3.1. Returns and dividend yields

Fama and French (1987a) find that the predictability of long-horizon returns implied by negative autocorrelation is stronger for portfolios of small firms. They also find that the return behavior of large- and small-firm portfolios

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is typified by the value- and equal-weighted portfolios of NYSE stocks constructed by the Center for Research in Security Prices (CRSP). Our tests use continuously compounded returns $r(t, t+T)$ on the two market portfolios for return horizons T of one month, one quarter, and one to four years. The monthly, quarterly, and annual returns are nonoverlapping. The two- to four-year returns are overlapping annual (end-of-year) observations. The sample period for the returns is 1927–1986.

The tests center on regressions of the future return, $r(t, t+T)$, on two measures of the time t dividend yield, $Y(t)$,

$$r(t, t+T) = \alpha(T) + \beta(T)Y(t) + \varepsilon(t, t+T). \tag{3}$$

The yields are constructed from returns, with and without dividends, provided by CRSP. Consider a one-dollar investment in either the value- or equal-weighted market portfolio at the end of December 1925. If dividends are not reinvested, the value of the portfolio at the end of the month m is

$$P(m) = \exp[r_0(1) + r_0(2) + r_0(3) + \cdots + r_0(m)], \tag{4}$$

where $r_0(m)$ is the continuously compounded without-dividend return for month m. If the continuously compounded with-dividend return is $r(m)$, the dividend on the portfolio in month m is

$$D(m) = P(m-1)\exp[r(m)] - P(m). \tag{5}$$

Two dividend yields, $D(t)/P(t-1)$ and $D(t)/P(t)$, are computed by summing the monthly dividends, from (5), for the year preceding time t and dividing by the value of the portfolio at the beginning or end of the year, from (4). We use annual yields to avoid seasonal differences in dividend payments. The annual yields are used in the estimates of (3) for all return horizons.

3.2. *Estimation problems and the definition of the yield*

The certainty model (2) shows that the dividend yield is a noisy proxy for expected returns because it also reflects expected dividend growth. Variation in the dividend yield, $Y(t)$, due to changes in the expected growth of dividends can cloud the information in the yield about time-varying expected returns. More generally, any variation in $Y(t)$ that is unrelated to variation in the time t expected return, $E_t r(t, t+T)$, is noise that tends to cause the regression of $r(t, t+T)$ on $Y(t)$ to miss some of the variation in expected returns – it shows up in the regression residuals.

On the other hand, when expected returns vary through time, the discount-rate effect tends to cause estimates of (3) to overstate the variation of expected

returns. Suppose an expected return shock at t increases discount rates. If the discount-rate increases are not offset by increases in expected dividends, the expected return shock causes an unexpected decline in $P(t)$. If dividend yields forecast returns, the expected return shock also causes an unexpected increase in $Y(t)$. Thus, because of the discount-rate effect, expected return shocks produce a negative correlation between unexpected returns and contemporaneous yield shocks that tends to produce upward biased slopes in regressions of returns on yields. [See Stambaugh (1986)]. This bias arises only when yields track time-varying expected returns. It does not bias the tests toward false conclusions that yields have forecast power.

Upward bias of the estimated slope in (3) due to the discount-rate effect and downward bias due to variation in $Y(t)$ unrelated to $E_t r(t, t+T)$ can arise for any definition of the yield. Other problems in estimating (3) are specific to the definition of $Y(t)$ as $D(t)/P(t)$ or $D(t)/P(t-1)$. For example, because we would like a yield with up-to-date but known information about expected returns for periods forward from t, $D(t)/P(t)$ is a natural choice. Because stock prices are forward-looking, however, $D(t)$ is old relative to the dividend forecasts in $P(t)$. Good news about future dividends produces a high price $P(t)$ relative to the current dividend $D(t)$ and a low dividend yield $D(t)/P(t)$. Good news about dividends also produces a high return $r(t-T, t)$. The result is a negative correlation between the disturbance $\varepsilon(t-T, t)$ and the time t shock to $D(t)/P(t)$ that again tends to produce upward-baised slopes in regressions of $r(t, t+T)$ on $D(t)/P(t)$.

Table 1 shows that the cross-correlations between one-year stock returns and dividend changes more than a year ahead are close to 0.0. These results suggest that stock prices do not forecast dividend charges more than a year ahead. Thus, variation in the dividend yield due to a denominator price that looks beyond the dividend in the numerator is substantially reduced when $Y(t)$ is defined as $D(t)/P(t-1)$, where $P(t-1)$ is the price at the beginning of the year covered by $D(t)$. If stock prices do not forecast dividend changes more than a year ahead, the dividend forecasts in $P(t-1)$ will not produce variation in $D(t)/P(t-1)$, and they will not produce upward-biased slopes in regressions of $r(t, t+T)$ on $D(t)/P(t-1)$.

Confident conclusions that $D(t)/P(t)$ or $D(t)/P(t-1)$ produces regressions that overstate or understate the variation of expected returns can not be made on *a priori* grounds. $D(t)/P(t-1)$ is more conservative. Any upward bias in the slopes it produces occurs only when expected returns vary through time (the discount-rate effect). Thus, regressions that use $D(t)/P(t-1)$ are more likely to avoid a false positive conclusion that yields track expected returns. They are, however, also more likely to be too conservative. The deviation of $D(t)$ from its expected value at $t-1$ is noise that tends to cause regressions of $r(t, t+T)$ on $D(t)/P(t-1)$ to understate the variation of expected returns. Moreover, because $P(t-1)$ can only reflect information

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Table 1

Cross-correlations between one-year continuously-compounded returns and current and future one-year changes in the log of annual dividends for the CRSP value-weighted and equal-weighted NYSE portfolios.

$$\mathrm{Cor}[r(t-1,t), \ln D(t+i) - \ln D(t+i-1)]$$

Period	Lead i					$s(0)$[a]
	0	1	2	3	4	
	Value-weighted nominal returns					
1927–1986	0.10	0.68	0.22	0.03	−0.16	0.13
1927–1956	0.13	0.78	0.26	0.08	−0.18	0.18
1957–1986	−0.09	0.37	0.05	−0.29	−0.10	0.18
1941–1986	−0.12	0.26	0.00	−0.16	−0.05	0.15
	Equal-weighted nominal returns					
1927–1986	0.17	0.72	0.21	0.04	−0.20	0.13
1927–1956	0.19	0.80	0.23	0.08	−0.22	0.18
1957–1986	0.09	0.46	0.13	−0.11	−0.10	0.18
1941–1986	0.03	0.46	0.11	−0.01	−0.12	0.15

[a] $s(0)$ is the asymptotic standard error of the contemporaneous cross-correlation, that is, $n^{-0.5}$, where n is the sample size. Real returns produce correlations similar to those shown for nominal returns.

about expected returns available at $t-1$, $D(t)/P(t-1)$ is about a year out of date with respect to expected returns measured forward from t. If current shocks have a decaying effect on expected returns, using an 'old' yield to track expected returns is likely to understate the variation of expected returns. We present results for the more timely measure, $D(t)/P(t)$, as well as for $D(t)/P(t-1)$.

4. Summary statistics

Table 2 shows summary statistics for one-year nominal and real returns on the value- and equal-weighted portfolios. Standard deviations of returns are about 50% higher during the 1927–1956 period than during the 1957–1986 period. As in Blume (1968), the high variability of returns for 1927–1956 is largely due to the 1927–1940 period. The standard deviations of returns are similar for 1957–1986 and 1941–1986. We shall find that the regression results are also similar for these periods.

Like stock returns, dividend changes are more variable toward the beginning of the sample. The standard deviations of year-to-year changes in the logs of annual dividends on the value- and equal-weighted portfolios for 1957–1986 are about 25% of those for 1927–1956. Dividend variability declines relative to that of returns. During the 1927–1956 period, dividend changes are almost as

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Table 2

Summary statistics for one-year nominal and real returns, dividend yields, and changes in the logs of annual dividends for the CRSP value-weighted and equal-weighted NYSE portfolios.[a]

Period	Mean	S.D.	Autocorrelations 1	2	3	4	5	Mean	S.D.	Autocorrelations 1	2	3	4	5
			Value-weighted nominal returns							Equal-weighted nominal returns				
1927–1986	0.092	0.206	0.10	−0.20	−0.07	−0.15	−0.02	0.125	0.280	0.13	−0.18	−0.14	−0.23	−0.11
1927–1956	0.088	0.244	0.21	−0.10	−0.18	−0.44	−0.03	0.124	0.336	0.19	−0.11	−0.23	−0.51	−0.12
1957–1986	0.096	0.163	−0.16	−0.39	0.19	0.30	0.06	0.125	0.216	−0.04	−0.36	0.13	0.26	−0.07
1941–1986	0.112	0.155	−0.08	−0.33	0.03	0.27	0.10	0.143	0.210	0.04	−0.28	−0.07	0.17	−0.01
			Value-weighted real returns							Equal-weighted real returns				
1927–1986	0.062	0.208	0.04	−0.24	−0.08	−0.09	0.05	0.094	0.282	0.08	−0.22	−0.15	−0.19	−0.04
1927–1956	0.074	0.239	0.11	−0.17	−0.22	−0.40	0.06	0.109	0.334	0.13	−0.15	−0.26	−0.47	−0.04
1957–1986	0.050	0.174	−0.10	−0.38	0.18	0.29	0.06	0.079	0.224	−0.03	−0.39	0.11	0.26	−0.05
1941–1986	0.068	0.173	−0.01	−0.29	−0.01	0.24	0.16	0.099	0.223	0.04	−0.31	−0.12	0.15	0.05
			Value-weighted $\ln D(t+1) - \ln D(t)$							Equal-weighted $\ln D(t+1) - \ln D(t)$				
1927–1986	0.041	0.133	0.30	−0.10	−0.17	−0.20	−0.00	0.079	0.220	0.31	−0.15	−0.16	−0.28	−0.20
1927–1956	0.028	0.184	0.28	−0.13	−0.21	−0.23	−0.00	0.083	0.304	0.30	−0.18	−0.17	−0.30	−0.21
1957–1986	0.055	0.041	0.54	0.30	0.22	0.08	−0.19	0.075	0.077	0.55	0.37	0.12	−0.09	−0.22
1941–1986	0.058	0.058	0.25	0.10	0.11	−0.21	−0.34	0.089	0.087	0.33	0.21	0.14	0.12	0.02
			Value-weighted $D(t)/P(t-1)$							Equal-weighted $D(t)/P(t-1)$				
1926–1985	0.047	0.012	0.81	0.59	0.48	0.44	0.39	0.044	0.013	0.78	0.51	0.36	0.30	0.28
1926–1955	0.053	0.009	0.64	0.18	−0.14	−0.25	−0.10	0.048	0.015	0.79	0.50	0.26	0.18	0.28
1956–1985	0.040	0.010	0.79	0.65	0.64	0.58	0.41	0.040	0.010	0.65	0.34	0.32	0.30	0.10
1940–1985	0.046	0.013	0.84	0.67	0.57	0.50	0.41	0.046	0.014	0.78	0.51	0.39	0.40	0.38

[a]The one-year value- and equal-weighted portfolio returns are continuously compounded. Real returns are calculated by summing the differences between monthly continuously compounded nominal returns and the one-month inflation rate, calculated from the U.S. Consumer Price Index (CPI). $D(t)/P(t-1)$ is the ratio of dividends for year t to the value of the portfolio at the end of year $t-1$. The time periods for $D(t)/P(t-1)$ are those for $D(t)$. The periods for $D(t)/P(t-1)$ match the periods to be used in the regressions of one-year returns on the yields. For example, the returns for 1927–1986 are regressed on the yields for 1926–1985.

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variable as returns. After 1940 returns are more than 2.4 times as variable as dividend changes.

Dividend variability also declines relative to the variability of earnings. For the 1927–1956 period, the standard deviation of annual changes in the log of annual earnings on the Standard and Poor's (S&P) Composite Index (0.259) is about 43% greater than that of changes in annual Index dividends (0.181). For 1957–1986, the standard deviation of changes in earnings (0.113) is more than three times that of dividend changes (0.037).

The estimated speed of adjustment of dividends to target dividends in Lintner's (1956) dividend model also declines over the sample period. Lintner postulates that a firm's target dividend $D^*(t)$ for year t is a constant fraction of earnings $E(t)$,

$$D^*(t) = kE(t). \tag{6}$$

The change in the actual dividends from $t-1$ to t is assumed to follow a partial adjustment model,

$$D(t) - D(t-1) = a + s\left[D^*(t) - D(t-1)\right] + u(t). \tag{7}$$

When this model is fitted to the annual S&P earnings and dividends, the estimated speed of adjustment s drops from 49% per year for 1927–1956 to 12% per year for 1941–1986, and 11% for 1957–1986.

In short, the data suggest systematic changes in the dividend policies of firms (toward dividends that are smoother relative to earnings) during the sample period. For our purposes, changes in dividend policy are important because they can produce variation in yields that obscures information about expected returns or causes the relation between the yield and expected returns to change through time.

Finally, table 2 shows summary statistics for end-of-year observations on the yield $D(t)/P(t-1)$, the explanatory variable in regressions of $r(t, t+T)$ on $D(t)/P(t-1)$ for one- to four-year returns. The first-order autocorrelations of $D(t)/P(t-1)$ are large, but the autocorrelations decay across longer lags. If yields track expected returns, high first-order autocorrelation implies persistence in expected returns. The decay of the autocorrelations across longer lags then suggests the appealing conclusion that, though highly autocorrelated, expected returns have a mean-reverting tendency.

5. Regressions for nominal and real returns

The change in return variability around 1940 suggests that a weighted least squares (WLS) approach that deflates the observations by estimates of return variability will produce more efficient estimates of regressions of returns on

dividend yields. Some of our more interesting analysis, however, involves explaining why the expected return variation tracked by yields is a larger fraction of the variation of returns for longer return horizons. WLS estimates would complicate the analysis by changing the meaning of what is being explained. Thus the text uses ordinary least squares (OLS) estimates. WLS regressions produce slopes that are similar to OLS slopes, however, and so produce similar estimates of the variation in expected returns. In fact, for periods that overlap the shift in return variances around 1940 (for example, 1927–1986 and 1927–1956), WLS estimates actually give a stronger view of the statistical reliability of return forecasts from yields. The WLS estimates are available on request.

Tables 3 and 4 summarize the OLS regressions of the value- and equal-weighted portfolio returns, $r(t, t+T)$, on their *ex ante* yields, $D(t)/P(t-1)$ and $D(t)/P(t)$. Because the regressions are the central evidence on the variation of expected returns, the results are shown in some detail. Each table splits the 1927–1986 sample into 30-year periods (1927–1956 and 1957–1986). Results for the 1941–1986 period of roughly constant return variances are also shown. Estimates of regression slopes and their t-statistics for 1946–1986 and 1936–1986 (not shown) are close to those for 1941–1986. Finally, to illustrate that the results are similar for different definitions of returns, regressions for nominal and real returns are shown.

5.1. Nominal returns

All the regression slopes in tables 3 and 4 are positive. For value-weighted nominal returns, regressions that use the less timely $D(t)/P(t-1)$ as the explanatory variable produce only one slope less than 1.8 standard errors from 0.0. Slopes for value-weighted nominal returns more than 2.0 standard errors from 0.0 are the rule, and slopes more than 2.5 standard errors from 0.0 are common. For 1941–1986, the longest period of roughly constant return variances, all the slopes for value-weighted nominal returns are more than 2.4 standard errors from 0.0.

Except for the 1927–1956 period, the regressions of equal-weighted nominal returns on $D(t)/P(t-1)$ are also strong evidence that expected returns vary through time. For the 1927–1986 sample period and the 1941–1986 and 1957–1986 subperiods, the regression slopes for equal-weighted nominal returns are typically more than 2.0 standard errors from 0.0. Moreover, the weak results for equal-weighted returns for 1927–1956 are a consequence of the high variability of returns in the early years of the sample. The slopes for 1927–1956 are similar to those for the 1941–1986 period of lower return variances, and the 1941–1986 slopes are all more than 2.6 standard errors from 0.0.

Regressions that use the more timely $D(t)/P(t)$ to explain nominal returns also produce strong evidence of forecast power for the 1927–1986 period and

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Table 3

Regressions of nominal and real CRSP value-weighted NYSE portfolio returns on dividend yields.[a]

$$r(t, t+T) = a + bY(t) + e(t, t+T)$$

Return horizon		Nominal returns								Real returns							
		$Y(t) = D(t)/P(t-1)$				$Y(t) = D(t)/P(t)$				$Y(t) = D(t)/P(t-1)$				$Y(t) = D(t)/P(t)$			
T	N	b	$t(b)$	R^2	$s(e)$	b	$t(b)$	R^2	$s(e)$	b	$t(b)$	R^2	$s(e)$	b	$t(b)$	R^2	$s(e)$
								1927–1986									
M	720	0.53	2.99	0.01	0.06	0.21	1.40	0.00	0.06	0.49	2.76	0.01	0.06	0.28	1.83	0.00	0.06
Q	240	1.12	1.87	0.01	0.11	1.07	2.10	0.01	0.11	1.04	1.71	0.01	0.11	1.26	2.48	0.02	0.11
1	60	5.37	2.40	0.07	0.20	2.47	1.27	0.01	0.20	5.32	2.35	0.07	0.20	3.35	1.72	0.03	0.20
2	59	9.10	2.18	0.10	0.29	7.38	2.04	0.09	0.29	9.08	2.31	0.11	0.28	8.77	2.59	0.15	0.28
3	58	11.56	2.14	0.13	0.33	9.94	2.21	0.13	0.33	11.73	2.51	0.15	0.31	11.53	2.93	0.21	0.30
4	57	12.68	1.93	0.13	0.37	12.86	2.43	0.19	0.36	13.44	2.46	0.17	0.33	14.43	3.25	0.29	0.31
								1927–1956									
M	360	0.93	2.77	0.02	0.07	0.17	0.69	−0.00	0.07	0.78	2.33	0.01	0.07	0.27	1.08	0.00	0.07
Q	120	1.79	1.55	0.01	0.14	1.16	1.41	0.01	0.14	1.38	1.20	0.00	0.14	1.42	1.75	0.02	0.13
1	30	11.04	2.49	0.15	0.22	1.50	0.46	−0.03	0.25	9.61	2.16	0.11	0.23	2.62	0.83	−0.01	0.24
2	29	22.49	2.88	0.28	0.33	8.92	1.49	0.07	0.37	19.43	2.65	0.23	0.32	10.16	1.89	0.13	0.34
3	28	29.24	2.86	0.33	0.39	15.27	2.21	0.18	0.43	24.73	2.74	0.29	0.36	15.94	2.73	0.26	0.36
4	27	28.16	2.25	0.24	0.46	20.86	3.14	0.30	0.44	23.00	2.21	0.22	0.40	20.39	3.70	0.40	0.35
								1957–1986									
M	360	0.53	2.31	0.01	0.04	0.68	2.66	0.02	0.04	0.42	1.79	0.01	0.04	0.51	1.95	0.01	0.04
Q	120	1.40	1.82	0.02	0.08	2.33	2.78	0.05	0.08	1.11	1.40	0.01	0.08	1.87	2.14	0.03	0.08
1	30	5.60	1.86	0.08	0.16	9.32	3.02	0.22	0.14	4.58	1.39	0.03	0.17	7.74	2.21	0.12	0.16
2	29	7.51	1.89	0.09	0.20	16.40	4.04	0.45	0.16	5.68	1.10	0.02	0.23	14.06	2.53	0.25	0.20
3	28	10.41	3.01	0.21	0.19	17.12	4.12	0.51	0.15	8.16	1.38	0.08	0.23	14.03	2.05	0.24	0.21
4	27	15.05	3.37	0.38	0.18	19.69	3.87	0.57	0.15	12.48	1.57	0.17	0.24	16.21	1.83	0.26	0.23
								1941–1986									
M	552	0.39	2.95	0.01	0.04	0.36	2.59	0.01	0.04	0.37	2.73	0.01	0.04	0.32	2.20	0.01	0.04
Q	184	1.07	2.47	0.03	0.08	1.20	2.64	0.03	0.08	1.04	2.28	0.02	0.08	1.07	2.23	0.02	0.08
1	46	4.46	2.62	0.12	0.15	5.09	2.88	0.14	0.14	4.40	2.29	0.09	0.17	4.82	2.38	0.09	0.16
2	45	7.15	3.04	0.17	0.19	10.34	4.18	0.35	0.17	7.21	2.36	0.13	0.23	10.26	3.15	0.25	0.21
3	44	9.42	4.77	0.29	0.19	12.94	5.68	0.51	0.15	9.66	2.91	0.21	0.24	13.10	3.53	0.36	0.21
4	43	12.75	5.49	0.49	0.17	15.35	5.62	0.64	0.14	13.34	3.18	0.36	0.23	15.71	3.31	0.45	0.22

[a] N is the number of observations. $P(t)$ is the time t price. $D(t)$ is the dividend for the year preceding t. $r(t, t+T)$ is the continuously compounded return from t to $t+T$. The regressions for T = one month (M), one quarter (Q), and one year use nonoverlapping returns. The regressions for two- to four-year returns use overlapping annual observations. The standard errors in the t-statistic $t(b)$ for the two- to four-year slopes are adjusted for the sample autocorrelation of overlapping residuals with the method of Hansen and Hodrick (1980). Regression slopes and t-statistics for 1946–1986 and 1936–1986 (not shown) are close to those for 1941–1986.

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Table 4

Regressions of nominal and real CRSP equal-weighted NYSE portfolio returns on dividend yields.[a]

$$r(t, t+T) = a + bY(t) + e(t, t+T)$$

Return horizon		Nominal returns								Real returns							
		$Y(t) = D(t)/P(t-1)$				$Y(t) = D(t)/P(t)$				$Y(t) = D(t)/P(t-1)$				$Y(t) = D(t)/P(t)$			
T	N	b	$t(b)$	R^2	$s(e)$	b	$t(b)$	R^2	$s(e)$	b	$t(b)$	R^2	$s(e)$	b	$t(b)$	R^2	$s(e)$
								1927–1986									
M	720	0.52	2.40	0.01	0.07	0.21	0.97	−0.00	0.07	0.45	2.10	0.00	0.07	0.24	1.15	0.00	0.08
Q	240	1.07	1.41	0.00	0.15	1.28	1.74	0.01	0.15	0.91	1.19	0.00	0.16	1.40	1.90	0.01	0.15
1	60	5.87	2.21	0.06	0.27	2.69	1.06	0.00	0.28	5.48	2.04	0.05	0.27	3.38	1.33	0.01	0.28
2	59	10.75	2.14	0.10	0.40	9.91	2.15	0.10	0.40	10.06	2.05	0.09	0.40	11.23	2.54	0.14	0.39
3	58	13.60	2.09	0.12	0.47	14.68	2.63	0.17	0.46	12.38	2.02	0.10	0.46	16.08	3.14	0.22	0.43
4	57	14.28	1.96	0.11	0.53	17.96	2.95	0.21	0.49	12.64	1.86	0.09	0.50	18.91	3.47	0.27	0.45
								1927–1956									
M	360	0.49	1.50	0.00	0.09	0.06	0.20	−0.00	0.09	0.38	1.18	0.00	0.09	0.10	0.34	−0.00	0.09
Q	120	0.85	0.73	−0.00	0.19	0.91	0.83	−0.00	0.19	0.56	0.48	−0.01	0.19	1.03	0.95	−0.00	0.19
1	30	5.14	1.25	0.02	0.33	0.38	0.10	−0.04	0.34	4.21	1.02	0.00	0.33	1.13	0.31	−0.03	0.34
2	29	11.97	1.45	0.09	0.50	7.86	1.11	0.03	0.52	10.18	1.28	0.06	0.49	8.97	1.35	0.05	0.49
3	28	16.05	1.44	0.11	0.61	14.92	1.73	0.13	0.61	12.92	1.23	0.07	0.59	15.65	2.00	0.17	0.56
4	27	13.92	1.11	0.05	0.71	19.35	2.03	0.19	0.65	9.58	0.84	0.01	0.66	18.93	2.23	0.22	0.59
								1957–1986									
M	360	0.87	2.76	0.02	0.05	0.99	2.80	0.02	0.05	0.76	2.37	0.01	0.05	0.82	2.30	0.01	0.05
Q	120	2.24	2.08	0.03	0.10	3.68	3.18	0.07	0.10	1.97	1.78	0.02	0.11	3.28	2.75	0.05	0.10
1	30	10.01	2.68	0.18	0.20	12.58	3.28	0.25	0.19	9.31	2.35	0.13	0.21	11.56	2.79	0.19	0.20
2	29	13.02	2.39	0.16	0.28	23.85	4.59	0.51	0.21	11.82	1.93	0.11	0.30	22.86	3.83	0.42	0.24
3	28	16.22	2.66	0.22	0.29	23.87	3.84	0.45	0.24	14.77	2.14	0.17	0.31	22.84	3.30	0.3[illegible]	0.26
4	27	21.99	3.01	0.35	0.30	25.98	3.39	0.42	0.28	20.26	2.47	0.28	0.32	24.85	3.00	0.3[illegible]	0.30
								1941–1986									
M	552	0.51	3.21	0.02	0.05	0.45	2.57	0.01	0.05	0.51	3.18	0.02	0.05	0.44	2.49	0.01	0.05
Q	184	1.42	2.64	0.03	0.10	1.64	2.78	0.04	0.10	1.47	2.64	0.03	0.10	1.63	2.67	0.03	0.10
1	46	6.75	3.35	0.19	0.19	7.05	3.15	0.17	0.19	6.99	3.24	0.17	0.20	7.27	3.03	0.15	0.21
2	45	10.38	3.15	0.22	0.27	14.64	4.02	0.37	0.24	10.89	3.07	0.21	0.29	15.51	4.00	0.36	0.26
3	44	11.90	2.94	0.23	0.30	17.71	4.02	0.43	0.26	12.37	2.96	0.22	0.32	18.99	4.25	0.45	0.27
4	43	13.68	2.76	0.26	0.32	19.00	3.60	0.43	0.28	14.19	2.90	0.27	0.33	20.50	3.97	0.47	0.28

[a]N is the number of observations. $P(t)$ is the time t price. $D(t)$ is the dividend for the year preceding t. $r(t, t+T)$ is the continuously compounded return from t to $t+T$. The regressions for T = one month (M), one quarter (Q), and one year use nonoverlapping returns. The regressions for two- to four-year returns use overlapping annual observations. The standard errors in the t-statistic $t(b)$ for the two- to four-year slopes are adjusted for the sample autocorrelation of overlapping residuals with the method of Hansen and Hodrick (1980). Regression slopes and t-statistics for 1946–1986 and 1936–1986 (not shown) are close to those for 1941–1986.

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especially for 1941–1986 and 1957–1986. For the two post-1940 periods, the slopes for $D(t)/P(t)$ are more than 2.5 standard errors from 0.0 for both market portfolios and for all return horizons. Slopes more than 4.0 standard errors from 0.0 are common.

5.2. Real returns

The slopes for real returns in tables 3 and 4 are typically close to those for nominal returns. Because the real and nominal regressions have the same explanatory variable, similar slopes indicate that variation in expected nominal returns translates into similar variation in expected real returns. If the market is efficient, the results indicate that dividend yields signal variation in equilibrium expected real returns.

Fama and French (1987b) show regressions of excess stock returns on dividend yields. Excess returns for horizons beyond a month are calculated by cumulating the differences between monthly nominal stock returns and the one-month U.S. Treasury bill rate. The results for excess returns are similar to those for real returns in tables 3 and 4. Thus the variation in expected real stock returns tracked by dividend yields is also present in the expected premiums of stock returns over one-month bill returns.

5.3. The behavior of the regression slopes

The slopes in the regressions of real or nominal returns $r(t, t+T)$ on $Y(t)$ increase with the return horizon T. When the explanatory variable is $D(t)/P(t-1)$, the increase in the slopes is roughly proportional to T for horizons to one year, but less than proportional to T for two- to four-year returns. For the more timely $D(t)/P(t)$ and for periods after 1940, the slopes increase roughly in proportion to T for return horizons to four years, but more slowly thereafter.

This behavior of the slopes has an appealing explanation. The slope in the regression of the T-period return $r(t, t+T)$ on $Y(t)$ is the sum of the slopes in the T regressions of the one-period returns, $r(t, t+1), \ldots, r(t+T-1, t+T)$, on $Y(t)$. Slopes in regressions of $r(t, t+T)$ on $Y(t)$ that increase in proportion to T for horizons of one or two years thus imply that variation in $Y(t)$ signals similar variation in one-period expected returns out to one or two years. Slopes that increase less than in proportion to T for longer return horizons suggest that $Y(t)$ signals less variation in more distant one-period expected returns. This behavior of the slopes suggests that expected returns are highly autocorrelated but slowly mean-reverting. The decay of the autocorrelations of $D(t)/P(t-1)$ in table 2 also suggests slow mean reversion.

5.4. Other tests

The intuition of the hypothesis that dividend yields forecast returns is that stock prices are low relative to dividends when discount rates and expected returns are high, and vice versa, so that yields capture variation in expected returns. There is a similar intuition for earnings/price ratios (E/P).

We have estimated regressions (available on request) of value- and equal-weighted NYSE returns, $r(t, t+T)$, on $E(t)/P(t-1)$ and $E(t)/P(t)$. $E(t)$ is earnings per share on the Standard and Poor's (S&P) Composite Index for calendar year t, as reported by S&P. $P(t)$ is the value of the index at the end of the year. In many ways the E/P results are similar to the D/P results. For example, the regression slopes and R^2 produced by E/P increase with the return horizon. The t's for the slopes suggest that E/P has reliable forecast power. E/P tends, however, to have less explanatory power than D/P.

Earnings are more variable than dividends. (See section 4). If this higher variability is unrelated to the variation in expected returns, E/P is a noisier measure of expected returns than D/P. This 'numerator noise' argument may also explain why the forecast power of dividend yields is higher in the periods after 1940, when the variability of dividends declines substantially relative to the variability of returns.

It would seem that a solution to problems caused by noise in the numerator of E/P or D/P is to use $1/P$ as the forecast variable. Miller and Scholes (1982) show that the cross-section of $1/P$ for common stocks helps explain the cross-section of expected returns. Suppose, however, that reinvestment of earnings causes stock prices to have an upward-drifting nonstationary component. Then $1/P$ is nonstationary (it tends to drift downward), and it is not a good variable for tracking expected returns in time-series tests. In fact, for the value- and equal-weighted NYSE portfolios, regressions (not shown) of $r(t, t+T)$ on $1/P(t)$, where $P(t)$ is the value of the portfolio at t produce slopes and R^2 close to 0.0.

6. Out-of-sample forecasts

The slopes in tables 3 and 4 are apparently strong evidence that yields signal variation in expected returns. Given the uncertainty about the bias of the slopes, however, further testing is in order. One approach is to use the regressions to forecast out-of-sample returns. We forecast returns for the 20-year period 1967–1986. Each forecast is from a regression of $r(t, t+T)$ on $Y(t)$ estimated with returns that begin and end in the preceding 30-year period. For example, to forecast the first one-year return (1967), we use coefficients estimated with the 30 one-year returns for 1937–1966. To forecast the first four-year return (1967–1970), we use coefficients estimated with the

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27 overlapping annual observations on the four-year returns that begin and end in the 1937–1966 period. For monthly and quarterly returns, the 30-year estimation period rolls forward in monthly or quarterly steps. For one- to four-year returns, the estimation period rolls forward in annual increments.

We start the estimation periods in 1937 because of the evidence that returns and yields behave differently during the first ten years of the sample. Because the overlap of annual observations on multiyear returns reduces effective sample sizes, we judge that estimation periods shorter than 30 years would not produce meaningful forecasts of two- to four-year returns. The 1937 starting date and the choice of 30-year estimation periods then limit the forecast period to 1967–1986. For this 20-year forecast period, there are only five nonoverlapping forecasts of four-year returns.

6.1. Perspective

With respect to possible bias of the regression slopes, the out-of-sample tests are conservative. They correct for bias that causes the in-sample slopes to overstate the variation of expected returns, but they leave the estimation problems that cause the regressions to understate the variation of expected returns.

Thus, section 3 argues that negative correlation between shocks to returns and yields (because of the discount-rate effect or because yields and returns respond to dividend forecasts) produces positive bias in the slope estimates for dividend yields, with possibly more bias in the slopes for $D(t)/P(t)$ than in the slopes for $D(t)/P(t-1)$. The bias means that in-sample R^2 tend to overstate explanatory power. The bias decreases out-of-sample forecast power, however, so out-of-sample tests are appropriately punitive.

On the other hand, yields contain noise (variation unrelated to expected returns) that tends to cause estimates of (3) to understate the variation of expected returns. Since the noise reduces both in-sample and out-of-sample forecast power, out-of-sample tests do not correct for this source of error. Likewise, if regressions of $r(t, t+T)$ on the less timely $D(t)/P(t-1)$ understate the variation of expected returns, the understatement remains in out-of-sample forecasts.

6.2. Results

Table 5 summarizes the mean squared errors (MSE) of the out-of-sample forecasts. To compare the forecasts with the in-sample fit of the regressions, the MSE are reported as R^2. Specifically, the MSE R^2 in table 5 is $1 - (\mathrm{MSE}/s^2[r(t, t+T)])$, where $s^2[r(t, t+T)]$ is the out-of-sample variance of the forecasted return. The out-of-sample forecasts cover 1967–1986. The

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Table 5

Mean squared error R^2 for out-of-sample forecasts for NYSE portfolio returns for 1967–1986 and R^2 for in-sample forecasts for 1957–1986.[a]

Return horizon T	$D(t)/P(t-1)$ Out	$D(t)/P(t-1)$ In	$D(t)/P(t)$ Out	$D(t)/P(t)$ In	$D(t)/P(t-1)$ Out	$D(t)/P(t-1)$ In	$D(t)/P(t)$ Out	$D(t)/P(t)$ In
	Value-weighted nominal returns				Value-weighted real returns			
M	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.01
Q	0.03	0.02	0.06	0.05	0.01	0.01	0.03	0.03
1	0.13	0.08	0.[illegible]	0.22	0.07	0.03	0.13	0.12
2	0.20	0.09	0.43	0.45	0.05	0.02	0.22	0.25
3	0.24	0.21	0.48	0.51	−0.18	0.08	0.00	0.24
4	0.35	0.38	0.50	0.57	−0.38	0.17	−0.26	0.26
	Equal-weighted nominal returns				Equal-weighted real returns			
M	0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.01
Q	0.02	0.03	0.04	0.07	0.02	0.02	0.04	0.05
1	0.17	0.18	0.16	0.25	0.17	0.13	0.15	0.19
2	0.18	0.16	0.34	0.51	0.18	0.11	0.35	0.42
3	0.16	0.22	0.35	0.45	0.10	0.17	0.36	0.38
4	0.23	0.35	0.36	0.42	0.09	0.28	0.36	0.37

[a]The out-of-sample (Out) mean squared error R^2 is $1-(\mathrm{MSE}/s^2[r(t,t+T)])$. Each out-of-sample forecast is made with coefficients estimated using the previous 30 years of returns and yields. Monthly (M), quarterly (Q), and one-year forecasts are for nonoverlapping periods. The two- to four-year forecasts are overlapping annual observations. The in-sample regressions are in tables 3 and 4.

in-sample R^2 for 1957–1986, the most comparable period in tables 3 and 4, are also shown in table 5.

For horizons out to two years, the MSE R^2 for the 1967–1986 out-of-sample return forecasts from $D(t)/P(t-1)$ and $D(t)/P(t)$ are close to the in-sample R^2 for 1957–1986. The signs of the differences between the in-sample R^2 and the out-of-sample MSE R^2 are random. The MSE R^2 for forecasts of three- and four-year value-weighted nominal returns from $D(t)/P(t-1)$ are also similar to the in-sample R^2. Otherwise, the MSE R^2 produced by $D(t)/P(t-1)$ deteriorate relative to the in-sample R^2 in three- and four-year forecasts. (The obvious worst cases are the negative MSE R^2 for forecasts of value-weighted three- and four-year real returns.) The results for longer return horizons are less reliable, however, because they involve fewer independent returns during the 20-year forecast period. The uniform similarity of in- and out-of-sample forecast power for horizons to two years suggests that regressions of $r(t,t+T)$ on either $D(t)/P(t-1)$ or $D(t)/P(t)$ do not produce strongly biased slopes and thus biased estimates of explanatory power.

The out-of-sample forecasts do not confirm that $D(t)/P(t)$ slopes are more biased than $D(t)/P(t-1)$ slopes. The out-of-sample forecast power of

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$D(t)/P(t)$ actually matches in-sample explanatory power better than $D(t)/P(t-1)$. Only the out-of-sample MSE R^2 for forecasts of three- and four-year value-weighted real returns from $D(t)/P(t)$ are much less than the in-sample R^2. Thus there is no evidence in the out-of-sample tests that slope estimates for the more timely $D(t)/P(t)$ exaggerate the variation in expected returns.

On the other hand, like the in-sample R^2, the MSE R^2 for out-of-sample forecasts from $D(t)/P(t)$ are higher, often much higher, than those for forecasts from $D(t)/P(t-1)$. For example, the MSE R^2 for forecasts of two- to four-year returns from $D(t)/P(t)$ commonly exceed 0.35, while those for forecasts from $D(t)/P(t-1)$ are typically less than 0.20. The out-of-sample forecasts thus confirm that using the less timely $D(t)/P(t-1)$ to avoid false positive conclusions about forecast power produces regressions that understate the variation of expected returns.

7. Why does forecast power increase with the return horizon?

The out-of-sample MSE R^2 tend to confirm the more extensive evidence from the in-sample R^2 in tables 3 and 4 that the explanatory power of the regressions increases with the return horizon. The in-sample R^2 in tables 3 and 4 and the out-of-sample MSE R^2 in table 5 are 0.07 or less for monthly and quarterly returns, but they are often greater than 0.25 for two- to four-year returns. That the same yields capture more return variance for longer forecast horizons is an interesting and challenging result.

Algebraically, the regression R^2 increase with the return horizon because the variance of the fitted values grows more quickly than the horizon, whereas the variance of the residuals generally grows less quickly than the horizon. Our goal is to explain why.

7.1. *The regression fitted values and residuals*

In the regressions of returns on dividend yields, the explanatory variable is the same for all return horizons. Thus, as return horizon increases, the variance of the fitted values grows in proportion to the square of the regression slopes. The slopes in tables 3 and 4 increase roughly in proportion to the return horizon out to one or two years, and then more slowly. As noted earlier, this behavior suggests that short-horizon expected returns are autocorrelated but slowly mean-reverting. The persistence of short-horizon expected returns implied by slow mean reversion causes the variances of multiperiod expected returns to grow more than in proportion to the return horizon.

On the other hand, tables 3 and 4 show that for periods after 1940, the residual variances in regressions of $r(t, t+T)$ on $Y(t)$ grow less than in proportion to the return horizon, at least for one- to four-year returns. For

Table 6

Correlations of residuals from regressions of one-year real CRSP value- and equal-weighted NYSE returns on the dividend yield $D(t)/P(t-1)$.[a]

$$r(t+i-1, t+i) = a + bD(t)/P(t-1) + e(t+i-1, t+i)$$

$$\mathrm{Cor}[e(t+i-1, t+i), e(t+j-1, t+j)], \quad i = 2,3,4, \quad j = 1,2,3$$

Lead i	Value-weighted returns Lead j 1	2	3	Equal-weighted returns Lead j 1	2	3
			1927–1986			
2	−0.05			−0.00		
3	−0.30	−0.05		−0.29	−0.00	
4	−0.14	−0.31	0.1	−0.20	−0.26	0.09
			1941–1986			
2	−0.15			−0.18		
3	−0.39	−0.09		−0.43	−0.00	
4	−0.08	−0.39	−0.05	−0.17	−0.35	0.02

[a]The residuals are from regressions that use $D(t)/P(t-1)$ to forecast one-year returns one, two, three, and four years ahead.

$\mathrm{Cor}[e(t+i-1, t+i), e(t+j-1, t+j)]$ is the correlation between the residual for the regression forecast of the one-year return i years ahead and the residual for the regression forecast of the one-year return j years ahead.

The correlations for nominal returns and for the other subperiods in tables 3 and 4 are similar to those shown. Using $D(t)/P(t)$ as the forecast variable produces similar results.

example, the residual standard errors for four-year returns never come close to twice the one-year standard errors. The residual in the regression of the multiyear return $r(t, t+T)$ on $Y(t)$ is the sum of the residuals from regressions of the one-year returns, $r(t, t+1), \ldots, r(t+T-1, t+T)$, on $Y(t)$. If multiyear residual variances grow less than in proportion to the return horizon, the correlations of the residuals from the one-year regressions must on average be negative. The negative correlation is documented in table 6. It has an economic explanation that, along with the persistence of expected returns, completes the story for the predictability of long-horizon returns.

7.2. *Stock prices and expected return shocks*

Suppose there is a shock at $t+1$ that increases expected returns. Since the shock occurs after the yield $Y(t)$ is set, fitted values from regressions of $r(t+1, t+2), \ldots, r(t+T-1, t+T)$ on $Y(t)$ will tend to underestimate returns after $t+1$, and the residuals will tend to be positive. On the other hand, if expected return shocks generate opposite unexpected changes in prices (the discount-rate effect), the positive shock to expected returns at $t+1$ will tend to produce a negative residual in the regression of the one-year return

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$r(t, t+1)$ on $Y(t)$. Thus, because of the discount-rate effect, the residual from the regression of $r(t, t+1)$ on $Y(t)$ is negatively correlated with the residuals from regressions of $r(t+1, t+2), \ldots, r(t+T-1, t+T)$ on $Y(t)$. A similar argument implies that the residuals from the regression of $r(t+k-1, t+k)$ on $Y(t)$ tend to be negatively correlated with the residuals from regressions of one-year returns after $t+k$ on $Y(t)$.

The next section presents further tests for the discount-rate effect, based on estimates of the relation between contemporaneous return and dividend yield shocks.

8. Yields and temporary components of stock prices

8.1. Yield shocks, price shocks, and future expected returns

Table 1 suggests that one-year returns are uncorrelated with dividend changes more than one year ahead. This suggests that $D(t+1)$ is an unbiased (but noisy) measure of the information in $P(t)$ about future dividends, so that $D(t+1)/P(t)$ is relatively free of variation due to dividend forecasts. Thus, the unexpected component of $D(t+1)/P(t)$ can be interpreted as a (noisy) measure of the shock to expected returns at t.

Preliminary tests (not shown) indicated that the highly autocorrelated yields on the value- and equal-weighted portfolios are approximated well by first-order autoregressions (AR1s), with AR1 parameters close to the first-order autocorrelations in table 2. We use residuals from AR1s estimated on end-of-year yields to measure yield shocks,

$$D(t+1)/P(t) = \alpha + \phi D(t)/P(t-1) + v(t-1, t). \tag{8}$$

We use the yield shock $v(t-1, t)$ as a proxy for the expected return shock from $t-1$ to t.

The discount-rate effect implies a negative relation between expected return shocks and contemporaneous returns; an unexpected increase in expected returns drives the current price down. We measure this relation with the slope δ in the regression of $r(t-1, t)$ on $v(t-1, t)$,

$$r(t-1, t) + \gamma + \delta v(t-1, t) + u(t-1, t). \tag{9}$$

We interpret δ as the response of $P(t)$ per unit of the time t yield shock. The slope $\beta(T)$ in the regression of $r(t, t+T)$ on $D(t)/P(t-1)$ then measures the T-period expected future price change due to the changes in expected returns implied by a yield shock. Comparing estimates of δ and $\beta(T)$ allows us to judge the relative magnitudes of the current and expected future price responses to yield shocks. The logic of this approach is that we want estimates of $\beta(T)$ for a long return horizon (we use $T = 4$ years), since the autocorrelation of expected returns implies that a yield shock has a slowly decaying effect on one-period expected future price changes.

Table 7

Tests for a discount-rate effect in stock returns.

Comparisons of the relation between contemporaneous real returns and dividend yield shocks (δ) and the relation between future returns and current dividend yields (b).[a]

$$D(t+1)/P(t) = \alpha + \phi D(t)/P(t-1) + v(t-1,t)$$

$$r(t-1,t) = \gamma + \delta v(t-1,t) + u(t-1,t)$$

$$r(t,t+4) = a + bY(t) + e(t,t+4)$$

			$Y(t) = D(t)/P(t-1)$		$Y(t) = D(t)/P(t)$	
Period	δ	$s(\delta)$	$b(4)$	$s[b(4)]$	$b(4)$	$s[b(4)]$
			Value-weighted real returns			
1927–1986	−22.27	2.71	13.44	5.47	14.43	4.44
1927–1956	−20.42	4.69	23.00	10.40	20.39	5.51
1957–1986	−25.72	2.44	12.48	7.94	16.21	8.88
1941–1986	−20.10	2.15	13.34	4.19	15.71	4.75
			Equal-weighted real returns			
1927–1986	−20.42	3.48	12.64	6.81	18.91	5.45
1927–1956	−17.80	5.95	9.58	11.45	18.93	8.47
1957–1986	−24.73	3.17	20.26	8.22	24.85	8.29
1941–1986	−20.37	2.23	14.19	4.90	20.50	5.16

[a]δ, the contemporaneous response of the return $r(t-1,t)$ to the yield shock $v(t-1,t)$ is estimated with regressions of annual observations on one-year returns on the residuals from a first-order autoregression for the yield. The estimates of $b(4)$, interpreted as the response of future one-year returns to a current yield shock, are from tables 3 and 4. $s(\delta)$ and $s[b(4)]$ are standard errors. The results for nominal returns are similar.

Estimates of δ in (9) must be interpreted cautiously. The lack of correlation between returns and dividend changes more than a year ahead suggests that $D(t+1)/P(t)$ is relatively free of variation due to dividend forecasts. But this does not mean that all variation in $D(t+1)/P(t)$ is due to expected returns. Moreover, whatever its source, variation in $P(t)$ that results in variation in $D(t+1)/P(t)$ tends to produce a negative correlation between $r(t-1,t)$ and the yield shock $v(t-1,t)$. Thus negative estimates of δ are not per se evidence of a discount-rate effect. To infer that negative estimates of δ reflect offsetting changes in current prices related to changes in expected future returns, we need the complementary evidence from estimates of $\beta(T)$ that yields track expected returns so that yield shocks imply expected future price changes of the same sign.

8.2. The estimates

Table 7 shows estimates of δ for real returns on the NYSE value- and equal-weighted portfolios. The estimates are always negative, less than −17.0, and more than 2.9 standard errors from 0.0. Table 7 also shows estimates of

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$\beta(T)$ for $T = 4$ years. Despite large standard errors, the estimates are usually more than 2.0 standard errors above 0.0. We conclude from the estimates of δ and $\beta(4)$ that dividend yield shocks are associated with (a) contemporaneous price changes of the opposite sign and (b) expected future price changes of the same sign.

The positive estimates of $\beta(4)$ from regressions of $r(t, t+T)$ on $D(t)/P(t-1)$ are large but typically smaller in magnitude than the negative estimates of δ. The out-of-sample forecasts in table 5 suggest, however, that the $D(t)/P(t-1)$ slopes understate the variation of expected returns because the information in $D(t)/P(t-1)$ is about a year out of date for expected returns measured forward from t. The estimates of $\beta(4)$ for regressions of $r(t, t+4)$ on the more timely $D(t)/P(t)$ are closer in magnitude to (usually within 1.0 standard error of) the estimates of δ.

We interpret the estimates of δ and $\beta(4)$ as suggesting that, on average, the expected future price increases implied by higher expected returns are just offset by the immediate price decline due to the discount-rate effect. Thus, as postulated in Summers (1986) and Fama and French (1987a), positively autocorrelated expected returns generate mean-reverting components of prices. We consider next competing scenarios for such temporary price components.

8.3. *Temporary price components*

Temporary components of prices and the forecast power of yields are consistent with an efficient market. Suppose investor tastes for current versus risky future consumption and the stochastic evolution of firms' investment opportunities result in equilibrium expected returns that are highly autocorrelated but mean-reverting. Suppose shocks to expected returns and shocks to rational forecasts of dividends are independent. Then a shock to expected returns has no effect on expected dividends or expected returns in the distant future. Thus, the shock has no long-term effect on expected prices. The cumulative effect of a shock on expected returns must be exactly offset by an opposite adjustment in the current price. It follows that mean-reverting equilibrium expected returns can give rise to mean-reverting (temporary) components of stock prices. See Poterba and Summers (1987) for a formal analysis.

On the other hand, temporary components of prices and the forecast power of yields are also consistent with common models of an inefficient market, such as Keynes (1936), Shiller (1984), DeBondt and Thaler (1985), and Summers (1986), in which stock prices take long temporary swings away from fundamental values. In this view, high D/P ratios signal that future returns will be high because stock prices are temporarily irrationally low. Conversely, low D/P ratios signal irrationally high prices and low future returns.

As always, market efficiency per se is not testable. It must be tested jointly with restrictions on the behavior of equilibrium expected returns. [See Fama (1970).] One reasonable restriction is that equilibrium in an efficient market never implies predictable price declines (negative expected nominal returns) for the value- and equal-weighted NYSE portfolios. The behavior of the fitted values for the regressions in tables 3 and 4 supports this hypothesis.

The fitted values from the regressions of nominal returns on dividend yields are rarely negative. For example, when the explanatory variable is the more timely $D(t)/P(t)$, the regressions for equal-weighted returns for all horizons produce a total of six negative fitted values during the 1927–1986 period and no negative fitted values during the 1941–1986 period. The regressions of value-weighted nominal returns on $D(t)/P(t)$ produce no negative fitted values in either period. In both the $D(t)/P(t)$ and the $D(t)/P(t-1)$ regressions, no negative fitted value is close to 2.0 standard errors from 0.0. As a rule at least two-thirds of the return forecasts are more than 2.0 standard errors above 0.0.

A stronger hypothesis is that equilibrium in an efficient market never implies negative expected real returns for the value- and equal-weighted NYSE portfolios. The regression fitted values are more often negative for real returns than for nominal returns, but again no negative forecast of real returns is more than 2.0 standard errors from 0.0, whereas typically more than half of the forecasts are more than 2.0 standard errors above 0.0.

In short, low dividend yields forecast that nominal returns will be relatively low, but they do not forecast that prices will decline. Likewise, the strong forecast power of yields does not imply that expected real returns are ever reliably negative.

8.4. *Dividend yields and the autocorrelation of returns*

Autocorrelated expected returns and the opposite response of prices to expected return shocks (the discount-rate effect) can combine to produce mean-reverting components of stock prices. Fama and French (1987a) show that mean-reverting price components tend to induce negative autocorrelation in long-horizon returns. Thus, the negative autocorrelation of long-horizon returns in the earlier work is consistent with the positive autocorrelation of expected returns documented here.

But a mean-reverting, positively autocorrelated expected return does not necessarily imply negative autocorrelated returns or a mean-reverting component of prices. If shocks to expected returns and expected dividends are positively correlated, the opposite response of prices to expected return shocks can disappear. In this case, the positive autocorrelation of expected returns will imply positively autocorrelated returns, and time-varying expected returns will not generate mean-reverting price components. Moreover, changes through

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time in the autocorrelation of expected returns, or in the relation between shocks to expected returns and expected dividends, can change the time-series properties of returns and obscure tests of forecast power based on autocorrelation.

In contrast, as long as yields move with expected returns, regressions of returns on yields can document time-varying expected returns irrespective of changes in the autocorrelation of returns. This may explain why yields have strong forecast power in post-1940 periods, when the autocorrelations of returns in Fama and French (1987a) give weak indications of time-varying expected returns.

Does the variation of expected returns tracked by yields subsume the predictability of long-horizon returns implied by the negative autocorrelation in Fama and French (1987a)? We have estimated multiple regressions of $r(t, t+T)$ on $D(t)/P(t)$ and the lagged return $r(t-T, t)$. The lagged return rarely has marginal explanatory power. Negative slopes for the lagged return are typically less than 1.0 standard error from 0.0. In contrast, as in the univariate regressions, the slopes for the dividend yield in the multiple regressions increase with the return horizon and are typically more than 2.0 standard errors from 0.0 for the 1927–1986 period and for all periods after 1935. Thus including the lagged return in the regressions has no effect on the conclusion that dividend yields have systematic forecast power across different time periods and return horizons.

9. Conclusions

Like previous work, our regressions of returns on dividend yields indicate that time variation in expected returns accounts for small fractions of the variances of short-horizon returns. Dividend yields typically explain less than 5% of the variances of monthly or quarterly returns. An interesting and challenging feature of our evidence is that time variation in expected returns accounts for more of the variation of long-horizon returns. Dividend yields often explain more than 25% of the variances of two- to four-year returns. We offer a simple explanation.

The persistence (high positive autocorrelation) of expected returns causes the variance of expected returns, measured by the fitted values in the regressions of returns on dividend yields, to grow more than in proportion to the return horizon. On the other hand, the growth of the variance of the regression residuals is attenuated by a discount-rate effect: shocks to expected returns are associated with opposite shocks to current prices.

The cumulative price effect of an expected return shock and the associated price shock is roughly zero. On average, the expected future price increases implied by higher expected returns are just offset by the immediate decline in the current price. Thus the time variation of expected returns gives rise to mean-reverting or temporary components of prices.

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BUSINESS CONDITIONS AND EXPECTED RETURNS ON STOCKS AND BONDS*

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Expected returns on common stocks and long-term bonds contain a term or maturity premium that has a clear business-cycle pattern (low near peaks, high near troughs). Expected returns also contain a risk premium that is related to longer-term aspects of business conditions. The variation through time in this premium is stronger for low-grade bonds than for high-grade bonds and stronger for stocks than for bonds. The general message is that expected returns are lower when economic conditions are strong and higher when conditions are weak.

1. Introduction

There is mounting evidence that stock and bond returns are predictable. Some argue that predictability implies market inefficiency. Others contend that it is a result of rational variation in expected returns. We offer evidence on this issue. The evidence centers on whether there is a coherent story that relates the variation through time of expected returns on bonds and stocks to business conditions. The specific questions we address include:

(1) Do the expected returns on bonds and stocks move together? In particular, do the same variables forecast bond and stock returns?

(2) Is the variation in expected bond and stock returns related to business conditions? Are the relations consistent with intuition, theory, and existing evidence on the exposure of different assets to changes in business conditions?

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Our tests indicate that expected excess returns (returns net of the one-month Treasury bill rate) on corporate bonds and stocks move together. Dividend yields, commonly used to forecast stock returns, also forecast bond returns. Predictable variation in stock returns is, in turn, tracked by variables commonly used to measure default and term (or maturity) premiums in bond returns. The default-premium variable (the default spread) is the difference between the yield on a market portfolio of corporate bonds and the yield on Aaa bonds. The term- or maturity-premium variable (the term spread) is the difference between the Aaa yield and the one-month bill rate.

The dividend yield and the default spread capture similar variation in expected bond and stock returns. The major movements in these variables, and in the expected return components they track, seem to be related to long-term business episodes that span several measured business cycles. The dividend yield and the default spread forecast high returns when business conditions are persistently weak and low returns when conditions are strong.

The term spread is more closely related to the shorter-term business cycles identified by the National Bureau of Economic Research (NBER). In particular, the term spread – and the component of expected returns it tracks – are low around measured business-cycle peaks and high near troughs.

There are clear patterns across assets in the slopes from regressions of returns on the forecasting variables. The slopes for the term spread are positive and similar in magnitude for all the stock portfolios and (long-term) bond portfolios we examine. This suggests that the spread tracks a term or maturity premium in expected returns that is similar for all long-term assets. A reasonable and old hypothesis is that the premium compensates for exposure to discount-rate shocks that affect all long-term securities (stocks and bonds) in roughly the same way.

In contrast to the slopes for the term spread, the slopes for the default spread and the dividend yield increase from high-grade to low-grade bonds and from bonds to stocks. This pattern corresponds to intuition about the business risks of the assets, that is, the sensitivity of their returns to unexpected changes in business conditions. The slopes suggest that the default spread and the dividend yield track components of expected returns that vary with the level or price of some business-conditions risk.

Does the expected-return variation we document reflect rational pricing in an efficient market? On the plus side, it is comforting that three forecasting variables, all related to business conditions, track common variation in the expected returns on bonds and stocks. It is appealing that the term spread, known to track a maturity premium in bond returns, identifies a similar premium in stock returns. It is also appealing that a measure of business conditions like the default spread captures expected-return variation that increases from high-grade bonds to stocks in a way that corresponds to intuition about the business-conditions risks of assets. Finally, it is comforting

that variation in the dividend yield, which might otherwise be interpreted as the result of 'bubbles' in stock prices, forecasts bond returns as well as stock returns, and captures much the same variation in expected bond and stock returns as the default spread.

What one takes as comforting evidence for market rationality is, however, somewhat a matter of predilection. As always, the ultimate judgment must be left to the reader.

2. Data

2.1. Common stocks

We use the value- and equal-weighted portfolios of New York Stock Exchange (NYSE) stocks, from the Center for Research in Security Prices (CRSP), to represent the behavior of stock returns. The value-weighted portfolio is weighted toward large stocks; equal-weighted returns are affected more by small stocks. The two portfolios thus provide a convenient way to examine the behavior of stock returns as a function of firm size, a dimension known to be important in describing the cross-section of expected stock returns [Banz (1981)] and the variation through time of expected returns [Keim and Stambaugh (1986), Fama and French (1988a)].

2.2. Corporate bonds

To study corporate bond returns, we use a sample maintained by Ibbotson Associates (obtained for us by Dimensional Fund Advisors). This database has monthly returns and yields for 1926–1987. The sample includes 100 bonds, chosen to approximate a value-weighted market portfolio of corporate bonds with maturities longer than one year. The sample starts in 1926 with 100 randomly chosen bonds, with probability of selection proportional to face value outstanding. Random selection based on face value is used at the start of each following year to add and delete bonds to maintain a 100-bond sample that approximates a value-weighted market portfolio. We use the portfolio of all 100 bonds (called All), and portfolios of bonds rated Aaa, Aa, A, Baa, and below Baa (LG, low-grade). Portfolio returns and yields are price-weighted averages of individual bond returns and yields. The average maturity of bonds in these portfolios is almost always more than ten years.

2.3. Explanatory variables for excess returns

The tests attempt to measure and interpret variation in expected excess returns for return horizons T of one month, one quarter, and one to four years. A one-month excess return is the difference between the continuously com-

pounded one-month return on a bond or stock portfolio and the continuously compounded one-month Treasury bill return (from Ibbotson Associates). Excess returns for quarterly and one- to four-year holding periods are obtained by cumulating monthly excess returns. The monthly, quarterly, and annual excess returns are nonoverlapping. The two- to four-year returns are overlapping annual (end-of-year) observations. Henceforth, the word return, used alone, implies excess return.

The tests center on regressions of future stock and bond returns, $r(t, t+T)$, on a common set of variables, $X(t)$, known at t,

$$r(t, t+T) = \alpha(T) + \beta(T)X(t) + \varepsilon(t, t+T). \tag{1}$$

One of the explanatory variables is the dividend yield, $D(t)/P(t)$, on the value-weighted NYSE portfolio, computed by summing monthly dividends on the portfolio for the year preceding time t and dividing by the value of the portfolio at t. [See Fama and French (1988b).] We use yields based on annual dividends to avoid seasonals in dividends. These annual yields are used to forecast the returns, $r(t, t+T)$, for all horizons.

The hypothesis that dividend yields forecast stock returns is old [see, for example, Dow (1920) and Ball (1978)]. The intuition of the efficient-markets version of the hypothesis is that stock prices are low in relation to dividends when discount rates and expected returns are high (and vice versa), so D/P varies with expected returns. There is a similar prediction, however, if variation in dividend yields is due to irrational bubbles in stock prices. In this case, dividend yields and expected returns are high when prices are temporarily irrationally low (and vice versa). Evidence that dividend yields forecast stock returns is in Rozeff (1984), Shiller (1984), Flood, Hodrick, and Kaplan (1986), Campbell and Shiller (1988), and Fama and French (1988b). The novel result here is that D/P also forecasts bond returns.

Expected returns on long-term corporate bonds can vary through time for at least two reasons: (a) variation in default premiums (differences between the expected returns on low- and high-grade bonds with similar maturities) and (b) variation in term or maturity premiums (differences between the expected returns on long- and short-term bonds).

To identify variation in term or maturity premiums, we use the term spread, $TERM(t)$, the difference between the time t yield on the Aaa bond portfolio and the one-month bill rate. This choice is consistent with evidence that spreads of long- over short-term interest rates forecast differences between long- and short-term bond returns [see, for example, Fama (1976, 1984, 1986, 1988), Shiller, Campbell, and Schoenholtz (1983), Keim and Stambaugh (1986), and Fama and Bliss (1987)]. Our novel result is that $TERM$ tracks a time-varying term premium in stock returns similar to that in long-term bond returns.

To track default premiums, we use the default spread, $DEF(t)$, the difference between the time t yield on the portfolio of (All) 100 corporate bonds and the Aaa yield. This choice is in line with evidence in Fama (1986) and Keim and Stambaugh (1986) that spreads of low- over high-grade interest rates forecast spreads of low- over high-grade bond returns.

The regression results are robust to changes in the definitions of the variables used to forecast returns. The dividend yield on the equal-weighted NYSE portfolio forecasts returns about as well as the yield on the value-weighted portfolio. Substituting a low-grade (Baa or below) bond yield for the market-portfolio bond yield in the default spread has little effect on the results. We use a market-portfolio bond yield because it is less subject to changes through time in the meaning of bond ratings. Substituting a long-term Treasury bond yield for the Aaa yield in the default and term spreads also has little effect on the results. We choose the Aaa yield to avoid potential problems caused by the change in the tax status of Treasury bonds (from nontaxable to taxable) in the early 1940s.

3. Business conditions and the behavior of the forecasting variables

3.1. Autocorrelations

The autocorrelations of the variables used to forecast returns are information about the behavior of expected returns. For the 1927–1987 and 1941–1987 periods used in the regressions, the autocorrelations of the dividend yield, the default spread, and the term spread (table 1) are large at the first-order (annual) lag, but tend to decay for longer lags. This suggests that D/P, DEF, and $TERM$ track components of expected returns that are autocorrelated but show some tendency toward mean reversion.

The autocorrelations of $TERM$ for 1941–1987 are smaller than those of D/P and DEF. Beyond the first (one-year) lag, the autocorrelations of $TERM$ for 1941–1987 are close to 0. Thus for the last 47 years of the sample, the component of expected returns tracked by $TERM$ is much less persistent than those tracked by D/P and DEF. This result is in line with our story that $TERM$ tracks variation in expected returns in response to short-term variation in business conditions, whereas DEF and D/P track expected-return variation that relates to more persistent aspects of business conditions. The business-conditions part of this story comes next.

3.2. Plots of the forecasting variables

Since we measure the variation of expected returns with linear regressions of returns on the forecasting variables, plots of the forecasting variables picture the components of expected returns they capture.

Table 1

Summary statistics for annual observations on one-year excess returns on the bond and stock portfolios, and the dividend yield (D/P), default spread (DEF), and term spread ($TERM$).[a]

	Mean	S.D.	Autocorrelations 1	2	3	4	5	6	7	8
					1927–1987					
Aaa	0.74	6.69	0.21	0.05	−0.06	−0.10	−0.16	0.05	−0.03	−0.04
Aa	0.67	6.82	0.20	−0.05	−0.13	−0.15	−0.13	0.03	−0.02	−0.10
A	0.87	8.38	0.25	−0.15	−0.24	−0.13	−0.02	0.12	−0.05	−0.13
Baa	1.45	8.65	0.24	−0.13	−0.24	−0.14	−0.01	0.15	−0.01	−0.07
LG	2.25	12.36	0.32	−0.03	−0.21	−0.21	−0.05	0.13	0.05	0.11
VW	5.70	20.81	0.10	−0.19	−0.06	−0.13	−0.01	−0.02	0.15	0.07
EW	8.80	28.26	0.13	−0.18	−0.12	−0.22	−0.10	−0.11	0.11	0.05
D/P	4.49	1.36	0.62	0.29	0.20	0.20	0.28	0.32	0.24	0.17
DEF	0.96	0.68	0.83	0.70	0.57	0.51	0.49	0.54	0.52	0.51
$TERM$	1.99	1.25	0.54	0.36	0.21	0.22	0.26	0.14	0.18	0.05
					1941–1987					
Aaa	−0.01	7.05	0.21	−0.03	−0.13	−0.16	−0.25	−0.03	−0.11	−0.11
Aa	0.08	7.02	0.23	−0.14	−0.12	−0.21	−0.17	−0.06	−0.05	−0.14
A	0.55	7.29	0.26	−0.13	−0.19	−0.15	−0.02	−0.02	−0.07	−0.18
Baa	1.38	7.36	0.26	−0.20	−0.17	−0.11	0.01	0.05	−0.01	−0.15
LG	2.71	9.88	0.30	−0.01	−0.13	−0.03	0.17	0.16	0.06	−0.02
VW	6.97	16.25	−0.03	−0.27	0.08	0.30	0.13	−0.13	0.18	0.05
EW	9.84	21.58	0.06	−0.27	−0.03	0.18	−0.01	−0.22	0.12	−0.03
D/P	4.33	1.20	0.79	0.62	0.52	0.43	0.36	0.35	0.37	0.30
DEF	0.74	0.45	0.74	0.61	0.34	0.38	0.42	0.51	0.46	0.43
$TERM$	1.76	1.23	0.46	0.24	0.04	0.13	0.20	0.01	0.06	−0.13

[a] One-year excess returns are sums of one-month excess returns (the difference between the continuously compounded one-month return on a portfolio and the one-month bill rate). Aaa,..., LG are bond portfolios formed according to Moody's rating groups. VW and EW are the value- and equal-weighted NYSE stock portfolios. D/P is the ratio of dividends on the VW portfolio for year t to the value of the portfolio at the end of the year. DEF is the difference between the end-of-year yield on All (the portfolio of the 100 corporate bonds in the sample) and the Aaa yield. $TERM$ is the difference between the end-of-year Aaa yield and the one-month bill rate. The yields and the bill rate in DEF and $TERM$ are annualized. As in the later regressions, the periods for D/P, DEF, and $TERM$ are one year prior to those for returns, e.g., 1926–1986 rather than 1927–1987.

If bonds are priced rationally, the default spread, a spread of lower- over high-grade bond yields, is a measure of business conditions. Fig. 1 shows that DEF indeed takes its highest values during the depression of the 1930s, and there are upward blips during the less severe recessions after World War II – for example, 1957–1958, 1974–1975, and 1980–1982. Although DEF shows some business-cycle variation, its major swings seem to go beyond the business cycles measured by the NBER. DEF is high during the 1930s and the early years of World War II, a period of general economic uncertainty [Officer

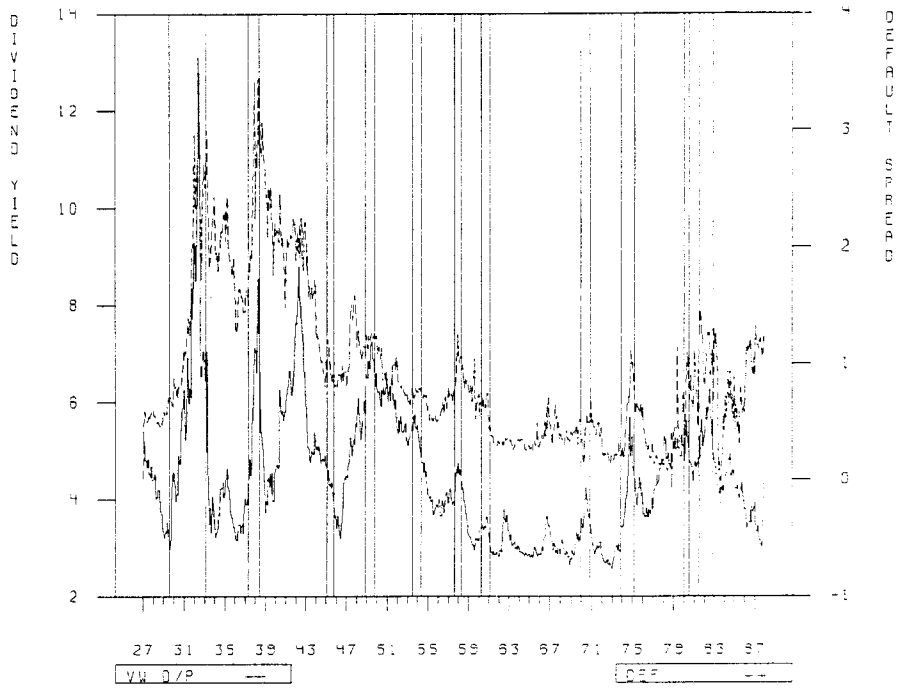

Fig. 1. Beginning-of-month values of the value-weighted dividend yield, D/P, and the default spread, DEF, in percent.

Vertical grid lines are NBER business-cycle peaks (P) and trough (T). The dates are:

8/29(P)	3/33(T)	11/48(P)	10/49(T)	4/60(P)	2/61(T)	1/80(P)	7/80(T)
5/37(P)	6/38(T)	7/53(P)	5/54(T)	12/69(P)	11/70(T)	7/81(P)	11/82(P)
2/45(P)	10/45(T)	8/57(P)	4/58(T)	11/73(P)	3/75(T)		

(1973) and Schwert (1988)]. It is consistently lower during the 1953–1973 period of stronger and more stable economic conditions, which nevertheless includes four measured recessions.

Similar comments apply to the dividend yield. Indeed, the correlation between D/P and DEF (0.61 for 1927–1987 and 0.75 for 1941–1987) is apparent in fig. 1. We interpret the figure as saying that the forecast power of the dividend yield and the default spread reflects time variation in expected bond and stock returns in response to aspects of business conditions that tend to persist beyond measured business cycles. This interpretation is buttressed by the high and persistent autocorrelation of D/P and DEF observed in table 1.

In contrast, fig 2 shows that, except for the 1933–1951 period, the variation of the term spread is more closely related to measured business cycles. $TERM$

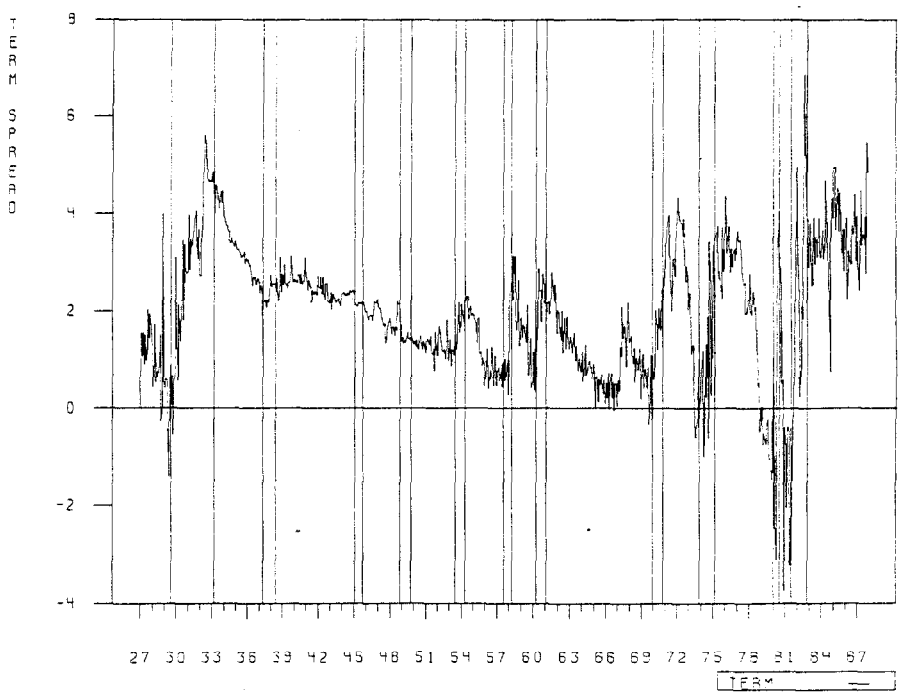

Fig. 2. Beginning-of-month values of the term spread, *TERM*, in percent.

Vertical grid lines are NBER business-cycle peaks (P) and troughs (T). The dates are:

8/29(P)	3/33(T)	11/48(P)	10/49(T)	4/60(P)	2/61(T)	1/80(P)	7/80(T)
5/37(P)	6/38(T)	7/53(P)	5/54(T)	12/69(P)	11/70(T)	7/81(P)	11/82(P)
2/45(P)	10/45(T)	8/57(P)	4/58(T)	11/73(P)	3/75(T)		

tends to be low near business-cycle peaks and high near troughs. The details of the story are in fig. 3 which shows the components of *TERM*, the Aaa yield and the one-month bill rate.

From 1933 to 1951, the bill rate is stable and close to 0. This period includes much of the Great Depression and then the period during and after World War II, when the Federal Reserve fixed bill rates. For the rest of the sample, the bill rate always rises during expansions and falls during contractions. Indeed, fig. 3 suggests that, outside of the 1933–1951 period, the bill rate comes close to defining the business peaks and troughs identified by the NBER. (The NBER says that interest rates are not used to date business cycles.)

Fama (1988) argues that the business-cycle variation in short-term interest rates is a mean-reverting tendency, which implies that the variation in long-term rates is less extreme. This is confirmed by the behavior of the Aaa yield in

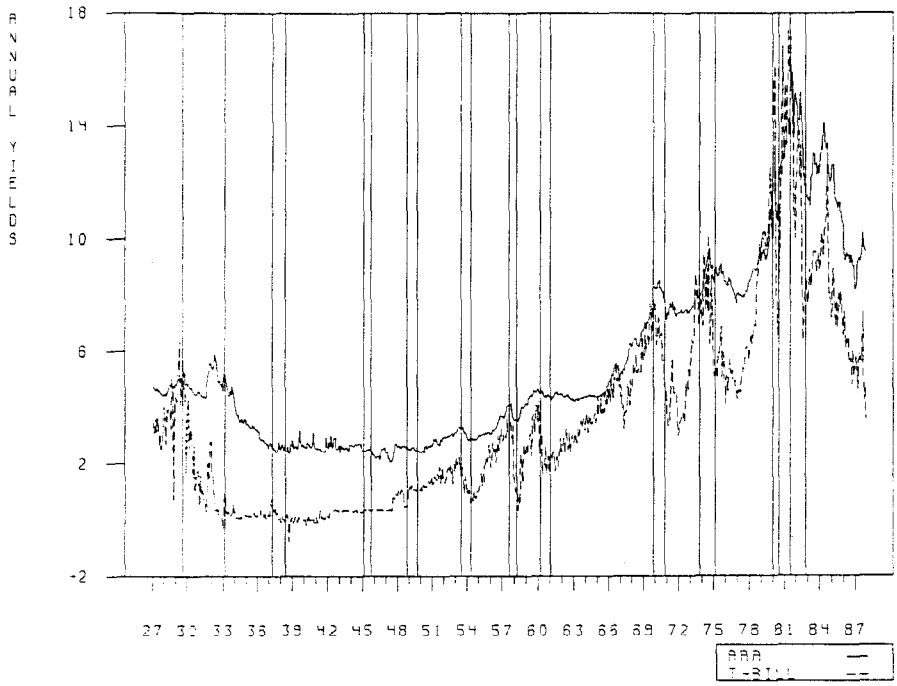

Fig. 3. Beginning-of-month values of the Aaa bond yield and the (annualized) one-month Treasury bill rate, in percent.

Vertical grid lines are NBER business-cycle peaks (P) and troughs (T). The dates are:

8/29(P)	3/33(T)	11/48(P)	10/49(T)	4/60(P)	2/61(T)	1/80(P)	7/80(T)
5/37(P)	6/38(T)	7/53(P)	5/54(T)	12/69(P)	11/70(T)	7/81(P)	11/82(P)
2/45(P)	10/45(T)	8/57(P)	4/58(T)	11/73(P)	3/75(T)		

fig. 3. The Aaa yield rises less than the bill rate during expansions and falls less during contractions. As a result, the term spread – the Aaa yield minus the bill rate – has a clear business-cycle pattern. For all business cycles after 1951, *TERM* is higher at the trough than at the preceding or following peak.[1,2]

[1]Kessel (1965) documents that yields on long-term Treasury bonds rise less during business expansions and fall less during contractions than yields on short-term bills. Thus spreads of long-term over short-term Treasury yields have a clear countercyclical pattern. Figs. 2 and 3 show that the cyclical behavior of interest rates documented by Kessel extends to the 1963–1987 period not included in his sample.

[2]The business-cycle behavior of the one-month bill rate suggests that the 'anomalous' negative relations between stock returns $r(t, t+T)$ and the time t bill rate [documented by Fama and Schwert (1977) and others] just reflects countercyclical variation in expected returns like that captured by *TERM*. Chen (1989) finds that the bill rate and *TERM* indeed have similar roles in stock-return regressions. He also finds that the negative relations between stock returns and the bill rate are typically weaker than the positive relations between stock returns and *TERM*.

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Table 2

Slopes, t-statistics, and R^2 from multiple regressions of excess returns on the term spread ($TERM$) and the value-weighted dividend yield (D/P) or the default spread (DEF); 1927–1987.[a]

	Portfolios													
T	Aaa	Aa	A	Baa	LG	VW	EW	Aaa	Aa	A	Baa	LG	VW	EW
	$r(t, t+T) = a + bD(t)/P(t) + cTERM(t) + e(t, t+T)$													
	Slopes for D/P							t-statistics for D/P slopes						
M	0.04	0.01	−0.05	−0.03	0.07	0.21	0.43	0.96	0.21	−0.55	−0.23	0.43	0.78	1.26
Q	0.20	0.14	0.03	0.14	0.48	1.09	2.05	1.07	0.69	0.09	0.31	0.79	1.09	1.58
1	0.30	−0.21	−0.64	−0.49	0.39	2.79	5.75	0.65	−0.45	−0.87	−0.68	0.30	1.31	2.31
2	1.09	0.25	0.99	0.91	3.92	8.89	15.66	1.38	0.31	0.95	0.62	1.62	3.13	4.98
3	1.83	1.17	2.91	2.87	7.83	12.20	20.21	2.24	1.66	6.49	2.62	3.21	3.77	4.91
4	2.72	2.16	4.14	4.47	10.54	15.37	23.29	3.91	2.76	5.20	6.22	5.94	5.08	4.74
	Slopes for $TERM$							t-statistics for $TERM$ slopes						
M	0.23	0.24	0.26	0.26	0.26	0.31	0.47	3.12	3.57	3.23	3.19	2.27	1.68	1.93
Q	0.57	0.52	0.59	0.55	0.60	0.65	0.96	1.75	1.63	1.83	1.74	1.37	1.03	1.10
1	3.36	3.30	3.92	3.36	3.61	1.56	2.69	5.44	5.25	5.81	4.88	3.78	0.82	1.01
2	4.23	4.22	4.46	4.15	4.41	−1.27	−0.38	3.98	3.83	2.83	2.80	1.85	−0.38	−0.07
3	5.01	4.62	4.86	4.63	4.66	−1.54	−0.17	3.52	3.27	2.56	2.47	1.70	−0.36	−0.03
4	5.09	4.61	5.50	5.22	6.06	0.32	4.07	2.39	2.15	2.36	2.66	2.95	0.09	0.73
	Regression R^2													
M	0.04	0.04	0.03	0.02	0.01	0.01	0.01							
Q	0.06	0.04	0.03	0.02	0.02	0.02	0.04							
1	0.39	0.33	0.30	0.20	0.11	0.02	0.07							
2	0.28	0.22	0.17	0.13	0.15	0.12	0.22							
3	0.26	0.19	0.21	0.18	0.24	0.18	0.27							
4	0.24	0.19	0.28	0.26	0.36	0.25	0.34							

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T	Aaa	Aa	A	Baa	LG	VW	EW	Aaa	Aa	A	Baa	LG	VW	EW
	Portfolios													
	$r(t, t+T) = a + bDEF(t) + cTERM(t) + e(t, t+T)$													
	Slopes for *DEF*							*t*-statistics for *DEF* slopes						
M	0.07	0.07	0.07	0.05	0.27	0.04	0.41	0.78	0.74	0.50	0.30	0.99	0.09	0.67
Q	0.31	0.34	0.47	0.54	1.30	0.99	2.78	0.85	0.91	0.84	0.85	1.30	0.56	1.12
1	0.76	0.41	0.76	1.49	4.12	4.38	11.59	0.79	0.46	0.57	1.12	1.62	1.15	2.38
2	4.18	3.51	6.41	6.70	13.49	14.62	29.22	1.96	1.75	2.86	2.47	3.04	2.18	2.73
3	7.21	7.14	11.12	11.83	22.25	19.96	37.61	2.01	2.14	3.21	5.51	4.61	2.25	2.52
4	10.11	9.66	13.62	15.29	27.07	24.56	41.41	2.11	2.07	3.20	4.46	4.64	2.42	2.80
	Slopes for *TERM*							*t*-statistics for *TERM* slopes						
M	0.22	0.23	0.24	0.24	0.22	0.34	0.47	2.81	3.21	3.02	3.04	1.99	1.83	2.00
Q	0.55	0.48	0.49	0.47	0.42	0.70	0.83	1.51	1.36	1.48	1.41	0.97	1.01	0.92
1	3.25	3.15	3.58	2.89	2.73	1.20	1.35	4.41	4.49	4.89	3.96	3.08	0.60	0.52
2	3.48	3.41	3.13	2.73	2.10	−2.53	−3.47	2.89	3.07	2.04	1.97	1.19	−0.74	−0.81
3	3.63	3.06	2.75	2.32	1.02	−3.30	−4.29	1.80	1.74	1.26	1.24	0.50	−0.84	−0.80
4	3.09	2.56	2.94	2.29	1.68	−1.89	−0.45	0.98	0.88	1.03	0.99	0.76	−0.51	−0.12
	Regression R^2													
M	0.04	0.04	0.03	0.02	0.01	0.00	0.01							
Q	0.05	0.04	0.03	0.03	0.03	0.01	0.02							
1	0.39	0.33	0.29	0.20	0.15	0.00	0.07							
2	0.32	0.26	0.25	0.22	0.25	0.05	0.16							
3	0.34	0.29	0.33	0.31	0.36	0.09	0.20							
4	0.34	0.31	0.40	0.41	0.45	0.13	0.23							

[a] The regressions for T = one month (M), one quarter (Q), and one year use nonoverlapping returns. The regressions for two- to four-year returns use overlapping annual observations. The numbers of observations in the regressions are (M) 732, (Q) 244, (1 yr) 61, (2 yr) 60, (3 yr) 59, and (4 yr) 58. The standard errors in the *t*-statistics for the slopes are adjusted for heteroscedasticity and (for two- to four-year returns) the sample autocorrelation of overlapping residuals with the method of Hansen (1982) and White (1980). See note to table 1 for definition of portfolios.

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Table 3

Slopes, t-statistics, and R^2 from multiple regressions of excess returns on the term spread ($TERM$) and the value-weighted dividend yield (D/P) or the default spread (DEF); 1941–1987.[a]

	Portfolios													
T	Aaa	Aa	A	Baa	LG	VW	EW	Aaa	Aa	A	Baa	LG	VW	EW
	$r(t, t+T) = a + bD(t)/P(t) + cTERM(t) + e(t, t+T)$													
	Slopes for D/P							t-statistics for D/P slopes						
M	0.13	0.11	0.11	0.13	0.30	0.40	0.53	2.75	2.58	2.54	2.81	3.82	2.88	2.99
Q	0.36	0.34	0.36	0.42	0.94	1.31	1.78	1.91	1.89	1.97	2.42	3.28	2.93	3.03
1	0.40	0.27	0.74	1.23	3.33	5.49	7.96	0.75	0.47	1.31	2.14	3.91	3.45	3.67
2	1.00	0.62	2.05	3.15	7.67	11.84	16.70	0.87	0.49	1.58	2.56	3.97	4.18	3.87
3	1.41	0.91	2.93	4.34	10.88	15.65	21.22	1.37	0.78	2.27	3.11	3.65	4.94	3.31
4	2.41	1.76	3.87	5.29	12.66	18.48	23.43	3.78	1.94	3.65	3.83	4.21	5.26	3.18
	Slopes for $TERM$							t-statistics for $TERM$ slopes						
M	0.25	0.28	0.31	0.32	0.31	0.48	0.51	2.77	3.55	4.35	4.81	3.32	3.29	2.97
Q	0.62	0.60	0.73	0.75	0.77	1.13	1.17	1.51	1.52	2.07	2.43	1.89	2.17	1.82
1	3.64	3.56	3.87	3.57	3.27	1.64	1.33	4.74	5.07	5.68	5.57	4.10	0.94	0.66
2	4.29	4.18	4.25	4.16	3.71	−1.34	−2.90	3.25	3.48	3.64	4.06	3.04	−0.63	−0.89
3	4.41	3.81	3.83	3.62	2.71	−3.95	−6.35	2.13	2.09	1.95	2.31	2.01	−1.23	−1.27
4	3.73	3.07	3.27	3.51	3.27	−2.40	−2.67	1.11	0.97	1.02	1.40	1.45	−0.75	−0.64
	Regression R^2													
M	0.04	0.06	0.08	0.08	0.05	0.03	0.03							
Q	0.06	0.05	0.08	0.10	0.10	0.06	0.06							
1	0.39	0.37	0.44	0.41	0.35	0.16	0.18							
2	0.21	0.18	0.24	0.30	0.44	0.36	0.37							
3	0.13	0.08	0.15	0.24	0.46	0.53	0.48							
4	0.09	0.04	0.13	0.25	0.51	0.60	0.50							

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T	Aaa	Aa	A	Baa	LG	VW	EW	Aaa	Aa	A	Baa	LG	VW	EW
	Portfolios													
	$r(t, t+T) = a + bDEF(t) + cTERM(t) + e(t, t+T)$													
	Slopes for *DEF*							*t*-statistics for *DEF* slopes						
M	0.23	0.27	0.30	0.36	0.84	0.52	0.91	1.87	2.35	2.93	3.08	3.89	1.43	1.77
Q	0.57	0.68	0.80	1.09	2.72	2.18	3.70	1.22	1.49	1.80	2.31	3.25	1.61	1.84
1	1.42	1.11	2.87	4.51	11.15	10.98	18.62	1.08	0.73	1.90	2.79	4.37	2.12	2.79
2	6.25	5.13	9.01	11.73	24.48	24.83	39.56	1.62	1.20	2.24	3.74	5.79	3.01	3.82
3	10.01	8.66	13.83	17.45	36.15	36.07	54.33	1.65	1.31	2.49	5.00	9.42	4.17	4.04
4	13.35	11.16	16.32	19.90	40.18	41.99	57.36	1.85	1.44	2.56	4.26	11.52	3.94	3.78
	Slopes for *TERM*							*t*-statistics for *TERM* slopes						
M	0.25	0.27	0.30	0.31	0.29	0.46	0.48	2.64	3.39	4.13	4.52	2.99	3.21	2.83
Q	0.61	0.58	0.71	0.71	0.68	1.09	1.08	1.44	1.44	1.96	2.25	1.64	2.03	1.62
1	3.60	3.53	3.79	3.46	3.03	1.75	1.31	4.59	4.97	5.61	5.55	4.41	0.99	0.61
2	4.05	3.95	4.01	3.94	3.44	−0.89	−2.57	3.26	3.61	3.86	4.89	4.82	−0.38	−0.70
3	3.94	3.33	3.38	3.18	2.19	−3.47	−6.12	1.74	1.69	1.51	1.74	1.28	−0.96	−1.16
4	3.22	2.59	2.85	3.12	2.92	−1.60	−1.97	0.87	0.75	0.81	1.12	1.05	−0.40	−0.49
	Regression R^2													
M	0.04	0.06	0.08	0.08	0.06	0.02	0.02							
Q	0.05	0.05	0.08	0.10	0.11	0.04	0.04							
1	0.40	0.38	0.46	0.45	0.45	0.09	0.13							
2	0.27	0.22	0.32	0.41	0.59	0.21	0.29							
3	0.23	0.16	0.29	0.42	0.70	0.39	0.44							
4	0.21	0.14	0.27	0.43	0.71	0.43	0.42							

[a] The regressions for T = one month (M), one quarter (Q), and one year use nonoverlapping returns. The regressions for two- to four-year returns use overlapping annual observations. The numbers of observations in the regressions are (M) 564, (Q) 188, (1 yr) 47, (2 yr) 46, (3 yr) 45, and (4 yr) 44. The standard errors in the t-statistics for the slopes are adjusted for heteroscedasticity and (for two- to four-year returns) the sample autocorrelation of overlapping residuals with the method of Hansen (1982) and White (1980). See note to table 1 for definition of portfolios.

The term spread is not highly correlated with the dividend yield or the default spread. (Over the 1941–1987 period, *TERM* has a correlation of 0.16 with *D/P* and 0.18 with *DEF*.) Yet all three variables are related to business conditions. Since the regressions, presented next, show that *D/P*, *DEF*, and *TERM* forecast returns on bonds and stocks, we infer that the variation of expected returns has a rich mix of components that relate to long- and short-term aspects of business conditions.

4. The regressions

Tables 2 and 3 show results for 1927–1987 and 1941–1987 from multiple regressions of bond and stock returns on the term spread and the dividend yield or the default spread. Slopes and t-statistics (not shown) for 1946–1987 and 1957–1987 are similar to those for 1941–1987. Thus the results for 1941–1987 are a good view of expected-return variation for the 47-year period after the Great Depression.

We argue that the regressions for 1927–1987 and 1941–1987 tell a similar story about the expected-return variation tracked by *D/P*, *DEF*, and *TERM*. The regression R^2 and the t-statistics for the regression slopes in tables 2 and 3 nevertheless illustrate that the forecast power of the three variables is stronger and more consistently reliable across different portfolios and return horizons for periods after the Great Depression. (See also table 5 below.)

4.1. Business conditions and common variation in expected returns

Tables 2 and 3 show that our forecasting variables have information about expected returns on stocks and bonds. All the regression slopes for the default spread and almost all the slopes for the dividend yield and the term spread are positive. Many of the slopes, especially for 1941–1987, are more than 2 standard errors from 0. The dividend yield, a variable from the stock market that is known to forecast stock returns, also forecasts corporate bond returns. The default and term spreads, variables from the bond market that are known to forecast bond returns, also forecast stock returns. In short, the three forecasting variables track components of expected returns that are common across assets.

The relatively high correlation between *DEF* and *D/P* (0.61 for 1927–1987 and 0.75 for 1941–1987) implies that the default spread and the dividend yield track similar predictable components of returns. Given the relation between long-term business conditions and these two forecasting variables (fig. 1), we infer that *DEF* and *D/P* track components of expected returns that are high during periods like the Great Depression, when business is persistently poor and low during periods like 1953–1973, when business is persistently strong. Fig. 1 and the regression slopes also imply that there are upward blips in the

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expected-return variation signaled by *DEF* and *D/P* during post-World War II recessions, especially the two major recessions of 1974–1975 and 1980–1982.

Fig. 2 says that the term spread is related to the shorter-term business cycles identified by the NBER. The component of expected returns captured by *TERM* is low around business-cycle peaks and high around troughs. This *TERM* component of expected returns is less persistent than the expected-return variation captured by *D/P* and *DEF*. Nevertheless, a general message from the regressions is that all three forecasting variables signal that expected returns are low when times are good and higher when they are poor.

4.2. *Business conditions and cross-sectional patterns in expected returns*

As indicated earlier, the slopes from regressions of returns on the default spread are in line with intuition about the business risks of bonds and stocks. The *DEF* slopes tend to be larger for lower-grade than for higher-grade bonds, larger for stocks than for bonds, and larger for the equal-weighted stock portfolio than for the value-weighted portfolio. The slopes for the dividend yield, especially for 1941–1987, also tend to increase from higher- to lower-grade bonds, from bonds to stocks, and from big stocks to small stocks.

The pattern in the slopes for *D/P* and *DEF* implies that the two variables track variation in expected returns that is largest for stocks and smallest for high-grade bonds. Thus, like the general level of expected returns, the differences between the expected returns on stocks and bonds vary with *D/P* and *DEF*. The spreads of the expected returns of stocks over bonds, and of low-grade over high-grade bonds, are high when the economy is weak, but they narrow when business conditions are strong.

Unlike the slopes for the default spread and the dividend yield, the slopes for the term spread in tables 2 and 3 are quite similar for different (long-term) bond portfolios. For example, in the monthly regressions for 1927–1987, the *TERM* slopes for the bond portfolios are between 0.22 and 0.24. The *TERM* slopes for the stock portfolios are in turn similar to those for bonds, at least for monthly, quarterly, and annual returns, where the slopes are estimated more precisely. The results suggest that *TERM* captures a term premium in expected returns that is largely a function of maturity and so is similar for all long-term securities. This inference is supported by the evidence in Keim and Stambaugh (1986) and Fama (1988) that variables like *TERM* (spreads of long-term over short-term bond yields) capture variation in the expected returns on Treasury bonds that increases with maturity.

What risk is associated with the term premium? The major difference between short- and long-maturity securities of the same quality is the higher sensitivity of long-maturity prices to general shifts in the level of discount rates. An old hypothesis [for example, Hicks (1947) and Kessel (1965)], easily accommodated in modern multifactor asset-pricing models, is that the term

premium compensates for this discount-rate risk. The compensation is low around business-cycle peaks and high around troughs.

4.3. Cross-sectional patterns in expected returns: Formal tests

Table 4 shows F-tests of the hypothesis that the slopes for D/P, DEF, or $TERM$ are equal across portfolios. F-tests are shown for nonoverlapping monthly, quarterly, and annual returns, where larger sample sizes imply that the tests are likely to have power. The F-tests are largely consistent with our inferences about the patterns in the regression slopes in tables 2 and 3.

The F-tests always reject the hypothesis that the slopes for DEF or D/P are the same for the seven stock and bond portfolios. The tests, especially for 1941–1987, also reject the equal-slope hypothesis for the five bond portfolios. Thus the pattern in the slopes for DEF or D/P (increasing from high-grade to low-grade bonds, from bonds to stocks, and from big stocks to small stocks) apparently reflects reliable differences across assets in the variation through time of expected returns.

The F-tests of the hypothesis that $TERM$ tracks a maturity premium that is the same for all long-term securities are less clearcut. When only bonds are considered, the F-tests are all consistent with the hypothesis that the $TERM$ slopes are the same for the five portfolios. When stocks are included, however, the tests for 1941–1987 and the tests on the monthly slopes for 1927–1987 tend to reject the hypothesis that the $TERM$ slopes are the same for the seven stock and bond portfolios. We infer that $TERM$ tracks what is essentially, but perhaps not entirely, a maturity premium in expected returns.

4.4. Explanatory power and the return horizon

The regression R^2 in tables 2 and 3 tend to increase with the holding period for both stock and bond returns. The R^2 are typically less than 0.1 for monthly and quarterly returns, but are often greater than 0.3 for one- to four-year returns. This pattern of stronger explanatory power for longer return horizons has a simple and interesting explanation that is linked to our business-conditions story for the variation in expected returns.

The dividend yield and the default spread are largely measures of long-term business conditions. Their autocorrelations decay slowly across longer lags (table 1). Thus the information in D/P and DEF about future one-period expected returns also decays slowly; that is, the current values of D/P and DEF contain information about distant one-period expected returns. Since the slopes for long-horizon returns cumulate the information in the independent variables, the slopes for D/P and DEF in tables 2 and 3 almost always increase with the return horizon.

Table 4

F-tests that regression slopes are equal across portfolios.[a]

		5 bond & 2 stock portfolios		5 bond portfolios	
Part A: $R(t, t+T) = a + bD(t)/P(t) + cTERM(t) + e(t, t+T)$					
T	Obs.	D/P	$TERM$	D/P	$TERM$
		1927–1987			
M	732	9.97	1.84	3.72	0.40
		(0.000)	(0.075)	(0.005)	(0.807)
Q	244	13.21	0.43	2.11	0.11
		(0.000)	(0.887)	(0.077)	(0.978)
1	61	9.77	1.53	2.13	0.65
		(0.000)	(0.154)	(0.077)	(0.627)
		1941–1987			
M	564	14.42	5.27	5.94	1.51
		(0.000)	(0.000)	(0.000)	(0.196)
Q	188	13.60	2.34	5.01	0.71
		(0.000)	(0.022)	(0.001)	(0.586)
1	47	24.55	2.67	9.61	0.36
		(0.000)	(0.010)	(0.000)	(0.839)
Part B: $R(t, t+T) = a + bDEF(t) + cTERM(t) + e(t, t+T)$					
T	Obs.	DEF	$TERM$	DEF	$TERM$
		1927–1987			
M	732	2.23	1.88	1.37	0.10
		(0.029)	(0.068)	(0.243)	(0.982)
Q	244	5.03	0.49	2.44	0.21
		(0.000)	(0.844)	(0.046)	(0.932)
1	61	7.11	1.72	2.66	0.62
		(0.000)	(0.103)	(0.033)	(0.652)
		1941–1987			
M	564	10.17	4.66	8.57	1.17
		(0.000)	(0.000)	(0.000)	(0.324)
Q	188	11.78	1.81	8.60	0.44
		(0.000)	(0.081)	(0.000)	(0.782)
1	47	23.45	2.44	16.65	0.62
		(0.000)	(0.019)	(0.000)	(0.652)

[a]The F-statistics test the hypothesis that the slopes (tables 2 and 3) from regressions of monthly (M), quarterly (Q), or annual (1) returns on the term spread ($TERM$) and the default spread (DEF) or the dividend yield (D/P) are equal for the five bond portfolios or for the five bond portfolios and the two stock portfolios. [See Theil (1971, p. 314).] P-values are in parentheses.

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Table 5

Slopes, t-statistics, and R^2 from multiple regressions of real returns on the term spread ($TERM$) and the value-weighted dividend yield (D/P) or the default spread (DEF); 1953–1987.[a]

	Portfolios													
T	Aaa	Aa	A	Baa	LG	VW	EW	Aaa	Aa	A	Baa	LG	VW	EW
	$r(t, t+T) = a + bD(t)/P(t) + cTERM(t) + e(t, t+T)$													
	Slopes for D/P							t-statistics for D/P slopes						
M	0.27	0.24	0.23	0.25	0.28	0.57	0.76	1.88	1.84	1.87	2.07	2.02	2.31	2.50
Q	0.76	0.73	0.77	0.81	0.88	2.01	2.65	1.38	1.40	1.54	1.73	1.72	2.87	2.72
1	0.32	0.32	1.10	1.58	1.83	7.80	11.28	0.24	0.23	0.85	1.31	1.29	2.69	3.01
2	2.09	2.01	3.97	4.74	5.82	16.76	22.67	0.55	0.51	1.02	1.28	1.48	2.93	3.20
3	3.50	3.37	5.98	6.41	8.30	18.64	24.02	0.80	0.76	1.33	1.52	1.75	2.60	2.71
4	5.66	5.34	7.85	8.08	9.32	19.18	23.35	1.23	1.21	1.63	2.03	1.98	2.75	2.44
	Slopes for $TERM$							t-statistics for $TERM$ slopes						
M	0.27	0.31	0.34	0.35	0.33	0.54	0.54	2.87	3.71	4.45	4.93	3.31	3.61	3.04
Q	0.74	0.73	0.85	0.86	0.84	1.36	1.30	1.75	1.80	2.36	2.73	1.99	2.58	1.99
1	4.40	4.38	4.64	4.28	4.00	2.47	1.58	4.45	4.70	5.15	5.11	4.15	1.32	0.75
2	4.99	4.98	4.93	4.75	4.19	−0.94	−3.83	2.53	2.72	2.79	3.03	2.65	−0.39	−1.13
3	4.53	4.07	3.85	3.45	2.18	−4.08	−8.39	1.54	1.58	1.45	1.50	0.92	−1.01	−1.53
4	3.05	2.55	2.53	2.48	1.44	−3.00	−5.53	0.64	0.57	0.57	0.65	0.37	−0.69	−1.18
	Regression R^2													
M	0.05	0.07	0.09	0.09	0.06	0.04	0.03							
Q	0.07	0.07	0.10	0.12	0.08	0.08	0.07							
1	0.39	0.40	0.46	0.44	0.33	0.17	0.18							
2	0.17	0.17	0.21	0.25	0.23	0.33	0.38							
3	0.08	0.06	0.10	0.13	0.14	0.38	0.44							
4	0.03	0.02	0.07	0.11	0.12	0.35	0.33							

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T	Aaa	Aa	A	Baa	LG	VW	EW	Aaa	Aa	A	Baa	LG	VW	EW
	Portfolios													
	$r(t, t+T) = a + bDEF(t) + cTERM(t) + e(t, t+T)$													
	Slopes for *DEF*							*t*-statistics for *DEF* slopes						
M	0.68	0.99	0.97	0.91	1.08	1.04	1.29	1.73	2.91	3.20	2.79	3.01	1.43	1.43
Q	1.87	2.65	2.72	2.77	3.60	4.78	5.85	1.24	1.98	2.12	2.09	2.56	1.97	1.80
1	5.79	7.29	9.49	10.51	12.75	23.33	30.27	1.56	2.11	2.61	3.16	2.99	2.27	2.52
2	24.22	24.98	29.73	29.25	30.91	43.43	52.31	2.95	3.06	3.68	4.04	3.22	2.42	2.43
3	35.21	36.54	41.55	38.99	42.02	46.14	49.56	3.45	3.61	4.77	5.04	4.50	2.70	2.20
4	44.16	43.67	48.24	44.49	45.21	53.55	49.21	3.67	3.67	4.75	4.24	5.72	3.22	2.14
	Slopes for *TERM*							*t*-statistics for *TERM* slopes						
M	0.26	0.29	0.32	0.33	0.31	0.53	0.52	2.68	3.47	4.22	4.62	3.12	3.55	2.97
Q	0.72	0.70	0.82	0.83	0.80	1.32	1.25	1.65	1.70	2.24	2.56	1.89	2.43	1.85
1	4.31	4.25	4.55	4.22	3.91	2.83	2.17	4.54	4.96	5.67	5.68	4.99	1.52	0.97
2	4.95	4.92	5.05	4.96	4.52	0.56	−1.73	3.30	3.83	4.47	5.40	4.51	0.24	−0.46
3	4.55	4.05	4.12	3.81	2.75	−2.18	−5.82	1.49	1.51	1.43	1.48	1.02	−0.54	−0.99
4	3.80	3.26	3.54	3.52	2.63	−0.64	−2.68	0.75	0.69	0.75	0.85	0.61	−0.15	−0.61
	Regression R^2													
M	0.05	0.09	0.10	0.10	0.07	0.04	0.03							
Q	0.06	0.08	0.11	0.13	0.11	0.07	0.04							
1	0.43	0.45	0.54	0.53	0.45	0.17	0.14							
2	0.38	0.39	0.47	0.50	0.46	0.22	0.20							
3	0.34	0.36	0.42	0.44	0.42	0.24	0.20							
4	0.32	0.33	0.38	0.41	0.37	0.28	0.12							

[a] The regressions for T = one month (M), one quarter (Q), and one year use nonoverlapping returns. The regressions for two- to four-year returns use overlapping annual observations. The numbers of observations in the regressions are (M) 420 (Q) 140, (1 yr) 35, (2 yr) 34, (3 yr) 33, and (4 yr) 32. The standard errors in the t-statistics for the slopes are adjusted for heteroscedasticity and (for two- to four-year returns) the sample autocorrelation of overlapping residuals with the method of Hansen (1982) and White (1980). See note to table 1 for definition of portfolios.

The term spread is more closely related to shorter-term measured business cycles. The first-order autocorrelations of annual observations on *TERM* are large for both 1927–1987 and 1941–1987 (table 1), but the higher-order autocorrelations for 1941–1987 are close to 0. Consistent with this pattern, the 1941–1987 *TERM* slopes in table 3 tend to increase with the return horizon out to one or two years, and then flatten or decline.

Since the variances of the regression fitted values grow like the squares of the slopes, slopes that increase with the return horizon can explain, in large part, why the regression R^2 tends to increase with the return horizon. In economic terms, D/P, *DEF*, and, to a lesser extent, *TERM* track autocorrelated components of expected returns, generated by persistence in business conditions, that become larger fractions of return variation for longer return horizons. In this view, the explanatory power (high R^2) of regressions for long-horizon returns is a simple consequence of persistence in short-horizon expected returns. [Fama and French (1988b) discuss this in more detail.]

5. Interpretation

5.1. Consumption smoothing

Consumption smoothing is a common feature of intertemporal asset-pricing models [see, for example, Merton (1973), Lucas (1978), and Breeden (1979)]. Like the permanent-income model of Modigliani and Brumberg (1955) and Friedman (1957), the asset-pricing models predict that consumption depends on wealth rather than current income. When income is high in relation to wealth, investors want to smooth consumption into the future by saving more. If the supply of capital-investment opportunities is not also unusually large, higher desired savings lead to lower expected security returns. Conversely, investors want to save less when income is temporarily low. Again, without an offsetting reduction in capital-investment opportunities, lower desired savings tend to push expected returns up. Thus variation in expected returns opposite to business conditions is consistent with modern asset-pricing models.

We find that expected *excess* returns (returns net of the one-month bill rate) are inversely related to business conditions. Some versions of the consumption-smoothing story – for example, Abel (1988) as interpreted by Chen (1989) – do predict that expected excess returns vary opposite to current business conditions. More typically, however, consumption-smoothing models predict that expected *real* returns vary opposite to business conditions. See, for example, Hansen and Singleton (1983) and Breeden (1986). It is thus interesting to check whether our forecasting variables also track expected real returns.

Table 5 replicates the regressions using real returns on the bond and stock portfolios for 1953–1987. We choose 1953–1987 to show some results for a

period that is free of any unusual effects of the Great Depression, World War II, the Korean War, and the pegging of Treasury-bill interest rates preceding the 1951 accord between the Treasury and the Federal Reserve. (The potential effects of these episodes on the results for 1927–1987 and 1941–1987 seem to concern many readers.) The timeliness and reliability of inflation rates estimated from the U.S. Consumer Price Index also improve in 1953 [Fama (1975)].

The 1953–1987 results for real returns are similar to the 1941–1987 results for excess returns. In short, given that *D/P*, *DEF*, and *TERM* move opposite to business conditions, the regressions for real returns show that, like expected excess returns, expected real returns move opposite to business conditions.

5.2. Other explanations

We do not mean to suggest that consumption smoothing is the whole story for the variation in expected returns. Another reasonable hypothesis is that the risks for which *D/P*, *DEF*, and *TERM* are proxies are higher when times are poor and lower when times are good. [Schwert (1988) provides suggestive evidence.]

It also seems likely that variation in capital-investment opportunities (the 'productivity shocks' of the business-cycles literature) generates some of the variation in expected returns. For example, there is suggestive evidence that investment opportunities play a role in the expected-return variation tracked by the term spread. Thus Chen (1989) formally documents the clear impression from fig. 2 that *TERM* is positively related to future real activity. Since *TERM* is low near business-cycle peaks and high near troughs, Chen's results suggest that poor prospects for future real activity (and thus investments) near business peaks may help explain low expected returns around peaks. Likewise, good prospects for future activity and investment after business troughs may contribute to high expected returns around troughs.

Our evidence documents variation in expected returns related to business conditions, but the evidence does not distinguish among the many potential explanations. Fleshing out the theoretical and empirical details of a story for the apparently rich variation in expected returns on bonds and stocks in response to business conditions is an exciting challenge.

6. Comparisons

6.1. Keim and Stambaugh (1986)

The paper closest to ours is Keim and Stambaugh (1986). They also test for common variation in expected returns on bonds and stocks. At least for bonds, they also find strong evidence that expected returns vary through time. Their tests are limited to monthly returns, however, so they miss the increase

in forecast power for longer return horizons observed here. Moreover, they do not attempt to relate expected returns to business conditions.

Keim and Stambaugh's evidence for stock returns is rather weak. They find strong evidence of time-varying expected returns only for the month of January. In their (table 2) regressions for all months of the 1928–1978 sample period, six of nine regression slopes for stock returns are within 2 standard errors of 0. When they split the data into subperiods (1928–1952 and 1953–1978), even this weak evidence of forecast power disappears.

To some extent, our stronger evidence on the predictability of stock returns comes from looking at return horizons longer than a month. Like those of Keim and Stambaugh, our results for monthly 1927–1987 returns are not strong. On the other hand, there is nothing in their subperiod tests that corresponds to our strong evidence on the predictability of stock returns for 1941–1987 (table 3), 1953–1987 (table 5), and 1967–1986 (table 6, below). We think these differences in results are due more to the choice of forecasting variables.

Their yield variable is the spread between the yield on bonds rated under Baa and the one-month bill rate. In our terms, their yield spread is like the sum of the default spread and the term spread. Since *DEF* and *TERM* track different components of expected returns, the sum can give an attenuated picture of the variation in expected returns. The sum also smears the differences in the patterns of the slopes for *DEF* and *TERM* that are among our more interesting and novel results.

The other two variables Keim and Stambaugh use to forecast returns are (1) minus the log of the ratio of the value of the Standard and Poor's 500 index to its average value over the preceding 45 years, and (2) minus the log of the average price of the shares of firms in the smallest quintile of NYSE stocks. Our tests indicate that these variables have less power to forecast stock returns than the dividend yield, the default spread, and the term spread, especially for periods after the Great Depression.

Our purpose is not to criticize Keim and Stambaugh. Their paper is painstaking and pathbreaking. A reasonable view of our work is that it (1) refines their choice of forecasting variables, (2) extends their tests on monthly returns to longer return horizons, (3) explains why expected (bond and stock) returns account for more return variation for longer return horizons, and, most important, (4) begins to tell a story that relates the common variation in expected bond and stock returns to business conditions.

6.2. *Chen, Roll, and Ross (1986)*

Our time-series evidence on the expected-return variation tracked by the default and term spreads complements the cross-section evidence of Chen, Roll, and Ross (1986). They argue (as we do) that the default spread is a measure of business conditions. Thus covariances of asset returns with shocks

to *DEF* are likely to help explain differences in expected returns in the multifactor asset-pricing models of Merton (1973) and Ross (1976). Their cross-section tests on stock returns support this hypothesis. They find that business risks (measured by the covariances of returns with shocks to *DEF*) and expected returns are larger for the stocks of smaller firms.

We find complementary evidence in our time-series tests. The variation in expected returns tracked by the default spread increases from high-grade to low-grade bonds, from bonds to stocks, and from big stocks to small stocks. Thus our results support and enrich their default-spread story.

Chen, Roll, and Ross also argue that the term spread is a measure of business conditions. In their tests, however, covariances with shocks to *TERM* show little power to explain the cross-section of expected stock returns. Again, this is consistent with our evidence. Our time-series tests suggest that all long-term securities (stocks and bonds) will have similar covariances with shocks to *TERM*. As a result, *TERM* will have power in cross-section tests only when securities with a range of maturities are included.

7. Out-of-sample forecasts

7.1. A statistical issue

In models like (1) that regress future returns on current yields, it is reasonable to assume that the residual, $\varepsilon(t, t+T)$, is uncorrelated with the independent variable, $X(t)$, and with past values of X. Stambaugh (1986) argues, however, that the residual is often correlated with future values of X. For example, in regressions of nominal bond returns on bond yields, the unexpected return from $t-T$ to t, $\varepsilon(t-T, t)$, and the yield shock between $t-T$ and t will be negatively correlated because shocks to yields produce opposite shocks to returns. In this case, Stambaugh shows that if the yield, $X(t)$, is positively autocorrelated, the ordinary least-squares (OLS) slope in (1) is upward biased; the estimated slope overstates forecast power.

When we apply Stambaugh's bias-adjustment procedure to our excess-return regressions, the estimates suggest that OLS slopes for D/P and *DEF* are slightly upward biased, but the slopes for *TERM* are downward biased. The bias-adjusted slopes do not change the inferences about explanatory power drawn above. Since the bias-adjusted slopes are based on strong assumptions [$X(t)$ is a first-order autoregression, and $\varepsilon(t-T, t)$ and shocks to $X(t)$ are only contemporaneously correlated], we do not show them. Instead, we examine the robustness of the OLS results with out-of-sample forecasts.

7.2. Construction of the forecasts

We forecast returns for horizons from one month to four years. Since the effective samples for the longer horizons are small, we would like a long period

to estimate the regressions and a long period to examine their out-of-sample forecasts. As tables 2 and 3 illustrate, however, the precision of the regression slopes falls if much of the volatile 1926–1940 period is used in the estimates. As a compromise, we forecast returns for the 21-year period 1967–1987 using rolling 30-year regression estimates that start in 1937.

Each forecast is from a regression estimated with returns that begin and end in the preceding 30-year period. For example, to forecast the first one-year return (1967), we use coefficients estimated with the 30 returns for 1937–1966. To forecast the first four-year return (1967–1970), we use coefficients estimated with the 27 overlapping annual observations on four-year returns that begin and end in the 1937–1966 period. For monthly and quarterly returns, the 30-year estimation period rolls forward in monthly or quarterly steps. For one- to four-year returns, the estimation period rolls forward in annual increments.

Although D/P and DEF capture similar components of expected returns, the results in tables 2 and 3 (t-statistics and regression R^2) suggest that D/P makes better forecasts of stock returns, while DEF is more informative for bond returns. Thus for the out-of-sample forecasts for bonds we use regressions of returns on DEF and $TERM$. For stocks, regressions of returns on D/P and $TERM$ are used to forecast monthly and quarterly returns. Since tables 2 and 3 say that $TERM$ does not have explanatory power for horizons beyond a quarter, only D/P is used to forecast longer-horizon stock returns.

7.3. Forecast results

Table 6 compares the out-of-sample forecasts for 1967–1987 with the in-sample R^2 from regressions estimated on the 1967–1987 period. To simplify the comparisons, out-of-sample forecast power is also measured in terms of R^2. The out-of-sample R^2 is $1-(MSE_R/MSE_N)$, where MSE_R is the mean-squared-error of the out-of-sample regression forecasts for 1967–1987 and MSE_N is the mean-squared-error of naive forecasts. Each naive forecast is just the average return during the 30-year period preceding the out-of-sample forecast (the same 30-year period used to obtain the slopes for the out-of-sample regression forecast). For example, the naive one-year return forecast for 1967 is the average annual return for 1937–1966. The naive four-year return forecast for 1967–1970 is four times the average annual return for 1937–1966.

The out-of-sample R^2 in table 6 tend to be smaller than the in-sample R^2 for 1967–1987, but the differences between in-sample and out-of-sample forecast power also tend to be small. Overall the results suggest that our OLS regressions have a bit of the Stambaugh (1986) bias problem; that is, the regression slopes and R^2 are slightly overstated.

The important result in table 6, however, is that the out-of-sample R^2 behave much like the in-sample R^2. Thus for higher-grade bonds (Aaa, Aa, A,

Table 6

R^2 for out-of-sample forecasts and for in-sample regressions for the 1967–1987 period.[a]

	Out	In	Out	In	Out	In	Out	In	Out	In
	Aaa		Aa		A		Baa		LG	
M	0.03	0.04	0.06	0.08	0.08	0.09	0.08	0.09	0.06	0.06
Q	−0.00	0.05	0.02	0.06	0.05	0.09	0.05	0.09	0.06	0.09
1	0.41	0.51	0.44	0.52	0.48	0.60	0.40	0.50	0.47	0.57
2	0.33	0.34	0.34	0.34	0.39	0.42	0.37	0.40	0.52	0.52
3	0.26	0.28	0.29	0.29	0.37	0.38	0.37	0.34	0.58	0.52
4	0.10	0.23	0.12	0.22	0.23	0.31	0.22	0.30	0.41	0.41
	VW		EW							
M	0.04	0.05	0.03	0.04						
Q	0.07	0.10	0.05	0.08						
1	0.18	0.15	0.19	0.23						
2	0.33	0.39	0.35	0.45						
3	0.40	0.53	0.45	0.53						
4	0.38	0.59	0.46	0.50						

[a] Each out-of-sample forecast is from regression coefficients estimated on the returns that begin and end in the preceding 30-year period. The bond return forecasts use *DEF* and *TERM*. The monthly (M) and quarterly (Q) stock return forecasts use *D/P* and *TERM*; longer-horizon stock return forecasts use only *D/P*. See note to table 1 for definitions of portfolios and variables. For monthly and quarterly returns, the 30-year estimation period and the subsequent forecast period roll forward in monthly or quarterly steps. For one- to four-year returns, the estimation and forecast periods roll forward in annual increments.

The out-of-sample R^2 (Out) is $1-(MSE_R/MSE_N)$, where MSE_R is the mean-squared-error of the out-of-sample regression forecasts for 1967–1987 and MSE_N is the mean-squared-error of naive forecasts. Each naive forecast is just the average return during the 30-year period preceding the out-of-sample forecast (the same 30-year period used to obtain the slopes for the out-of-sample regression forecast). The in-sample R^2 (In) are from regressions for 1967–1987.

The out-of-sample R^2 for two-, three-, and four-year stock returns are substantially larger than those in Fama and French (1988b). The higher values here reflect the use of MSE_N as the benchmark (the denominator in R^2) against which the out-of-sample MSE_R are compared. Fama and French (1988b) use the variance of the out-of-sample realized returns as the denominator for the out-of-sample R^2. For the overlapping two- to four-year returns, the out-of-sample variance and the resulting R^2 are biased downward.

and Baa), the shorter-term forecast power of *TERM* is more important than the longer-term forecast power of *DEF*. As a result, for these portfolios, both in- and out-of-sample R^2 increase from 0.09 or less for monthly and quarterly returns to an impressive 0.40 or more for annual returns, and then decay some for two-, three-, and four-year returns. In contrast, the longer-term forecast power of *DEF* and *D/P* is relatively more important for low-grade bonds and the two stock portfolios. For these portfolios, the in- and out-of-sample R^2 increase from 0.10 or less for monthly returns to an impressive 0.40 or more in three- and four-year returns. In short, since the out-of-sample R^2 reproduce the interesting patterns in the in-sample R^2, the out-of-sample tests support our basic inferences about the variation in expected returns.

8. Conclusions

The default spread is a business-conditions variable, high during periods like the Great Depression when business is persistently poor and low during periods like 1953–1973 when the economy is persistently strong. The dividend yield is correlated with the default spread and moves in a similar way with long-term business conditions. For most of the 1927–1987 period, the term spread is related to shorter-term measured business cycles. It is low near business-cycle peaks and high near troughs. The fact that the three variables forecast stock and bond returns then suggests that the implied variation in expected returns is largely common across securities, and is negatively related to long- and short-term variation in business conditions.

One story for these results is that when business conditions are poor, income is low and expected returns on bonds and stocks must be high to induce substitution from consumption to investment. When times are good and income is high, the market clears at lower levels of expected returns. It is also possible, however, that variation in expected returns with business conditions is due to variation in the risks of bonds and stocks. Our regressions allow us to identify variation in expected returns. To decide how this variation splits between changes in the levels of different risks and their prices, other approaches will be needed.

What economic forces drive the economy between long- and short-term good and bad times? Invention? Changes in tastes for current versus uncertain future consumption? Government monetary and fiscal policies? These are, of course, the central and largely unanswered questions of macroeconomics. Answers to such questions are probably necessary, however, to explain our evidence that long- and short-term economic conditions produce a rich mix of variation in expected asset returns.

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Attachment

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Views of Financial Economists on the Equity Premium and on Professional Controversies*

The consensus of 226 academic financial economists forecasts an arithmetic equity premium of 7% per year over 10- and 30-year horizons and of 6%–7% over 1- and 5-year horizons. Pessimistic and optimistic 30-year scenario forecasts average 2% and 13%, respectively. Respondents claim to revise their forecast downward when the stock market rises. They perceive the profession's consensus to be higher than it really is and are influenced by this perception. There is agreement that markets are efficient and lack arbitrage opportunities and that government intervention in financial markets is detrimental.

The equity premium is perhaps the single most important number in financial economics: the rate by which risky stocks are expected to outperform safe fixed-income investments, such as bonds or bills. It is the main input both in asset allocation decisions—how much of one's portfolio an investor should put into stocks versus bonds—and in the capital asset pricing model (CAPM)—the model used by most practitioners in computing an appropriate hurdle rate for accepting investment projects.

The academic finance profession has been teaching asset allocation and CAPM budgeting for many years. But oddly, it has been relatively quiet in recommending an appropriate ''standard'' for the equity premium, the key input to these models. This is unfortunate, in that without a good estimate of the equity premium, the mainstream theories are really quite useless from a practical perspective. The main reason for the scarcity of good justifications and recommendations for a ''good practical estimate'' is, of course, that neither do financial economists know what the correct equity premium is nor is there

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a consensus on how it should be estimated. Existing estimates are discussed in more detail in Section I.

This article intends to supplement existing equity premium estimates with a ''common practice estimate,'' the consensus in the academic profession. Although this consensus is itself likely to be a weighted estimate obtained by other methods, the distribution of estimated values among academics is itself interesting. The consensus estimate can be a number of some relevance in classroom, courtroom, and boardroom discussions, even if it may not be the best estimate of the equity premium itself. Then again, if there was agreement on how to calculate the best estimate, there would be no need for a survey of financial economists to begin with. Still, surveys in general and this survey in particular have shortcomings, and these are discussed in Section II, which describes the design of the survey.

Section III discusses the principal survey results, that is, the consensus view about the equity premium among the 226 responding financial economists. The most important findings, in brief, follow. The arithmetic 30-year equity premium consensus forecast is about 7%. It is between 0.5% and 1.5% lower on the 1-year horizon, depending on the central statistic. The consensus perception of a pessimistic outcome (at one in 20 probability assessments) over 30 years is 2%–3%; the optimistic equivalent is 12%–13%. There is evidence for a ''false-consensus effect,'' in that economists seem to anchor their forecast to what they perceive the consensus to be—and this perceived consensus is about 0.5%–1% above the actual consensus. Finally, economists claim that increases in the stock market would, on the margin, cause them to reduce their forecast of the equity premium. Section IV briefly discusses the answers to a set of issues of interest to both financial academics and financial practitioners. The strongest consensus obtains that markets are efficient and lack arbitrage opportunities and that government intervention in financial markets is detrimental. Section V concludes with a summary of the findings.

I. Existing Estimates of the Equity Premium

Cochrane (1997) and Siegel and Thaler (1997) provide comprehensive surveys of the macroeconomics and finance literature about the equity premium puzzle—the question as to why stocks have historically performed so well relative to bonds. This section briefly discusses existing methods to estimate the equity premium.

A. Equity Premium Measurement Issues

Unfortunately, there is neither a uniformly accepted precise definition nor agreement on how the equity premium should be computed and applied.

First, the geometric average is earned by a buy-and-hold investment strategy that is long on stocks and short on interest-bearing securities, while the arithmetic average is earned by a strategy that rebalances investment to a fixed amount each year. Mathematically, the geometric mean is always lower than the arithmetic mean. For example, a 50% decrease followed by a 100% increase leaves an investor with a 0% geometric return, although the arithmetic average would suggest a positive 25% return. Historically, the 30-year geometric mean equity premium has been about 2% lower than the arithmetic mean (see app. A for more detail). It is not clear whether the arithmetic or the geometric average should be used in capital budgeting applications using the CAPM (Indro and Lee 1997).

Second, stocks are long-term investments, and the most common method to compute the equity premium—subtracting a short-term bond return from a long-term equity return—is neither parsimonious nor necessarily a fair investment holding-period comparison.[1] Subtracting off the return to long-term bonds instead of the return to short-term bonds for a 30-year equity premium computation decreases the long-term equity premium by between 1% and 2%. Shiller (1989) subtracts a bond index that splices corporate bonds with treasuries. This, too, results in a lower equity premium.

Lacking formal agreement on how the equity premium should be computed and used, even identical views on the implied equity premium can easily lead different individuals to respond with and themselves use different estimates for the same task. This article describes arithmetic equity premia relative to short-term bills, unless otherwise indicated.

B. Historical Average Equity Premia

Perhaps the most popular method to obtain an estimate of the equity risk premium is an extrapolation of historically realized equity premia into the future. Table 1 shows that practitioners can advocate a whole range of estimates as ''their'' equity premium choice. The use of Ibbotson equity premia estimates seems to be particularly widespread. For example, the most popular finance textbook, Brealey and Myers (1996, p. 146), recommended 8.2%–8.5% in 1996, as sourced from the *Ibbotson 1995 Yearbook.* Table 1 shows that as of December 1998, the equivalent 1926–98 Ibbotson historical arithmetic equity premium average has risen to 9.4%. Shiller (1989, ch. 26) has assembled a longer data set, which can justify as low an equity premium average as 4.3%, using geometric averages over the entire 129-year history.

1. Abel (1999) decomposes the equity premium into a risk and a term premium. Not surprisingly, the term premium accounts for about 25% of the observed equity premium.

TABLE 1 Historical Stock Market and Equity Premium Performance

Source and Time Frame	Number of Years	Geometric Mean (%)	Arithmetic				
			Mean (%)	SD (%)	Minimum (%)	Maximum (%)	SE (%)
Stock market return historical averages:							
Shiller 1870–1998	129	9.3	10.8	17.8	−42.9	54.9	1.6
Shiller 1899–1998	100	10.2	11.9	18.6	−42.9	54.9	1.9
Ibbotson 1926–98	73	11.2	13.2	20.3	NA	NA	2.4
Shiller 1926–98	73	11.0	12.8	19.3	−42.9	55	2.3
Shiller 1949–98	50	13.3	14.3	15.1	−21	46	2.1
Shiller 1974–98	25	14.8	15.9	15.5	−20.8	38.6	3.1
Shiller 1994–98	5	23.8	24.5	13.4	.0	35.1	7.4
Equity premiums historical averages:							
Shiller 1870–1998	129	4.3	6.0	18.5	−45.4	53.4	1.6
Shiller 1899–1998	100	5.3	7.1	19.1	−45.4	53.4	1.9
Ibbotson 1926–98	73	7.1	9.4	NA	NA	NA	NA
Shiller 1926–98	73	6.1	8.0	19.8	−45.4	53.4	2.3
Shiller 1949–98	50	6.9	8.2	16.1	−31.8	44.1	2.3
Shiller 1974–98	25	6.5	7.9	16.3	−31.8	31.3	3.3
Shiller 1994–98	5	18.4	19.0	12.7	−.0	28.6	5.7

NOTE.—Ibbotson estimates are published in the Year-End Summary Report (1998). They are based on the Standard and Poor's 500 Stock Index (S&P500) return with dividends (''large company stocks'') and 30-day-to-maturity Treasury bills. Shiller indices are published in Shiller (1989, ch. 26) and updated on http://www.econ.yale.edu/~shiller/chap26.html. They are based on the dividend-adjusted S&P500 (formerly called the Standard and Poor's Composite Index) and a short interest rate spliced from corporates and treasuries, and are computed from January-to-January index averages (of the following year), not December-to-December closing prices. Thus, the last price used in the computations is an average January 1999 index price. The indices differ primarily because of the use of different interest rates. Geometric means are computed as $g_T = \sqrt{[\Pi_{y=1}^{T}(1 + rm_y)]/[\Pi_{y=1}^{T}(1 + rf_y)]}$, where rm_y is the market return and rf_y is the risk-free rate in year y. Arithmetic statistics are computed from a T-year series of $(rm_y - rf_y)$ in a standard fashion. Unreported: averages computed using the value-weighted stock market index obtained from Center for Research in Security Prices have means of about 0.3% more and standard deviations of about 2% more than equivalent S&P returns. Unreported: inflation from 1926 to 1997 was about 3.1%. NA = not available.

Yet, historical averages have limits. Even from a theoretical perspective, an observer could interpret recently high historical stock returns to be indicative of lower (not higher) future stock returns. If the true expected rate of return on stocks were to have fallen over the last couple of years because investors were unexpectedly streaming into the stock market and competing away previously higher expected rates of return, because investors became less risk averse, or because volatility declined, recent increases in stock prices (high stock returns) would soon be followed by lower stock returns in the future. There is also the more mundane nonstationarity problem that 50-year old equity premia may have little relevance to the world today. But stock returns are so volatile that shorter time series have too high a standard deviation to be useful estimators. For example, a 95% confidence interval (plus or minus two standard errors) for the true equity premium average over the 1994–98 period ranges from +7.6% to +30.4%—not a useful range for practical capital budgeting purposes.

C. Predictive Regressions

An alternative popular method to estimate future expected returns relies on the observation that, in the very long run, expected corporate payouts and expected investment returns must be equal. The stock price today must be the present value of all future dividend payouts (or earnings). Many researchers (e.g., Campbell and Shiller 1988; Fama and French 1988; Blanchard 1993) have used this observation to predict future equity returns and equity premia with dividend yields (and, to a lesser extent, other variables).[2] As of 1999, a regression of annual data from 1927–97 yields

$$\mathrm{EQP}_y = -11.5\% + 3.95\left(\frac{D_{y-1}}{P_{y-2}}\right) + \mathrm{noise}_y, \qquad (1)$$

where EQP_y is the equity premium (here the difference between the return on a value-weighted stock index and short-term treasury investments) in year y, and D_{y-1}/P_{y-2} is the lagged dividend yield. As of 1999, with a dividend yield of below 1.5%, this regression predicts a 1-year-ahead forecast of less than −10%. (Longer period forecasts converge to the historical average.) Variations of such ''conditional models'' predict equity premia ranging from about −10% to about 0%. These are not comfortable estimates. After all, why would anyone hold equity if stocks did not offer higher expected returns than bills? And, what

2. ''Fortunately,'' aside from a number of statistical problems, such models have predicted consistently poorly out of sample at least since 1946. Goyal and Welch (1999) show that this is because simple linear models are unstable—the coefficients have declined over time.

does this imply for firms' capital budgeting decisions—should firms place a lower hurdle rate on riskier projects?

D. Theoretical Arguments

Yet another popular approach to estimating the expected equity premium relies on calculations of what reasonable expected rates of returns are necessary to entice the average investor to be roughly indifferent between investing in stocks and bonds, given historical aggregate volatility and covariances. Assuming reasonable risk aversion for such an investor (and introspection), such estimates typically arrive at estimates of about 1%–3% (Mehra and Prescott 1985).

Unfortunately, these calculations have predicted about 1%–3% for decades, while the historical 1926–98 average has increased to an all-time high of 9.4%. This puzzle deepens even further if the average investor is not tax-exempt, because equity capital gains face lower effective tax rates than bond interest receipts. Cochrane (1997) and Siegel and Thaler (1997) both conclude that economic theory has great difficulty in explaining such high figures (even with high degrees of risk aversion and all sorts of modifications to standard consumer choice models).[3] Still, they remain skeptical about the continued presence of an equity premium in the (often quoted) 6%–8% range.

E. Popular Views

Small investor surveys tend to find equity premium expectations between 10% and 15% per year. On October 10, 1997, The *New York Times* reports that a Montgomery Asset Management telephone survey found an expected 1-year stock market return of 22%. On November 22, 1999, *Fortune* Magazine mentions that a similar Paine-Webber survey in July 1999 found expected stock market returns in excess of 20% for both the 1-year and 10-year horizons. On November 15, 1999, the *Financial Times* reports a Gallup/Paine-Webber poll that found ''only'' a 16% expected stock market return over both 1- and 10-year horizons.[4]

3. In addition to models based on standard representative agent utility maximization, these summary papers also discuss other, more ''radical'' explanations, such as behavioral explanations (e.g., Benartzi and Thaler 1995) and ex post survival bias (e.g., Jorion and Goetzmann 1999).

4. Not surprisingly, investors have poured into the stock market in unprecedented numbers. In the 1996 *Mutual Fund Fact Book,* the Investment Company Institute reports a strong positive correlation between stock market rallies and mutual fund net inflows (p. 130). In 1995, investors poured in $164 billion, which was up from $2.8 billion, just after the crash (in 1988), up from a $40 billion/year average throughout the 1980s, and up from net outflows during the 1970s. (In general, the more aggressive the equity fund investment style, the larger the net fund inflows in the 1990s.) Aggregate net inflows into the three major public equity markets (equity issues minus dividends and repurchases and bankruptcies) have seen multiyear levels unprecedented since the Great Depression.

In contrast, professionals tend to be more conservative. A survey of pension fund executives and other institutional investors by *Pensions and Investments* (January 12, 1998, p. 1) found an expected equity premium of 3%, and the 1997 Greenwich Associates survey of fund professionals found an expected 5-year equity premium of 4%–6%.[5]

Individual organizations tend to be in line with professional investors. Financial Engines appears to use a short-term equity premium of about 6%. McKinsey seems to have standardized recently on an equity premium arithmetic figure of 5%–5.5% for valuation purposes. The Social Security Administration Office assumes a 7%–3% = 4% geometric equity premium, based on a dated historical average. Naturally, those arguing that rescuing Social Security requires an asset reallocation into equities contend that the 4% equity premium is too low, based on observed historical averages; others consider this figure too high (Diamond 1999).

A sampling of finance textbooks shows that, for instance, Copeland, Koller, and Murrin (1995, p. 260) recommends a 5%–6% geometric average. Grinblatt and Titman (1998, p. 174) uses 10% in an example but, after giving a discussion, is notably silent on giving any estimate (see p. 176). Ross, Westerfield, and Jaffe (1993, p. 257) recommends 8.5%, Van Horne (1992, p. 214) 3%–7%, and Weston, Chung, and Siu (1997, p. 190) 7.5%.

F. Summary

In sum, there are wide discrepancies in estimates of the expected equity premium, ranging all the way from −10% to +20%, depending on the source of the forecast. Such disagreement about the expected equity premium can lead to absurd consequences in the classroom, courtroom, and boardroom: the same project may require passing a hurdle rate of 10% in one company and 20% in another; the same investor may receive retirement advice that suggests vastly different retirement ages, saving needs, and investment policies; and politicians may or may not advocate different reforms of the social security system, each based on a different estimate of the equity premium and each backed up by a generally accepted estimation method.

The goal of this survey is to provide a ‘‘metaestimate,’’ that is, a

5. Fund managers predicted the Standard and Poor’s 500 Stock Index (i.e., without dividends that account for about 1%–2% per year) to offer a 10.4% mean and a 9.8% median. A range of 8%–14% represents about two-thirds of the distribution. The survey was taken in September and October 1997 and encompassed 2,309 funds, of which about 75% responded. It is published in ‘‘What Now?’’ by Greenwich Associates. Prior academic research on investment expectation can be found in Shiller (1987, 1999), Pound and Shiller (1989), and Kon-Ya, Shiller, and Tsutsui (1991, 1996). An update of Kon-Ya et al. (1996) of their 1991 article on Shiller’s website (http//aida.econ.yale.edu/Schiller/data.htm) shows a 1-year stock market expectation of 6.6% by U.S. respondents but high year-to-year variability.

weighted average of estimates used by financial economists, which could become a focal point different from the aforementioned estimates. Although this consensus has no claim that it offers the correct best ex ante estimate, it is at least an appropriate common-practice estimate among one group of well-informed individuals, who are usually asked to provide such estimates in their ordinary course of instruction and who are without financial incentives to radiate biased estimates.

II. The Survey Design

This article summarizes the results of two surveys, henceforth referred to as the first and second survey.

A. The First Survey

The first survey is reprinted in appendix B. This article reports statistics for (*a*) forecasts of the mean and 5% and 95% confidence intervals for the equity risk premium (stocks minus equivalent horizon bonds) for 1-year, 5-year, 10-year, and 30-year horizons; (*b*) an estimate of the mean that other academics would provide on this survey; and (*c*) views regarding nine issues of relevance to the academic finance literature.

This survey was posted on my World Wide Web site (http://linux.agsm.ucla.edu/) in October 1997. In addition, a hard copy was mailed to finance professors at 11 universities with large finance faculties, associate editors at three major journals, and my colleagues at the University of California, Los Angeles. Almost all of the responses came from the mailings, not from visitors to the Web site. There were 114 valid completed forms, the first arriving in October 1997, the last in February 1998.

To correct the major ambiguity in the first survey, whether participants had responded with a geometric or arithmetic average, respondents were contacted by e-mail in October 1998 and asked whether their 30-year answers were arithmetic or geometric averages and whether their views on the 30-year equity premium forecast had changed. Eighty-five participants responded to the request for clarification; only 29 did not. Overall figures provided in the tables reflect appropriate adjustments to the first-survey estimates, as described in appendix A, to make them equivalent to answers to the second survey.

B. The Second Survey

The second survey is reprinted in appendix C. It was shorter than and corrected several shortcomings of the first survey. It elicited explicitly both geometric and arithmetic 30-year averages, requested an equity premium defined as the difference between stocks and short-term bills, posed a question about how an increase in equity prices would influence

a researcher's views, and added questions on the 100-year equity premium and 30-year inflation, on whether the respondent considered himself an expert or had published on the subject, and on survey completion time and clarity of the survey. This second version was posted both on my Web site and on the *Journal of Finance* World Wide Web site and elicited 112 responses by Ph.D.-level financial economists.[6] The first response was received in January 1999, the last in May 1999. Reported figures in the tables break out responses to this second (more accurate) survey.

C. Problems

The surveys admittedly suffer from a number of problems. First, economists had no powerful incentive to reveal their best estimates. However, the cost of jotting down a number that all finance professors have to tell students on a daily basis is low. The majority of professors contacted were willing to participate. Even though it is possible that participants represent a biased sample, a visual inspection reveals a fairly large subset of professors at many leading universities. Second, the surveys were not a controlled experiment but an attempt to take the pulse of the profession. The surveys did not permit anonymous responses, and none was received. I was clearly identified as the person asking the question. Most finance professors would be unlikely to answer a survey sent by someone they do not know. Indeed, most responses were received only after private e-mail reminders. Third, second-survey participants answered 1 year later—after a significant market rise and after the first write-up of this article was available. Yet, even if the circulated first draft of the article had changed some participants' views, I would be interested more in their revised than in their original views for this article. Fourth, the presence of the Brealey and Myers's (1996) historical figures on the right of each question may have induced respondents to anchor on them. In defense, the Ibbotson numbers are familiar to most finance professors, and their presence may have increased the survey response rate by allowing participants to answer without delaying until they could find the time to verify the Ibbotson numbers. (Moreover, these figures were originally intended to clarify whether I was asking for a geometric or arithmetic average.) Fifth, the questions in the first survey were ambiguously phrased and required e-mail clarification and adjustments. Unfortunately, it is not possible to find a fresh set of participants to replenish the pool. Fortu-

6. Fourteen responses were from individuals who were not financial economists with a Ph.D. (mostly finance Ph.D. students; their 30-year arithmetic average forecast was 5.3% on average, with a median of 5.9%).

nately, clarified adjusted answers to the first survey are very close to the answers of the second survey.

III. The Academic Equity Premium Consensus

A. Long-Horizon Equity Premia

Figure 1*D* plots the distribution of 226 answers to the 30-year arithmetic forecast for the equity premium using the largest set of answers. Impulse lines within the bars on the 30-year graph plot the distribution of answers to the second survey only.

Table 2 shows that various central statistics (the mean, the 5% and 95% truncated mean, and median) suggest an academic expected arithmetic 30-year equity premium consensus of about 7%.[7] Figure 1 shows that the mode response is about 8%. Still, only about 20% of participants on either the first or the second survey picked an (unadjusted)[8] number between 8% and 8.9% (8.5% being the largest), equal to the historical Ibbotson estimate quoted by the questionnaire itself. The historical average does seem to have strong influence, but about 80% of the participants provided their own estimate instead. The standard deviation of the expected 30-year premium is about 2.0%,[9] the first quartile is 6%, and the third quartile is 8.4%. There is a pronounced clustering between 5% and 9%, but there are more individuals below 5% than there are above 9%. Remarkably, figure 1 does not indicate multimodality—the profession does not divide neatly into two or three camps, each of which forecasts its own number. Most individuals choose a convex combination of the above-mentioned forecast methods, with most of the weight on the long-term historical average.

As to differences between the first and second survey, 112 second-survey respondents offered an equity premium estimate of 6.7%–7.0%, depending on the central statistic. Adding in the e-mail-clarified responses (for a total of 197 clear responses), the mean 30-year equity premium forecast rises back to the 7.1%, equal to the average of all 226 respondents. The (relatively small) difference of 0.4% can thus be mostly attributed to a sampling variation across individuals (perhaps because of the increased stock market level by the time the second

7. There is one outlier of 15%, which is responsible for a 0.04% higher estimate. In correlation and regression computations, this observation was eliminated.

8. This is the only exception where the frequency of unadjusted estimates to the first survey is quoted. This is because there is a question as to how many individuals just copied the provided 8% Ibbotson estimate provided by the survey. The median and mean unadjusted response to the first survey was about 6%, not 8%.

9. Nordhaus (1994) surveys a set of economic and natural researchers about the potential impact of global warming and finds remarkably high dispersion in expert opinion. This equity premium survey mirrors this dispersion in expert opinion in finding high across-expert dispersion.

survey was run; see Sec. III*E*) and only secondarily to remaining miscorrection in the adjustment calculation.

In sum, 6.8%–7.0% is a robust estimate for the consensus about the 30-year arithmetic equity premium among financial economists. However, there is considerable disagreement across economists. The following are not reported in table 2.

Geometric average. About half the respondents explicitly offered a geometric 30-year equity premium forecast. The academic consensus for the geometric 30-year equity premium is around 5.2% per year.

One-hundred-year equity premium forecast. Among 45 responses to the (optional) request for 100-year forecasts on the second survey, the 100-year arithmetic equity premium forecast mean was 6.5%, which was about 1% less than the same respondents' 30-year forecast mean.

Stock market forecast. Respondents to the second survey offered a 30-year arithmetic stock market forecast of 11% (SD of 2.1%).

Recent updating. Among 85 first-survey respondents contacted by e-mail about a year later, only nine individuals chose to reduce their estimates; four individuals chose to increase their estimates.

B. Shorter-Horizon Equity Premia

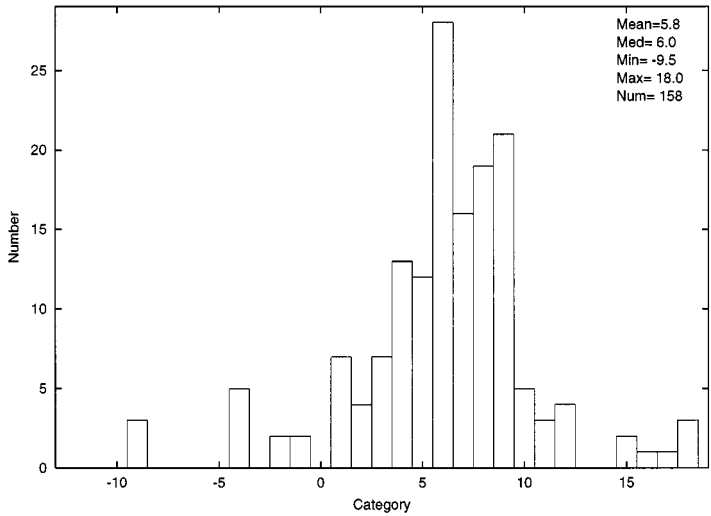
Table 2 shows that the largest set of adjusted responses, 170 in total,[10] indicates an arithmetic 10-year equity premium forecast of 7% (SD: 2%). For the 58 individuals answering this question on the second survey, the average was slightly lower and practically identical to the average of these respondents' 30-year arithmetic equity premium forecasts; both were 6.8%. (The average difference between 10-year and 30-year arithmetic equity premia forecasts when both are available is 0.2%.) It is fair to characterize any difference between 10- and 30-year equity premia forecasts as insignificant.

However, the two shorter-term (1-year and 5-year) arithmetic equity premium forecasts are lower, both in economic and statistical terms.[11] Relative to the 10-year and 30-year forecasts of about 7.1%, the 5-year untruncated forecast mean is about 0.5% lower, and the 1-year untruncated mean forecast is about 1% lower. (Truncated mean differences are smaller, and the average drops for respondents for which I

10. In the second survey, shorter-term equity premia estimates were optimal. There is no real difference between statistics computed over all reported answers or only for those individuals' answers where both shorter- and longer-equity premia forecasts were available. See app. A for more details.

11. About 20% of survey participants offered an expected premium term structure that was monotonically increasing in horizon; 50% had the expected premium term structure monotonically decreasing. This decline in forecast by horizon is comforting in another sense: many financial economists did not just copy the provided Ibbotson estimate but instead provided their own estimate. The number of unadjusted 8% answers drops from the 20% for the 30-year estimate to about 15% for the 1-year estimate.

A



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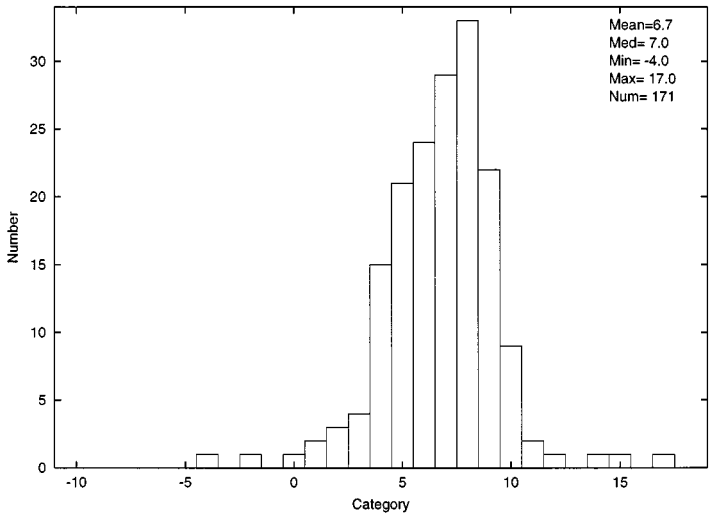
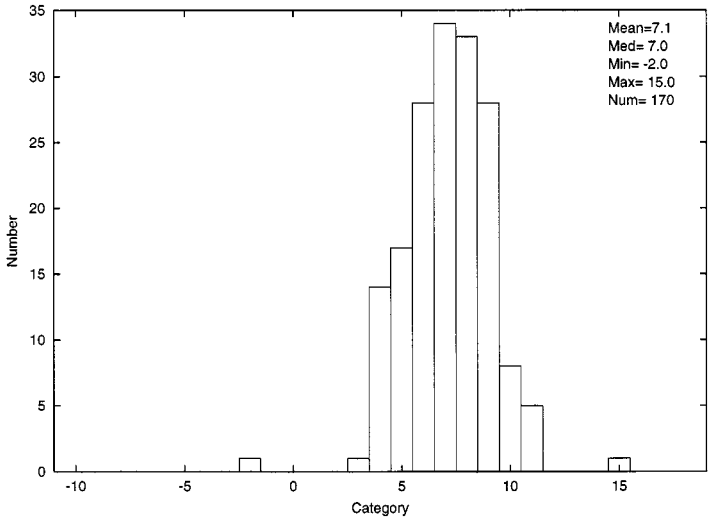


FIG. 1.—The distribution of arithmetic equity premia forecasts by financial economists. The surveys from which these histograms were computed are reproduced in appendices B and C. Statistics are over both the first and second survey (after adjustments to first-survey responses explained in app. A). *A*, Distribution of the 5-year expected equity premium; *B*, distribution of the 1-year expected equity premium; *C*, distribution of the 30-year expected equity premium; and *D*, distribution of the 10-year expected equity premium. 1*D* reports responses to the second survey as impulse lines inside the bars.

C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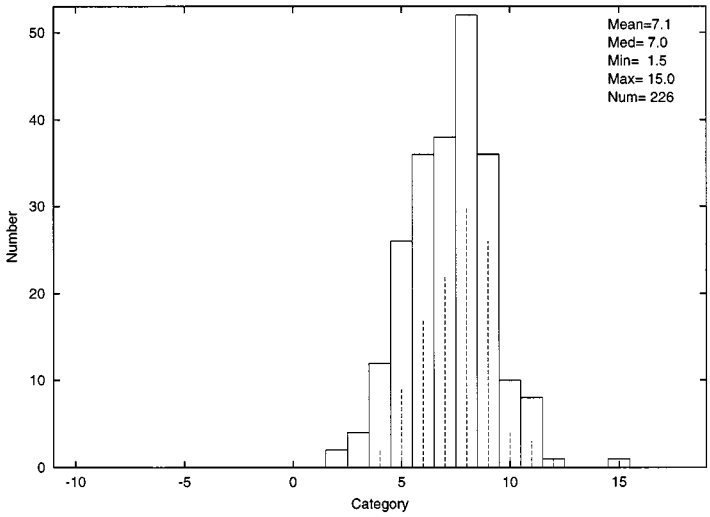
D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15

TABLE 2 Univariate Statistics for Arithmetic Equity Premia Forecasts

Description	Mean5 (%)	Mean (%)	SD5 (%)	SD (%)	Minimum (%)	Q1 (%)	Median (%)	Q3 (%)	Maximum (%)	*N*
30-year forecast	7.1	7.2	1.7	2.0	1.5	6	7	8.4	15	226
30-year forecast (S2)	6.7	6.8	2.0	2.2	1.5	5	7	8	15	112
10-year forecast	7.0	7.1	1.9	2.0	−2	6	7	8.4	15	170
5-year forecast	6.7	6.7	2.0	2.6	−4	5	7	8.0	17	171
1-year forecast	6.5	5.8	2.4	4.5	−9.5	4	6	8.5	18	158

NOTE.—The table presents the distribution of arithmetic equity premia forecasts by financial economists. The surveys themselves are reproduced in appendices B and C. The ''S2'' line reports only responses to the second survey. Other lines report statistics from both surveys after adjustments to first-survey responses, as explained in appendix A. Mean5 and SD5 are the mean and standard deviation after each series is truncated at its fifth and ninety-fifth percentile. Q1 and Q3 are quartiles 1 and 3.

have a 30-year forecast are 0.7% and 1.4%.) This is primarily because of a more frequent presence of negative forecasts rather than a left shift of the distribution. Twelve respondents recommend an estimate that suggests that they believe Treasury bills will outperform stocks over the next year (two believe that this will occur over the next 5 years). Compared to the long-term forecast, there is also considerably more disagreement among economists for what the best short-term equity premium forecast is. The truncated standard deviation across financial economists rises from the 1.7% for 30-year forecasts to about 2.5% for a 1-year forecast; the untruncated standard deviation rises even more.

C. Optimistic and Pessimistic Scenarios

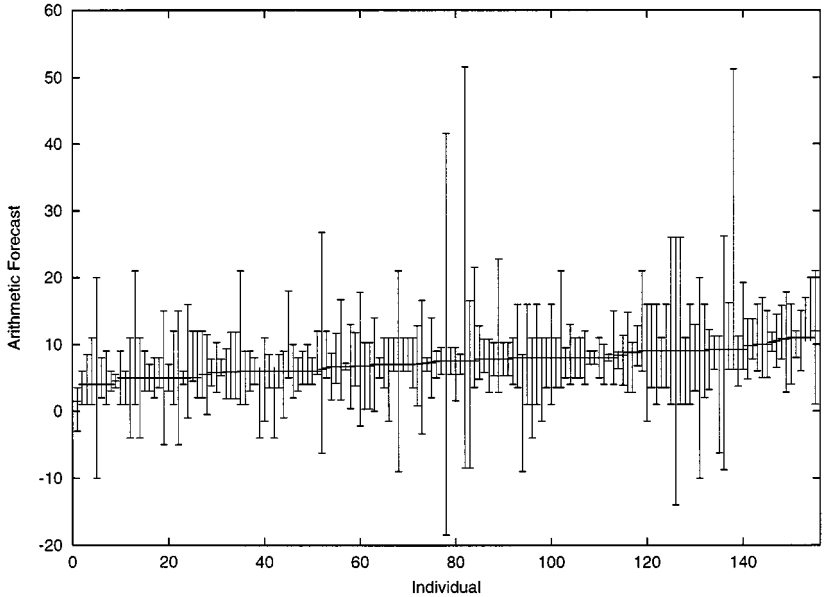
Respondents were also asked to provide their fifth percentile and ninety-fifth percentile scenarios for the equity premium. This was an optional question, so the number of responses to these questions is lower than the number of responses to the earlier question about the 30-year mean forecast. Most finance professors are unlikely to have given much thought to this question, because they do not usually have to provide such figures. Consequently, scenario estimates are intrinsically less reliable than economists' own expected forecasts. This unreliability is reflected in a much wider dispersion of answers and some inconsistencies.[12] The reader should focus primarily on the more robust statistics based on medians and truncated means and not on the simple means.

Figure 2 graphs the expected, most optimistic, and most pessimistic scenarios when individuals are sorted by their 30-year arithmetic forecasts. The statistics are provided in table 3. The top half of table 3 shows that the most optimistic arithmetic 30-year equity premium scenario consensus is somewhere between 11% and 13% per year. (For 56 answers to the second survey, the median and mean is about 11%.) Shorter-term optimistic-case scenarios are successively more optimistic, but the magnitude depends strongly on the central statistic used. The 10-year optimistic scenario arithmetic equity premium forecast lies at around 15%, the 5-year optimistic scenario lies at around 20%, and the 1-year optimistic scenario lies between 25% and 30%. In the minds of many academics, the most recent 3 years were rather unusual (one in 20) realizations.

The bottom half of table 3 shows that the consensus for the pessimistic arithmetic 30-year equity premium scenario (at the 5% level) is between 2% and 3% (median) per year. (For 55 answers to the second survey, the median and mean are about 4%—higher than they are in

12. There were four responses for which the optimistic scenario was not better than the average forecast and one response for which the pessimistic scenario was not worse than the average forecast. These five responses were first eliminated.

A



B

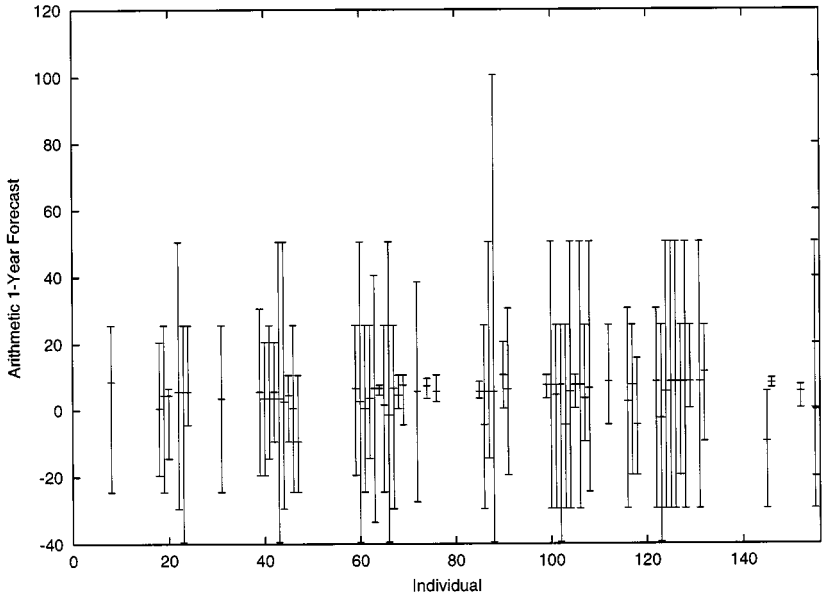


FIG. 2.—The pessimistic-scenario, average, and optimistic-scenario 30-year arithmetic equity premium forecast by 226 financial economists. Forecasts from the first survey were adjusted, as explained in appendix A. In both figures, individuals are indexed (lined up) identically, sorted by their mean forecast. Clustering in 1-year responses is induced because of discreteness in 30-year responses and the sorting procedure. *A*, Distribution of the 1-year expected equity premium; *B*, distribution of the 10-year expected equity premium.

TABLE 3 Univariate Statistics for Arithmetic Equity Premia Optimistic and Pessimistic Outcome Forecasts

Description	Mean5 (%)	Mean (%)	SD5 (%)	SD (%)	Minimum (%)	Q1 (%)	Median (%)	Q3 (%)	Maximum (%)	*N*
Optimistic:										
30-year scenario	12.8	13.3	4.9	6.7	3.5	9	11.2	16	51.5	158
10-year scenario	15.4	16.5	5.5	10.9	6	11	15.4	19.1	101.2	104
5-year scenario	21.2	23.1	11.5	22.3	8	11	17.8	26	201	101
1-year scenario	28.6	29.2	14.9	17.0	6	17	26	51	101	71
Pessimistic:										
30-year scenario	2.2	2.2	4.0	4.5	−18.5	1	3.2	5	11	159
10-year scenario	−.8	−1.0	5.4	6.2	−24	−4	1	2.8	8.9	106
5-year scenario	−8.3	−9.0	10.2	12.4	−59	−14	−7.2	.3	8.9	102
1-year scenario	−19.2	−19.6	13.5	11.9	−39	−29	−24	−9	6.5	72

NOTE.—The table presents the distribution of arithmetic equity premia pessimistic and optimistic scenarios (at the 5% level) by financial economists. The surveys themselves are reproduced in appendices B and C. The ''S2'' line reports only responses to the second survey. Other lines report statistics from both surveys after adjustments to first-survey responses, as explained in appendix A. Mean5 and SD5 are the mean and standard deviation after each series is truncated at its fifth and ninety-fifth percentile. Q1 and Q3 are quartiles 1 and 3.

the overall sample [not lower as is the mean forecast].) Shorter-term pessimistic-case scenarios are successively more pessimistic. The 10-year pessimistic scenario forecast lies around 0%, the 5-year pessimistic scenario lies around −8%, and the 1-year pessimistic scenario lies between −20% and −25%.

It is remarkable that even at a probability of one in 20, financial economists tend not to believe that a meltdown of Japanese-style proportion lasts for 10–30 years. Indeed, the confidence of financial economists is remarkable: the typical pessimistic one-in-20-case 30-year scenario foreseen by financial economists is about the equity premium that Mehra and Prescott (1985) consider to be consistent with reasonable risk aversion. This low a number would be consistent with the hypothesis that recent high stock returns are simply reflections of lower required future equity returns, which coincides with the personal view of Siegel (1999) and myself.[13]

There is a negative correlation between the optimistic and pessimistic estimates across economists—economists who indicate a more positive optimistic scenario also indicate a more negative pessimistic scenario. Thus, variation in optimistic/pessimistic scenarios are driven more by differences in confidence than by differences in estimates of the mean. The correlation between the pessimistic and mean equity premium forecast is positive—economists with higher equity premium mean forecasts also provided more favorable pessimistic scenarios. Thus, the pessimistic estimates in the survey tend less to reflect disagreement on where the economy lies in terms of the risk-return tradeoff—in which case one would expect individuals indicating a more positive equity premium mean also to indicate a more negative possible outcome—but more to reflect across-economist views about the attractiveness of the stock market. The term structure of volatility that can be extracted from these extreme forecasts is roughly consistent with a random walk with a volatility of about 15%.

D. The Perceived Consensus

What equity premium do financial economists believe their peers are recommending? This is interesting for a number of reasons. Economists are likely to weigh their otherwise private estimates against what they perceive to be a common consensus and to come up with a posterior estimate that averages the two. An incorrect perception of the estimates of others can delay the process of collective adjustment. If one believes that everyone else believes the equity premium to be 8%, then one may be reluctant to quickly adjust one's view away from 8%. In this sense,

13. To avoid economists' 7% consensus from becoming the ''Welch number,'' I must take the unusual step of quoting my own personal estimate: 2–3% arithmetically over 30 years (see also Welch 1998).

this survey may aid the profession's aggregation of opinions. Further, the perception might indicate the extent to which this survey is informative to researchers. If economists' personal views and views of the profession's consensus already coincided, this article would be less informative and economists' estimates could be considered more reliable.

Table 4 shows that economists' perceived consensus is not monotonic in the horizon, although differences are small. The belief is that the 30-year and 5-year equity premium consensuses are each about 7.5%, about 8% for the 10-year consensus, and 6% for the 1-year consensus. When this is compared to the equity premia forecasts themselves (on the left side), the popular view is that their own consensus is between 0.5% and 1% higher than what it actually is. Except on the 1-year horizon (which has fewer responses and higher standard series deviation), the difference is statistically significant. Note also that economists believe more in their ability to judge the consensus than to judge the equity premium itself, even over 30 years. However, there is still substantial disagreement among economists.

The influence of this overestimate is further explored in table 5. The left part of the table provides the univariate means and standard deviations for the set of researchers with both a forecast and a consensus estimate. Again, the misperception is between 0.5% and 1.0%. However, economists' own estimates need not be influenced by their perceptions of the prevailing consensus—for example, everyone may invariably believe that others use the Ibbotson 8% figure and, thereby, have their own equity premium forecast be unaffected. To explore whether there is an ''anchoring'' effect, that is, whether economists have a perception of the consensus and shade their own equity premium forecast toward this perception, table 5 describes the results of a regression with the demeaned consensus on the demeaned forecasts.[14] A coefficient of one indicates perfect shading, a coefficient of zero perfect irrelevance.

The regressions reported on the right side of table 5 show that the same economists who indicate that they believe the professional consensus to be higher also offer a higher equity premium forecast themselves. This is especially pronounced on the 1-year and 30-year horizons. It is weaker on the 5-year and 10-year horizons. Perhaps financial economists often use either short-horizon (1-year) or long-horizon (30-year) rates but less often use either 5-year or 10-year rates.

14. Naturally, economists may settle on their own forecast and believe that it is also held by the profession. Ross, Greene, and House (1977, p. 280) reported a series of studies in which subjects show a tendency to ''see their own behavior choices and judgments as relatively common and appropriate to existing circumstances while viewing alternative responses as uncommon, deviant, or inappropriate.'' Marks and Miller (1987) summarize this literature and describe some explanations. However, in this equity premium survey context (in which there is no temporal precedence), it is not even clear if there is a philosophical difference between this view (in which own choices influence the consensus perception) and the view stated in the text.

TABLE 4 Univariate Statistics for Economists' Arithmetic Equity Premia Consensus Estimates

Actual Mean (%)	Description	Mean5 (%)	Mean (%)	SD5 (%)	SD (%)	Minimum (%)	Q1 (%)	Median (%)	Q3 (%)	Maximum (%)	*N*
7.1	Perception 30-year	7.6	7.6	1.5	1.7	1	6.5	7.8	9	12	216
6.7	Perception 30-year (S2)	7.5	7.4	1.6	1.9	1	6	7	9	12	112
7.0	Perception 10-year	8.1	8.2	1.3	1.4	4	7	8	9	12	101
6.7	Perception 5-year	7.7	7.6	1.6	1.7	1	7	8	9	11	99
6.5	Perception 1-year	6.0	6.0	2.3	2.4	0	6	7	8	12	69

NOTE.—The table presents the distribution of economists' perception of the prevailing equity premia forecast. The surveys themselves are reproduced in appendices B and C. The ''S2'' line reports only responses to the second survey. Other lines report statistics from both surveys after adjustments to first-survey responses, as explained in appendix A. Mean5 and SD5 are the mean and standard deviations after each series is truncated at its fifth and ninety-fifth percentile. Q1 and Q3 are quartiles 1 and 3.

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Attachment MDU-016

TABLE 5 Statistics for Economists' Arithmetic Equity Premia Consensus Estimates

	Univariate Statistics, Common				$\hat{A}_i - \hat{A}_i = \alpha_0 + \alpha_1(\hat{C}_i - \hat{C}_i) + e_i$			
Description	Mean_A (%)	SD_A (%)	Mean_C (%)	SD_C (%)	α_0	α_1	SE (α_1)	N
30-year	7.1	1.9	7.6	1.7	.0	.62	.06	214
30-year (S2)	6.7	2.1	7.4	1.9	.0	.73	.08	111
10-year	7.2	1.8	8.2	1.4	.0	.31	.12	99
5-year	6.7	2.3	7.7	1.7	.0	.28	.14	97
1-year	4.7	4.2	6.0	2.4	.0	.79	.19	67

NOTE.—The left side of the table presents the mean and standard deviation of economists' arithmetic equity premia forecasts (A_i) and their perceptions of the prevailing equity premia consensus forecast (C_i), provided an individual supplied both an equity premium estimate and a consensus estimate for the same horizon. The right side provides ordinary least squares regression output when the demeaned arithmetic forecast ($\hat{A}_i - \hat{A}_i$) is regressed on this economist's demeaned perception of the professional consensus about the same-horizon arithmetic forecast ($\hat{C}_i - \hat{C}_i$). The surveys themselves are reproduced in appendices B and C. The ''S2'' line reports only responses to the second survey. Other lines report statistics from both surveys after adjustments to first-survey responses, as explained in appendix A.

In sum, the regressions are consistent with an attempt by economists to provide a forecast that lies between their personal estimate and their perceived consensus belief. If this is the case, the results of this survey may help economists improve their anchoring their own predictions relative to the profession, which would cause a downward revision in the aggregate consensus forecast.

E. Other Statistics

The most interesting remaining question concerns the influence of market movements. Almost all finance professors subscribe to the view that markets follow a random walk in the short run. Updating of equity premia opinions is likely to be a very slow process, and changes in opinion are likely to be marginal only. Still, participants on the second survey were also asked to indicate whether they would be positively, negatively, or not at all influenced by stock market movements on the margin. Coding this feedback rule as $+1$, -1, and 0, respectively, the mean response by 112 participants to this question was -0.367, with a standard deviation of 0.5. Thus, average participants claim that a bull market leads them to predict a lower future equity premium.[15]

Finally, the second survey asked whether financial economists considered themselves to be relatively better informed with respect to the equity premium and whether they have published in the area. Fifty-one respondents indicated no prior relevant publication, 13 of whom considered themselves less qualified (mean arithmetic 30-year equity premium: 6.6%), three of whom considered themselves better qualified (mean: 7.3%), and 35 of whom considered themselves equally qualified (mean: 7.3%). Of the 17 individuals who indicated a relevant publication, six considered themselves better qualified (mean: 6.4%) and 11 considered themselves equally qualified (mean: 6.6%). Thus, lower forecasts tend to be either by individuals who had published related work or by individuals who felt ill-qualified to answer the survey.

IV. Questions Debated in Academic Finance

The first survey took the opportunity to add a set of questions that asked respondents' views on issues that are commonly debated in the academic literature and on which most researchers who attend finance

15. Respondents indicating that they follow a positive feedback rule are also more optimistic about the market. Sixty-six individuals indicate they are not influenced by stock market movements on the margin and provide 7.3% as their equivalent average; 43 individuals follow a negative feedback rule, with 5.7% as their equivalent average; and only two individuals follow a positive feedback rule (with 4% and 8% as their average arithmetic 30-year equity premium estimates). The fact that there is a correlation between the indicated feedback rule and the forecast should not be surprising, given the stellar recent stock market performance.

conferences and seminars are likely to have an interest in (or at least an opinion on). Answers could range from 1 (strongly disagree) to 3 (neither agree nor disagree) to 5 (strongly agree). Table 6 lists both the questions and the received responses (see also app. B).

The first question asked whether the stock market is more likely to follow a random walk or more likely to have long-horizon negative autocorrelation. It turns out that more professors have an opinion (''agree'' or ''disagree'') than no opinion (''neither agree nor disagree''), but when they do, this opinion is roughly evenly split. The jury is still out.

The second question concerned the use of the capital asset pricing model (CAPM) for capital budgeting purposes. Although a sizable minority of professors do not believe that it is ''good enough'' to be used for capital budgeting purposes, a majority feels that it is.

The third question asked whether size and book-market values are more likely to be characteristics (in the Daniel and Titman [1997] sense) or more likely to be risk factors (in the Fama and French [1993] sense). The respondents mildly favored the view that they are characteristics.

The fourth question asked whether the risk factors or characteristics (size, book-market, price-earnings, or momentum) are likely to be useful for portfolio selection in the future. The profession does not have a strong view on this issue. The ambivalent view is remarkable, given the large number of publications and strong ongoing interest in detecting past ''anomalies.'' Prior to conducting this survey, it had seemed to me that the common working hypothesis in finance is that at least the major anomalies are universally viewed to represent persistent phenomena. This survey does not confirm this hypothesis.

The fifth and sixth questions asked whether markets are basically efficient and arbitrage-free. There was much agreement here: financial economists feel that, by and large, financial markets are efficient. The sixth question asked whether economists believe in arbitrage opportunities—an ability to make money without risk. Apparently, the respondents did pay attention and also marked a strong view in favor of absence of arbitrage.

The only question that elicited more support than absence of arbitrage was the question about whether governments should intervene more in financial markets. The profession strongly feels that this would be counterproductive.

Finally, there are two questions related to corporate finance. The eighth question asked whether large Fortune 500 firms have too little debt in the capital structure and whether share repurchases dominate dividends as a means of payout. The profession has no views on whether large Fortune 500 firms would be better off with more debt

TABLE 6 Questions on Issues Debated in Academic Finance

	Question	Univariate Statistics		Response Count					
		Mean	SD	1	2	3	4	5	Total
Q1	I believe that the true stock-market index's 3–5-year return autocorrelations are zero (random walk [à la Richardson, choose agree]), rather than negative (à la Fama-French, Shiller, choose disagree).	2.85	1.1	7	42	17	31	5	102
Q2	I believe that the CAPM is a good enough approximation of reality to deserve use in capital budgeting contexts.	3.41	1.1	5	22	19	51	13	110
Q3	I believe that size/book-market/price-earnings/momentum power can explain cross-sectional returns primarily because they are **risk** factors (in the Fama-French sense) and not just firm **characteristics** (in the Daniel-Titman sense).	2.64	1.2	18	33	19	20	7	97
Q4	I believe that size/book-market/price-earnings/momentum factors are **stationary** enough, so that they will work well in the future in explaining cross-sectional expected return differences.	2.77	1.0	9	37	24	26	3	99
Q5	I believe that, by and large, public securities market prices are efficient.	3.84	.8	1	9	13	71	16	110
Q6	I believe that, by and large, public securities market prices offer arbitrage opportunities.	2.16	.9	22	60	17	8	2	109
Q7	I believe that, by and large, government regulation and intervention in public securities markets should be increased. (Please select **middle** if intervention should be held steady, and **strongly disagree** if intervention should be decreased.)	2.13	.8	29	39	40	0	1	109
Q8	I believe that Fortune-500 U.S. corporations, by-and-large, have too little debt in their capital structure.	3.09	1.0	4	26	23	30	6	89
Q9	I believe that Fortune-500 U.S. corporations, by-and-large, should use share repurchases instead of dividends as payout means.	3.68	1.0	4	7	21	42	18	92

NOTE.—''Response Count'' tallies number of respondents selecting each number on a 1–5 scale, where 1 = disagree and 5 = agree; see app. B for details.

in their capital structure. But they perceive dividends to be an unwise mechanism for corporations to disburse funds relative to share repurchases.

In sum, it is remarkable how weak the views of financial economists are, even on issues, such as absence of arbitrage, that are typically seen as relatively uncontroversial: about one-quarter of the participants responded with a value between ''strongly disagree'' and ''neither agree nor disagree.'' On most questions, there was neither strong agreement nor strong disagreement by many participants, even when central issues in finance and stark positions were concerned.

V. Conclusion

This article presents the results of the first comprehensive survey of financial economists. Two hundred and twenty-six finance professors shared their forecasts and perspectives on the equity premium and some related issues. The primary findings are as follows.

1. The average arithmetic 30-year equity premium consensus forecast hovers around 7%. On the one hand, this is not as high as the current historical 9.4% arithmetic average quoted by Ibbotson or even as high as the Brealey and Myers (1996, p. 146) quoted average of 8.4% per year. Practitioners who would prefer to base their estimates on the perceived academic consensus should thus use a lower 7% arithmetic premium instead.

On the other hand, the 7% equity premium consensus forecast seems too high for comfort among macroeconomists, who argue that stock prices have risen because rational, informed investors now require and expect lower future equity rates of return. These rational, informed investors are not the finance professors surveyed here. Indeed, the 1%–3% theoretical estimate is roughly the academic consensus for a worst-case (one in 20) 30-year scenario.

2. There is a term structure of equity premia forecasts: short-term forecasts are lower than long-term forecasts. (Unfortunately, this consensus also prevailed on the first survey in early 1998!)

3. There is evidence for a ''false-consensus effect.'' On average, finance professors believe that their consensus is about 0.5%–1% higher than it actually is, especially on shorter horizons; there is also a strong correlation between researchers' perceptions of the consensus and their own estimate. This is evidence that participants anchored their own responses on their perceptions of the professional consensus—and it may indicate that the publication of this article may shade down the equity premium consensus forecast among financial economists.

4. On average, financial economists claim to revise their forecast down as markets increase (''negative feedback'').

5. There is strong agreement among financial economists that the government ought to decrease its intervention and regulation of public securities markets and that markets are by and large efficient and arbitrage-free. They also would mildly recommend to corporations to use more share repurchases and fewer dividends. And they have no strong views, one way or another, whether the stock market follows a random walk, whether firms can reasonably use the CAPM for capital budgeting, whether large firms should use more debt financing, whether size and book-market are risk factors or characteristics, or even whether size and book-market will continue to predict stock returns in the future.

Appendix A

Adjustments

The first survey considered the request for an average, paired with the well-known Brealey and Myers/Ibbotson 8% estimate, to mean ''arithmetic''; it also considered the use of a long-term bond for long-horizon premia (rather than short-term bonds) to be the relevant definition. Because neither is a standard in this literature, this introduced ambiguities in the first (but not second) survey.

Geometric versus arithmetic averages. A Taylor approximation yields

$$\frac{[(1+r)^T - 1] - T \cdot r}{T} \sim \left(\frac{T-1}{2}\right) r^2 + \left[\frac{(T-1)\cdot(T-2)}{6}\right] r^3 + O(r)^4, \quad \text{(A1)}$$

where r is the rate of return and T is the horizon, which can be used to adjust geometric and arithmetic averages. Because market returns are not perfectly serially uncorrelated (see Roll 1983), the historical 1926–97 differences provide a better adjustment.

	Number of Holding Years						
	1	2	3	4	5	10	30
Equity premium (%)	.0	1.0	1.4	1.7	1.8	1.9	1.8

To correct the casual distinction between geometric versus arithmetic averages, I e-mailed participants of the survey with a request for clarifications of answers generated by the first survey. This revealed that about a third of respondents had originally quoted a geometric average. To adjust answers to the first survey, for the 25 individuals who indicated that their answer was for a geometric average (out of 85 who responded to the request for clarification), the historically appropriate adjustment of 1.8% was added to 5-year, 10-year, and 30-year estimates. For the 31 individuals who did not respond to the request for clarification, the following adjustment was computed. Among the 85 received clarification responses, a regression was fitted with the dependent variable being a dummy indicating whether the response was geometric (G_i) and the independent variable being the quoted 30-year forecast (Q_i):

$$G_i = 0.823 - 0.0877 \cdot Q_i + \text{noise}_i. \tag{A2}$$

The fitted estimate was used as a ''probability'' adjustment ($p_g(Q_i) \equiv \hat{G}_i$) to translate the original answers by the 31 participants who had not responded to the request for clarification into arithmetic averages (a_i):

$$a_i = Q_i + p_g(Q_i) \cdot 1.8\% \tag{A3}$$

for 5-year, 10-year, and 30-year forecasts. Of course, no adjustment was necessary for 1-year forecasts.

Bonds versus bills. Historically, over the 1926–98 period, long-term bonds offered a geometric return of about 5.3% (arithmetic: 5.8%), whereas short-term bills offered a return of about 3.8%. However, these averages can be deceptive. The return on both instruments over the 1926–81 period was identical; the long-term bond has been a much better performer only since 1981. Over the sampling period (October 1997–May 1999), the quoted yield difference between the short-term and long-term bond was about 1.1%. (Other bond features, e.g., the value of a long-term call feature, reduce this figure.)

The first survey asked for the difference between the equity premium and the long bond, whereas the second survey asked for the difference between the equity premium and short-term treasuries. To translate all quoted first-survey forecasts into bill-adjusted equity premia, a reasonable adjustment into Treasury bill–adjusted rates was added (1% for the 5-year, 10-year, and 30-year forecasts, and 0.5% for the 1-year forecasts).[16] A reader interested in using an equity premium forecast relative to a bond rather than a bill should subtract about 0.5% to the 1-year bill-quoted equity premia and about 1% to the longer-term bill rates. These adjustments were applied to all quoted figures from the first survey: long-horizon and short-horizon equity premia, optimistic and pessimistic scenarios, and consensus estimates.

Other adjustments. In addition, there were five extreme outliers on the first survey, in which the respondent quoted either 12% or 1,500%. I sent e-mails to these respondents to ask them if this was their correct estimate of the per annum equity premium. All five respondents replied that they had misread the survey, either assuming that I had asked for the market expected return (not net of the risk-free rate) or that I had asked for a compound figure. Although it is possible that they meant to say 12% and I unduly influenced them, this is unlikely—these particular finance professors happened to have made their relevant views on this issue publicly known in other venues. In four cases, the answer in the survey was corrected. In one case, the respondent indicated that his numbers were wrong but that he was too busy to fill out the survey again. This answer has been removed from the survey. The second survey had some automatic checks to alert respondents to extremely large or small estimates, which were primarily useful for catching individuals quoting total rather than average returns.

Perceived clarity. The second survey also gathered some descriptive statis-

16. This is lower than the historical 1.5% difference because some participants may have assumed a definition of equity premia without reading the question more carefully. (This adjustment adds 112/226*1.0% $\sim$ 0.5% to the overall average.) The closeness of results from the first survey and the second survey, especially after adjusting for the rising equity market, further indicates that this issue has been dealt with appropriately.

tics. For 110 responses, the average time spent on the survey was about 3.5 minutes. On a scale of 1–10, with 1 indicating perfect clarity and 10 indicating perfect opacity, the mean was 1.8. There was a small negative correlation between perceived clarity and equity premia mean estimates, and a small positive correlation between time spent and equity premia mean estimates. In a regression, the coefficients indicate that an individual who felt one point more confused and an individual who spent about 2 minutes less indicated an arithmetic equity premium mean of about 0.25% less.

Other adjustments. Residual adjustment error is likely to play only a small role. Sampling variation and the bull market of 1998 probably account for much of the 0.4% difference between the overall survey figures and the second survey figures. This difference is well within the range of disagreement among economists' answers.

Appendix B

The First Survey

Market Risk Premium (E R_m - r_f) Survey

Dear Colleague:

Please take 5 minutes to answer the questions in this survey. The first set of questions concern the market risk premium. It should take about 3 minutes of your time. The second set of questions concern such issues as "will the size/book-market/etc. characteristics continue to predict expected return characteristics?," and should take another 3 minutes. All survey questions pertain exclusively to the U.S. market.

I hope the consensus view on these questions will be of great interest to the finance profession. I am planning to publish an academic paper that summarizes the results of this survey.

Market Risk Premium

(**Background Information:** As of October 6, 1997, the S&P-500 stood at 965, the DJ stood at 8,040, the 30-year T-bond stood at 6.3%, the 3-month T-bill stood at 4.9%.)

Define the so-called "market risk premium" as *your* expected return on the SP500 minus the equivalent treasury bond, please give *your* opinion on the *expected* (forward-looking) annualized market risk premium. (Note: use this definition, even if this spread reflects factors other than risk. The famous Ibbotson "historical" equivalent is 8.2%.) I would like your estimate of the future market risk premium, conditional today, i.e., beginning on the day on which you fill out the survey.

Market-Risk-Premium-Survey

Per-Annum Market Risk Premium: Exp. Return on SP500 *MINUS* Risk-Free Bond

	1-year	5-year	10-year	30-year
Total Return Translation Table	not necessary	click here	click here	click here
Your Expectation (Mean, Per-Annum)				
Your "Worst Case" (<5% prob), **Per-Annum**				
Your "Best Case" (<5% prob), **Per-Annum**				
Guess the academic finance profession's mean e.g., as expressed on this survey by other finance professors				

What percentage of their new retirement contributions would you advise a new finance colleague to put into stocks (rather than bonds)? %

I permit publication of my name as one in many in a list of participants **with identification of my name with the risk premium choices above**: yes no

I permit publication of my name as one in many in a list of participants, but I do not permit publication of my choices together with my name. yes no

Additional Questions

The following are 9 "optional" questions. Please answer them. They concern basic debates in finance today. If you do not like a particular question, or do not have a view on it, just leave it blank. Remember: I am asking for your personal view, not whether a null hypothesis can be rejected with 95% probability!

I permit publication of my name as one in many in list of participants on the following questions: ◉ yes ○ no

(Unlike answers to the above questions, for which I requested permission to identify the respondent, the answers to the questions below will be strictly anonymous and confidential.)

	Question	Strongly Agree	Agree	Middle	Disagree	Strongly Disagree	No View
1	I believe that the true stock-market index's 3-5-year return autocorrelations are zero (random walk [ala Richardson, choose agree]), rather than negative (ala Fama-French, Shiller, choose disagree).	○	○	○	○	○	○
2	I believe that the CAPM is good enough an approximation of reality as to deserve use in capital budgeting contexts.	○	○	○	○	○	○
3	I believe that size/book-market/ price-earnings/momentum power can explain cross-sectional returns primarily because they are **risk** factors (in the Fama-French sense) and not just firm **characteristics** (in the Daniel-Titman sense).	○	○	○	○	○	○
4	I believe that size/book-market/ price-earnings/momentum factors are **stationary** enough, so that they will work well in the future in explaining cross-sectional expected return differences.	○	○	○	○	○	○
5	I believe that, by and large, public securities market prices are efficient.	○	○	○	○	○	○
6	I believe that, by and large, public securities market prices offer arbitrage opportunities.	○	○	○	○	○	○
7	I believe that, by and large, government regulation and intervention of public securities markets should be increased. (Please select **middle** if intervention should be held steady, and **strongly disagree** if intervention should be decreased.)	○	○	○	○	○	○
8	I believe that Fortune-500 U.S. corporations, by-and-large, have too little debt in their capital structure.	○	○	○	○	○	○
9	I believe that Fortune-500 U.S. corporations, by-and-large, should use share repurchases instead of dividends as payout means.	○	○	○	○	○	○

Identification

Date (Fill in only if printed, not if filled out via WWW)		
Your Email Address:		
Your Name:		
Professional Status:	○ Professor ○ PhD Student ○ MBA Student	○ PhD Graduate ○ MBA Graduate ○ Other ;
Area	○ Finance ○ Accounting	○ Economics ○ Other ;
Primary specialization:	○ Asset-Pricing - Empirical ○ Asset-Pricing - Theory ○ Asset-Pricing - Both ○ Asset-Pricing - Derivatives ○ Asset-Pricing - Fixed Income	○ Corporate Finance ○ Market Microstructure ○ Other Empirical ○ Other Theoretical ○ Other

Feel free to comment, but please note that you should instead send me email about this survey if you think I have made a mistake (or that I could do the survey better). I will not see these comments until I tabulate the surveys.

Submit Survey Answers | Reset Survey Answers

Please do not forget to check your own WWW and email entries in the directory: http://linux.agsm.ucla.edu/dir/ (or to look up anyone of your choice).
For feedback about this website, please send email to ivo.welch@anderson.ucla.edu. To get back to the home page, click homepage.

Appendix C

The Second Survey

Ivo Welch, UCLA
January 1999

[The intent of this survey is to gauge consensus estimates of the equity premium from academic and academically oriented finance and economics professionals, e.g., members of the AFA, WFA, AEA, or ASSA. If you have difficulties filling out this survey, please send an email to Ivo Welch.]

equity-survey

Dear Colleague:

Please take a moment to answer the 5 primary questions in this survey (and to input your email address). After you have filled out the form, please press the "submit" button at the end of the page.

The distribution of answers to this survey will be published in an academic paper, possibly in the Journal of Finance. Your identity will be strictly confidential, i.e., it will not be released or published anywhere, much less jointly with your estimates.

The following 5 questions revolve around 30-year forecasts of the equity premium and the stock market. For your convenience, equivalent historical averages, published by Ibbotson, for the 1926-1997 period are in the right-most column of the table. Please enter percentages without "%". PLEASE send email if you encounter difficulties.

	Please Fill In	Requested (30 year forecast)	Long Definition all over the next 30 years	Historical Ibbotson
1	____ % per-annum	**Stock Market** (S&P) *Arithmetic* Per-Annum Rate of Return, Nominal	*Your* expected arithmetic per-annum return on the stock market (e.g., the S&P500) over the next 30 years. if unclear, click for mathematical definition.	13.0% *
2	____ % per-annum	**Equity Premium**, *Arithmetic* Per-Annum Average Rate	*Your* expected arithmetic per-annum average return over the next 30 years on: the stock market (S&P500) return minus the arithmetic per-annum average return on rolled-over 30-day T-bills. if unclear, click for mathematical definition.	9.2% *
3	____ % per-annum	Equity Premium, **Geometric** Per-Annum Average Rate	*Your* expected *geometric* per-annum average return over the next 30 years on: the stock market (S&P500) return net of the *geometric* per-annum average return on rolled-over 30-day T-bills. if unclear, click for mathematical definition.	6.9% *
4	____ % per-annum	Other Economists' Forecasts of Equity Premium, Arithmetic Average, 30 Years	What do you think will be the average answer of other economists to this survey's Question 2?	

5 ○ Decrease it very slightly (neg feedback)
○ Not even the slightest epsilon change
○ Increase it very slightly (pos feedback)

◉ Presume that the stock market closed up much higher today, while interest rates remained constant. On the margin, how would today's positive stock market return influence your forecast of the 30-year arithmetic equity premium tomorrow?

Identity Information

The identity information on this page will be held strictly confidential.

Background ◉	○ Finance/Econ Professor ○ Other Professor ○ Finance/Econ PhD or PhD Student ○ Other
Please fill in your email address:	
Please fill in the date:	used to infer current stock price level
How much time did you spend on this survey?	
Was this survey clear? ◉	Very Clear 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10 ○ Not Clear at All

◉ This is my first submission to this survey.
○ This is an update of my earlier submission, indicating how my views have changed.
○ This entry supersedes an earlier erroneous entry.

○ I would likely participate in a future survey.
◉ I would not object to receiving a very short email request for a future survey.
○ I would never participate in such a survey again. Please do not email me any such requests.

After the results of this survey will have been written up in a working paper, and posted on the WWW.

◉ Don't bother sending me a copy---I already have too many papers on my desk.
○ I would like to receive a short email alert with the URL pointing to the paper.
○ I would like to receive a printed copy of the paper by U.S. mail.
Postal Address:

Optional Questions

Please answer any of the following 10 questions, omit what you do not want to answer, then press the submit button below:

	Please Fill In	Requested	Long Definition
6	____% per-annum to ____% per-annum	95% Confidence Range for Your *Arithmetic* Equity Premium Forecast, **30-Years** (Q2)	*Your* 95% confidence interval around *your* 30-year arithmetic equity premium per-annum rate forecast (i.e., your answer to Question 2). if unclear, click for mathematical definition.
7	○ Same ○ Different	◉ Would your answer to question 2 (your equity premium forecast) be the same if the time frame was 1, 5, 10, or 100 years, instead of 30 years? (If different, please fill in differing choices below in questions 8 through 11.)	
8	____% per-annum	Equity Premium, Arithmetic Mean, **1 Year**	*Your* expected forecast of the arithmetic equity premium over the next 1 year. (Like Question 2, but different time horizon.) if unclear, click for mathematical definition.
9	____% per-annum	Equity Premium, Arithmetic Mean, **5 Years**	*Your* expected forecast of the arithmetic equity premium over the next 5 years. (Like Question 2, but different time horizon.) if unclear, click for mathematical definition.
10	____% per-annum	Equity Premium, Arithmetic Mean, **10 Years**	*Your* expected forecast of the arithmetic equity premium over the next 10 years. (Like Question 2, but different time horizon.) if unclear, click for mathematical definition.
11	____% per-annum	Equity Premium, Arithmetic Mean, **100 Years**	*Your* expected forecast of the arithmetic equity premium over the next 100 years. (Like Question 2, but different time horizon.) if unclear, click for mathematical definition.
12	• ○ The equity market is essentially a random walk. • ○ There may or may not be mean reversion in equity premia, but the statistical significance thereof is so low that these changing means have almost no influence on my asset allocation decision. • ○ The term structure of (my expected) equity premia has (or should have) a significant influence on my asset allocation decisions. • ◉ No Answer.		
13	○ Above Average ○ About The Same ○ Below Average	◉ How do you consider your ability to forecast the equity premium, relative to the average finance professor?	
14	○ Yes ○ No	◉ Have you published on the subjects of this survey (the equity premium or aggregate stock returns)?	
15	____% per-annum	30-Year Inflation, Expected Arithmetic Average	The arithmetic average of the annual CPI inflation rates over the next 30 years. (The historical average from 1926 to 1997 was 2.5%.) if unclear, click for mathematical definition.

Submit Survey Answers | Reset Survey Answers

Your help is highly appreciated.

* Ibbotson data are computed from 1926 to 1997 means, and provided only for calibration purposes---these numbers clarify comparables to finance professors familiar with the basic series. They are not guaranteed to be correct---please contact Ibbotson Associates for definite and up-to-date numbers.

Mathematical Definitions of Requested Expectations

Question 1: Stock Market Return, Nominal, Arithmetic Average, 30 Year Horizon

Your expectation for the arithmetic stock market return (ASMR):

$$\mathrm{ASMR}(30) = \left(\frac{1}{30}\right) \cdot \sum_{y=1}^{30} \mathrm{mr}_y,$$

where mr_y is the (unknown) one-year stock market return in y years. (Note also that all stock market related questions do not request the performance of stocks as constituted in the current S&P index, but the performance of stocks in the then-prevailing S&P in the future.) click here for more details on requested time frame.

Question 2: Equity Premium, Arithmetic Average, 30 Year Horizon

Your expectation for the arithmetic equity premium (AEQP):

$$\mathrm{AEQP}(30) = \left(\frac{1}{30}\right) \cdot \sum_{y=1}^{30} (\mathrm{mr}_y - \mathrm{tbr}_y),$$

where mr_y is the (unknown) one-year stock market return in y years, and tbr_y is the (unknown) one-year return on rolled-over short-term (30-day) treasury bonds in y years. click here for more details on requested time frame.

Question 3: Equity Premium, Geometric Average, 30 Year Horizon

Your expectation for the **geometric** equity premium (GEQP):

$$\mathrm{GEQP}(30) = \frac{\mathrm{GSMR}(30)}{\mathrm{GTBR}(30)},$$

$$\mathrm{GSMR}(P) = \sqrt[P]{\prod_{y=1}^{P}(1+\mathrm{mr}_y)} \qquad \mathrm{GTBR}(P) = \sqrt[P]{\prod_{y=1}^{P}(1+\mathrm{tbr}_y)}$$

where mr_y is the (unknown) one-year stock market return in y years, and tbr_y is the (unknown) one-year return on rolled-over short-term (30-day) treasury bonds in y years. click here for more details on requested time frame.

Questions 7-10: Equity Premium, Arithmetic Average, Different Horizons

Your expectation for

$$\mathrm{AEQP}(P) = \left(\frac{1}{P}\right) \cdot \sum_{y=1}^{P} (\mathrm{mr}_y - \mathrm{tbr}_y),$$

where P=1 in question 7, P=5 in question 8, P=10 in question 9, and P=100 in question 10. As above, mr_y is the (unknown) annual stock market return in y years, and tbr_y is the (unknown) annual return on rolled-over short-term (30-day) treasury bonds in y years. click here for more details on requested time frame.

Question 13: 30-Year Inflation, Arithmetic Average

Your expectation for

$$\mathrm{AIR}(30) = \left(\frac{1}{30}\right) \cdot \sum_{y=1}^{30} i_y,$$

where i_y is the (unknown) annual inflation rate "in y years." click here for more details on requested time frame.

Timing Details

The 30-year questions ask you for your forecasts from tomorrow through 30 years after tomorrow. Thus, if you answered this questionaire on 12/31/1998, the 30-year questions asks you for annualized forecasts using returns from 1/1/1999 to 12/31/2028--i.e., from 1999 (inclusive) through 2028 (inclusive). Note also that *within* each year, the returns are compounded (not averaged), even if the requested average is arithmetic.

Similarly, if you answered this questionaire on Dec 31, 1998, the 1-year forecast question 7 asks you for your forecast for 1999, and the 100-year forecast question 10 asks you for your forecast from 1999 (inclusive) through 2028 (inclusive).

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