INVESTMENT INCOME, UNDERWRITING PROFIT INCLUDING THE TAX REFORM ACT OF 1986 AND CONTINGENCIES: FINANCIAL MODELS

INVESTMENT INCOME, UNDERWRITING PROFIT AND CONTINGENCIES: FINANCIAL MODELS

BY RICHARD A. DERRIG

INTRODUCTION

THE ESSENCE OF AN INSURANCE POLICY IS THE PROMISE BY THE INSURER TO PAY ALL CLAIMS OF THE INSURED THAT ARE COVERED BY THE POLICY. IN RETURN FOR THE INSURER'S PROMISE, THE INSURED PAYS THE POLICY PREMIUM. THE INSURER CAN BE PARTIALLY DESCRIBED FINANCIALLY OR ECONOMICALLY BY THE SET OF ALL THESE POLICIES. BEFORE PROCEEDING WITH A DISCUSSION OF THE USE OF INVESTMENT INCOME IN RATEMAKING, ALLOW ME TO FIT OUR INSURANCE TRANSACTION INTO A GENERAL ECONOMIC OR FINANCIAL PICTURE BY A TRANSLATION TABLE OF THE KEY WORDS IN THE DESCRIPTION OF THE INSURANCE POLICY.

KEY WORDS

INSURANCE	ECONOMICS
POLICY	CONTRACT
PROMISE	
ALL	GOODS & SERVICES
CLAIMS	
PREMIUM	PRICE

I WANT TO DESCRIBE RATEMAKING IN THIS CONTEXT AS THE METHOD FOR DETERMINING THE (LIST) PRICE TO BE CHARGED FOR EACH HOMOGENEOUS SUBSET OF INSURANCE CONTRACTS. WHAT MAKES THE INSURANCE TRANSACTION ESSENTIALLY DIFFERENT FROM SOME OTHER TRANSACTIONS IN THE ECONOMY, AND THEREFORE INTERESTING TO US, IS THAT THE PAYMENT OF THE PRICE (PREMIUM) AND THE DELIVERY OF THE GOODS AND SERVICES (PROMISE TO PAY

ALL CLAIMS) DO NOT OCCUR SIMULTANEOUSLY, BUT RATHER THEY CAN OCCUR WITH A LONG TIME GAP BETWEEN PREMIUM AND CLAIM PAYMENTS. THIS MAKES THE INSURANCE CONTRACT RISKY. INDEED, THE INSURANCE CONTRACT IS RISKY FOR BOTH THE INSURED AND THE INSURER.[1] THIS TIME GAP IS ALSO PRESENT IN OTHER FINANCIAL INTERMEDIARY TRANSACTIONS SUCH AS STOCK AND BOND ISSUES, MORTGAGE CONTRACTS, AS WELL AS OPTIONS AND FUTURE CONTRACTS. THE PRICING OF THOSE RISKY FINANCIAL CONTRACTS ARE GENERALLY ACCOMPLISHED IN OPEN COMPETITIVE MARKETS FOR CAPITAL.

INSURANCE RATEMAKING SHOULD RECOGNIZE THAT IT MUST COEXIST WITH THE COMPETITIVE MARKET PRICING OF OTHER FINANCIAL INTERMEDIARY PRODUCTS AND OTHER GOODS AND SERVICES IN GENERAL. FOR INSURANCE POLICIES IN A COMPETITIVE MARKET WE MIGHT FURTHER STRIKE AN ANALOG WITH PRICES IN THE GENERAL ECONOMY.

PREMIUM	PRICE
ACTUARIAL	LIST
MARKET	SALE

[1]IF YOU CAN'T IMAGINE THAT YOUR OWN PERSONAL AUTO POLICY IS RISKY TO YOU AS THE INSURED THEN THINK OF YOUR COMPANY AS AN INSURED WHEN IT REINSURES SOME OF ITS DIRECT BUSINESS. THE RISK TO YOUR COMPANY IS IN WHETHER THE REINSURERS WILL PAY, A VERY REAL PROBLEM IN TODAY'S MARKETS.

INVESTMENT INCOME, UNDERWRITING PROFIT AND CONTINGENCIES: FINANCIAL MODELS

BY THE ACTUARIAL PREMIUM, I MEAN THE RESULT OF PROVIDING THE BEST CURRENT VALUE ESTIMATE OF ALL THE COMPONENTS OF THE POLICY CONTRACT BY MEANS OF THE INSURER'S ANALYTIC PROCESS. IN A REAL SENSE, THE ACTUARIAL PREMIUM IS ONLY THE LIST PRICE FOR THE INSURANCE CONTRACT.

BY THE MARKET PREMIUM, I MEAN THE POLICY PREMIUM THAT RESULTS FROM THE ACTUARIAL PREMIUM AFTER DIVIDENDS, SCHEDULE RATING AND ALL OTHER MARKETING DEVICES HAVE HAD THEIR INFLUENCE ON THE ACTUARIAL PRICE IN ORDER TO MATCH THE COMPETITIVE MARKET SOLUTION OF THE SALE PRICE. SOME OF THOSE PRESENT AT THIS SEMINAR MAY WANT TO FORECAST THE DAY WHEN THOSE TWO INSURANCE CONTRACT PRICES, ACTUARIAL AND MARKET, ARE EQUAL; OTHERS WILL BE MORE REALISTIC AND RECOGNIZE THE EVER-PRESENCE OF SALE PRICES FOR INSURANCE POLICIES. (CAN ANYONE FORGET THE FABULOUS 1983-85 GOING-OUT-OF-BUSINESS SALE BY MISSION INSURANCE OF WORKERS' COMPENSATION AND REINSURANCE CONTRACTS?)

WITH THIS GENERAL CONTEXT IN MIND, LET ME PROVIDE YOU WITH A VERY BRIEF SUMMARY OF SOME OF THE ACTUARIAL PRICING MODELS OF TWO BASIC TYPES: MARKUP MODELS AND FINANCIAL MODELS. I WILL THEN CONCENTRATE ON A FEW DETAILS OF THE FINANCIAL MODELS ACTUALLY USED TO SET MASSACHUSETTS AUTOMOBILE AND WORKERS' COMPENSATION RATES. REFERENCES FOR FURTHER READING ARE PROVIDED AT THE END OF THE DISCUSSION.

INVESTMENT INCOME, UNDERWRITING PROFIT AND CONTINGENCIES: FINANCIAL MODELS

MARKUP MODELS

BY A MARKUP MODEL I MEAN SIMPLY THAT THE OTHERWISE DETERMINED ACTUARIAL ESTIMATE OF LOSSES AND EXPENSES EXPECTED TO BE INCURRED UNDER THE TERMS OF THE INSURANCE CONTRACT IS LOADED OR MARKED-UP FOR AN UNDERWRITING PROFIT TO GET THE ACTUARIAL PREMIUM. THE NOTION HERE IS THAT JUST AS THE SUPERMARKET MARKS-UP THE PRICE OF TOMATOES FOR PROFIT, INSURANCE CONTRACTS TOO CAN BE PRICED USING SOME FIXED PROFIT MARGIN.

STATED IN WORDS,

PREMIUM = (LOSSES + EXPENSES) X (1 + PROFIT)

STATED SOMEWHAT MORE FORMALLY,

$$P = \frac{L + E}{1 - \mu}$$

WHERE:

P = PREMIUM (ACTUARIAL)

L = LOSSES

E = EXPENSES[2]

μ = UNDERWRITING PROFIT PERCENT OF PREMIUM

[2]FOR THIS PURPOSE, EXPENSES ARE ASSUMED NOT TO VARY WITH PREMIUM.

OVER TIME, THERE HAVE BEEN SOME TRADITIONAL UNDERWRITING PROFIT MARK-UPS FOR PROPERTY-LIABILITY INSURANCE CONTRACTS. YOU MAY HAVE HEARD THAT 5% WOULD BE APPROPRIATE FOR THE PROPERTY-LIABILITY LINES[3] AND 2.5% FOR THE WORKERS' COMPENSATION LINE. HISTORY SHOWS US QUITE CLEARLY THAT IF TRADITIONAL MARKUPS HAD BEEN USED TO SET ACTUARIAL PREMIUMS, THEN THE OBSERVED MARKET PREMIUMS HAVE DEVIATED DOWNWARD FROM THOSE ACTUARIAL PREMIUMS.[4] SURPRISED?

FOR THE SAME REASON AMERICANS FLOCK TO COMPETITIVE 20%-40% OFF SALES, WE SHOULD EXPECT THE COMPETITIVE MARKET TO PROVIDE ITS DETERMINATION OF THE (PRESENT) VALUES OF LOSSES AND EXPENSES, THEREBY GIVING A MARKET-DRIVEN NET PREMIUM OR SALE PRICE FOR INSURANCE CONTRACTS.[5] THE ATTACHED GRAPH, LABELED COUNTRYWIDE ACTUARIAL VS NET PREMIUM, ILLUSTRATES THIS PHENOMENON BY DISPLAYING A PLANE OF POSSIBLE NET

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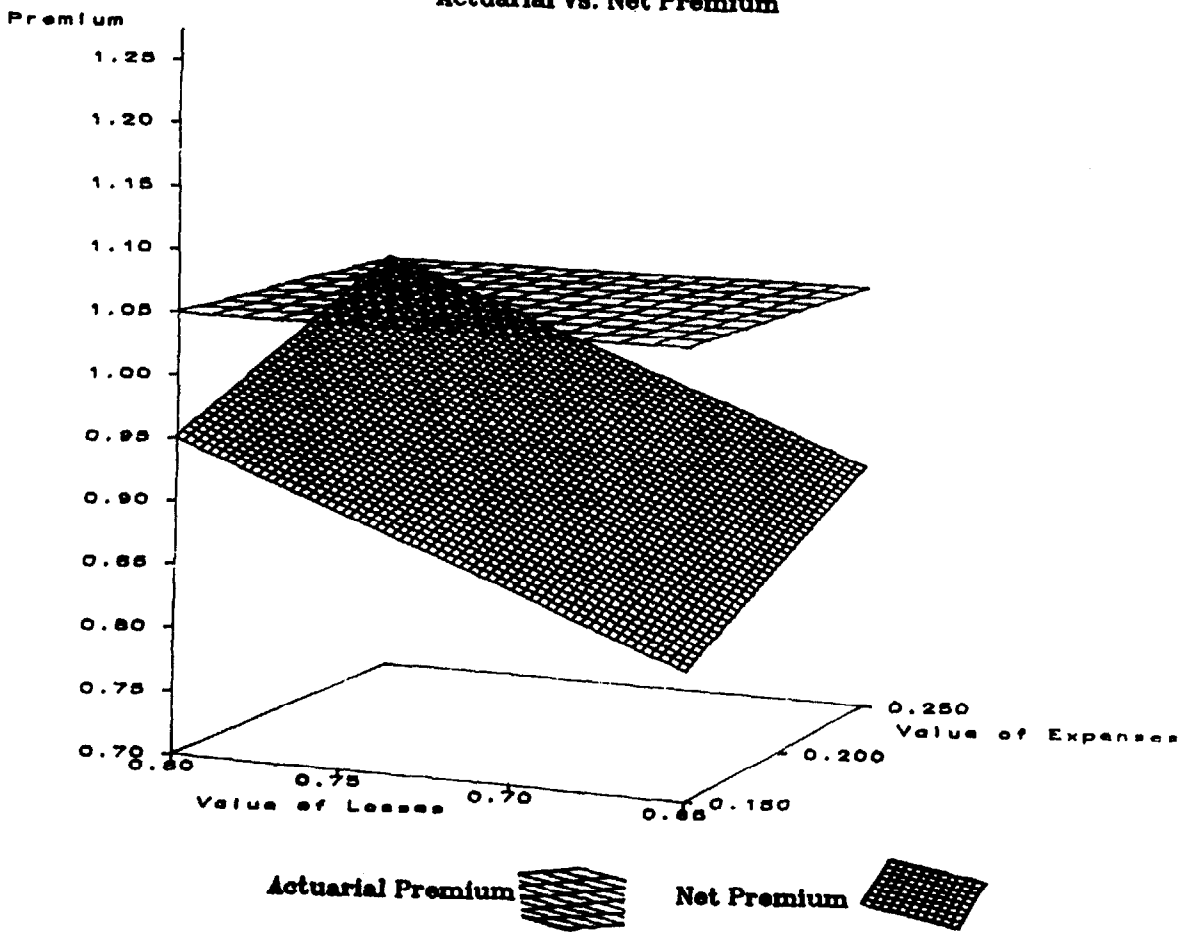
[3]THIS IS THE SO-CALLED 1921 PROFIT FORMULA. IT ACTUALLY SUGGESTED AN ADDITIONAL 3% FOR "CONFLAGRATION", REDUCED IN THE LATE 1940'S TO 1%. SEE NAIC [13, VOL. I, PAGE 28]. [] REFERS TO REFERENCES AT THE END OF THIS DISCUSSION.

[4]THIS DOWNWARD DEVIATION PHENOMENON HAS BEEN ILLUSTRATED MOST RECENTLY, AT THE RATE OF RETURN LEVEL, BY INDUSTRYWIDE RETURNS ON NET WORTH FROM 1968-1984. SEE ATTACHED GRAPH FROM A 1986 ARTICLE BY DAVID ELEY. OTHERWISE THIS IS THE SO-CALLED "SHORTFALL" PHENOMENON (SEE FAIRLEY (1), P.20 IN CUMMINS AND HARRINGTON [3]).

[5]SEE APPEL AND GEROFSKY [1] FOR THE WORKERS' COMPENSATION CASE.


Countrywide
Actuarial Vs. Net Premium
Premium
1.25
1.20
1.15
1.10
1.05
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.80
0.75
0.70
0.65
Value of Losses
0.150
0.200
0.250
Value of Expenses
Actuarial Premium
Net Premium

PREMIUMS GIVEN MARKET VALUATIONS OF LOSSES AND EXPENSES AND A TRADITIONAL 5% PROFIT LOADING IN THE ACTUARIAL PREMIUM.

MOST OF THE INSURANCE PRICING MODELS I KNOW ABOUT USE AN UNDERWRITING PROFIT MARKUP MODEL.[6] THE DIFFERENCES AMONG MODELS CAN BE FOUND IN HOW THE VALUE OF THE MARKUP IS DETERMINED. ONE FEATURE IS, OR SHOULD BE, COMMON TO THEM ALL; NAMELY, THAT SOUND AND UNBIASED ACTUARIAL TECHNIQUES ARE BROUGHT TO BEAR ON THE DIFFICULT PROBLEM OF FORECASTING LOSSES AND EXPENSES EXPECTED DURING THE POLICY CONTRACT.

FINANCIAL MODELS

BY A FINANCIAL MODEL I MEAN SIMPLY THAT SOME PRINCIPLES OF FINANCE (RATES OF RETURN, RISK, PRESENT VALUES) ARE USED TO SUPPORT THE CHOICE OF THE VALUE OF THE UNDERWRITING PROFIT LOADING. FINANCIAL MODELS OF EVER-INCREASING COMPLEXITY HAVE BEEN USED TO SET AUTOMOBILE AND WORKERS' COMPENSATION RATES IN MASSACHUSETTS SINCE 1976. THESE HAVE BEEN DOCUMENTED THROUGH 1983 IN MY ARTICLE[7] IN THE RECENTLY PUBLISHED BOOK, FAIR RATE OF RETURN IN PROPERTY-LIABILITY INSURANCE, EDITED BY DAVE CUMMINS AND SCOTT HARRINGTON, BOTH AT THE WHARTON SCHOOL, UNIVERSITY OF PENNSYLVANIA.

TWO KINDS OF FINANCIAL MODELS HAVE BEEN USED IN MASSACHUSETTS, RATE OF RETURN AND PRESENT VALUE MODELS. A

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[6] AN EXCEPTION IS FOUND IN ROSS AND KRAUS (3) IN CUMMINS AND HARRINGTON [3].

[7] SEE DERRIG (6) IN CUMMINS AND HARRINGTON [3].

RATE OF RETURN MODEL SEEKS TO DETERMINE THE RATE OF RETURN ON THOSE INSURANCE CONTRACTS (THE UNDERWRITING PROFIT) AS THAT RESIDUAL PROFIT NEEDED IN ORDER THAT THE RATE OF RETURN ON INVESTMENTS PLUS THE UNDERWRITING PROFIT EQUAL AN APPROPRIATE RATE OF RETURN ON THE EQUITY INVESTED TO UNDERWRITE THOSE CONTRACTS. RATE OF RETURN MODELS ARE MOST NATURALLY APPLICABLE IN A ONE-PERIOD CONTEXT WITH THE CENTRAL VALUATION TAKING PLACE AT THE END OF THE PERIOD. FOR ACTUARIAL PRICING PURPOSES, SINCE MOST INSURANCE CONTRACTS EXPECT MULTIPERIOD PAYMENTS OF CLAIMS, THE SIMPLE RATE OF RETURN MODEL MUST BE RESET WITHIN THE MULTIPERIOD CONTEXT TO BE PRACTICAL. THESE ARE NECESSARILY APPROXIMATE METHODS. THEY HAVE BEEN IMPLEMENTED BY STONE AND FAIRLEY [3,(1)] AND MODIGLIANI AND HILL [3,(2)] AND DISCUSSED EXTENSIVELY AS TO FORM BY MAHLER [11]. OF NOTE, IS THE FACT THAT THE FAIRLEY MODEL COMBINES THE GENERAL RATE OF RETURN APPROACH WITH A SPECIFIC FINANCIAL RATE OF RETURN MODEL CALLED THE CAPITAL ASSET PRICING MODEL (CAPM). THIS RESULTS IN A WORKABLE EQUILIBRIUM SOLUTION MATCHING THE INVESTOR'S EXPECTED RETURN ON EQUITY WITH THE INSURANCE COMPANY'S EXPECTED RETURN ON OPERATIONS. THE UNDERWRITING PROFIT MARGIN IS A RESIDUAL. A VERSION OF THE FAIRLEY MODEL WAS USED IN MASSACHUSETTS FROM 1978 TO 1981. ALTERNATIVELY, INTERNAL RATE OF RETURN MODELS CAN BE DEVISED WITH MULTIPERIOD CASH FLOWS AS EXEMPLIFIED IN RECENT FILINGS BY THE N.Y. COMPENSATION INSURANCE RATING BOARD AS WELL AS IN NCCI

FILINGS AROUND THE COUNTRY. A BRIEF EXHIBIT HIGHLIGHTING THE ESSENTIALS OF THE RATE OF RETURN MODELS IS ATTACHED.

A PRESENT VALUE MODEL, ON THE OTHER HAND, DEALS DIRECTLY WITH THE MULTIPERIOD CONTEXT BY SIMPLY EQUATING THE PRESENT VALUE OF THE PREMIUM PAYMENTS WITH THE PRESENT VALUE OF ALL LOSS, EXPENSE AND TAX PAYMENTS. THE PRESENT VALUE MODEL DEVELOPED FOR MASSACHUSETTS BY PROFESSORS MYERS AND COHN[8], AND ADOPTED FOR RATEMAKING IN 1981, HIGHLIGHTED TWO ADDITIONAL REQUIREMENTS FOR INSURANCE CONTRACTS. FIRST, THE PRESENT VALUE OF LOSSES AND EXPENSES MUST BE CALCULATED USING A DISCOUNT RATE ADJUSTED FOR RISK. THIS RESULTS IN USING A DISCOUNT RATE SOMEWHAT HIGHER THAN THE PREVAILING RISK-FREE RATE IN ORDER TO LOAD A POSITIVE EXPECTED PROFIT. SECOND, THE ACTUARIAL PREMIUM MUST CONTAIN A PROVISION FOR THE PRESENT VALUE OF ALL FEDERAL INCOME TAXES, TAXES ON BOTH INVESTMENT AND UNDERWRITING INCOME. THE INCLUSION OF TAXES IS OF THE UTMOST IMPORTANCE FOR REAL APPLICATIONS OF THESE MODELS.[9]

ALTHOUGH TIME LIMITATIONS DO NOT ALLOW ME TO COVER DETAILS, PERMIT ME TO INCLUDE WITH THIS DISCUSSION PAPER RECYCLED COPIES OF EXHIBITS ON THIS SUBJECT FROM A PRESENTATION TO THE CASUALTY ACTUARIES OF NEW ENGLAND

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[8]SEE MYERS AND COHN (3) IN CUMMINS AND HARRINGTON [3].

[9]SEE DERRIG [6].

(CANE). ALSO INCLUDED IS A SAMPLE CAR COMPANY CALCULATION OF AN UNDERWRITING PROFIT PROVISION USING THE MYERS-COHN MODEL, TOGETHER WITH A TEMPLATE FOR THOSE WISHING TO TEST THEIR OWN CALCULATION SKILLS. THE KEY IS NOT SO MUCH IN THE ARITHMETIC BUT RATHER IN UNDERSTANDING THE CONCEPTS AND ASSUMPTIONS WHICH UNDERLIE THOSE DECEPTIVELY-SIMPLE CALCULATIONS. LET ME TURN, IF I HAVE TIME, TO SOME OF THOSE ISSUES.

ISSUES

THE IMPLEMENTATION OF ANY OF THESE APPROACHES TO DETERMINING AN ACTUARIAL PREMIUM, WHICH PRESUMABLY IN "EQUILIBRIUM" WILL BE THE MARKET PREMIUM, FORCES THE ACTUARY TO CONFRONT MANY ISSUES DIRECTLY. THE CANE WORKSHOP EXHIBIT REPRODUCED HERE, LISTS WHAT I BELIEVE ARE THE MAJOR CONSIDERATIONS WHICH ENTER INTO THE SKILLFUL USE OF ANY OF THESE PROFIT MODELS. ALTHOUGH WE COULD SPEND DAYS ON EACH ONE, WE DO THAT IN MASSACHUSETTS RATE HEARINGS[10], I WOULD LIKE TO HIGHLIGHT ONE CURRENT ISSUE -- THE PRICING OF THE TAX REFORM ACT OF 1986 AND ONE GENERAL ISSUE -- PRECISELY THE ONE ACTUARIES MUST PAY STRICT ATTENTION TO -- LOSS AND EXPENSE BIAS.

[10]THE HEARING ON 1987 PRIVATE PASSENGER AUTOMOBILE RATES CONCLUDED AFTER A RECORD-BREAKING 86 HEARING DAYS STRETCHING MORE OR LESS CONTINUOUSLY FROM SEPTEMBER 1986 TO FEBRUARY 1987.

INVESTMENT INCOME, UNDERWRITING PROFIT AND CONTINGENCIES: FINANCIAL MODELS

PRICING THE TAX REFORM ACT OF 1986

THE TAX REFORM ACT (TRA) WAS SIGNED BY PRESIDENT REAGAN ON OCTOBER 22, 1986. IT HAS SET IN MOTION CHANGES TO A GREAT MANY PARTS OF THE FEDERAL TAX CODE. AN ANALYSIS OF THE TEXT OF THE NEW TAX LAW, EXAMPLES OF HOW THE TAX BURDEN WILL BE CALCULATED, AND AN ANALYSIS OF INVESTMENT STRATEGIES WERE ALL COVERED NICELY IN A MAY, 1987 CAS DISCUSSION PAPER BY OWEN GLEESON AND GERALD LENROW [9]. MY SUMMARY ANALYSIS WILL DEAL WITH THE MOST IMPORTANT ASPECTS OF THE TAX CHANGES AS THEY WILL AFFECT PROPERTY-CASUALTY INSURERS, ESPECIALLY HOW THEY WILL AFFECT THE ACTUARIAL PRICING OF THE PROPERTY-CASUALTY INSURANCE CONTRACT.[11] THE PRICING EFFECTS OF THE CHANGES WILL ALL BE FELT IN THE CALCULATION OF THE UNDERWRITING PROFIT PROVISION, A CALCULATION NOT NECESSARILY LEFT TO THE ACTUARY.

THE SUM OF THE EFFECTS OF THE TAX CODE CHANGES ON MASSACHUSETTS PRIVATE PASSENGER AUTOMOBILE INSURANCE IN 1988 WAS TO RAISE THE OTHERWISE-DETERMINED OVERALL UNDERWRITING PROFIT PROVISION FROM -7.8% TO -6.3%. THIS INCREASE OF 1.5% RESULTS FROM THE DIRECT INCORPORATION OF THE REFORM ACT PROVISIONS RELATING TO (1) THE INCLUSION IN TAXABLE INCOME OF A PORTION OF THE UNEARNED PREMIUM RESERVE, THE SO-CALLED "REVENUE OFFSET", (2) THE INCLUSION OF LOSS RESERVE

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[11] FULL DETAILS OF THE CALCULATIONS ARE AVAILABLE UPON REQUEST.

DISCOUNTING FOR INCURRED LOSSES AND EXPENSES, AND (3) THE CORPORATE TAX RATE CHANGE TO 34% FOR TAXABLE YEARS BEGINNING JULY 1, 1987. THE CHANGES TO THE DEDUCTIBILITY, FOR REGULAR TAX PURPOSES, OF STOCK DIVIDENDS AND TAX-EXEMPT INCOME, SO-CALLED "PRORATION", IS INCLUDED IN THE CALCULATION OF THE INVESTMENT TAX RATE.

UNDER THE "REVENUE OFFSET" PROVISION, A PORTION OF THE UNEARNED PREMIUM RESERVE IS INCLUDED IN TAXABLE INCOME. ONE-SIXTH OF 20% OF THE 1986 YEAR-END UNEARNED PREMIUM RESERVE IS INCLUDED BY CALCULATING ITS PROPORTIONAL RELATIONSHIP TO 1988 WRITTEN PREMIUM. ONE FIFTH OF THE CHANGE IN THE UNEARNED PREMIUM RESERVES, 1987 TO 1988, IS INCLUDED BY ESTIMATING THE EXPECTED GROWTH RATE IN THE UNEARNED PREMIUM RESERVE.[12] THE NET EFFECT OF EACH OF THE TWO PARTS OF THE "RESERVE OFFSET" PROVISION IS TO RAISE THE PROFIT PREMIUM BY ABOUT 0.4% FOR A COMBINED EFFECT OF 0.8%.

THE EFFECT ON THE UNDERWRITING TAX LOSS FLOW OF THE DISCOUNTING OF LOSS RESERVES CAN BE CALCULATED FROM AVAILABLE IRS AND MASSACHUSETTS DATA. INDUSTRY DISCOUNT FACTORS ARE APPLIED TO PROSPECTIVE MASSACHUSETTS LOSS FLOWS IN ORDER TO PRODUCE THE EXPECTED TIME PATTERN OF DEDUCTIONS FOR LOSS RESERVES EMANATING FROM AN AVERAGE POLICY. THE NET EFFECT OF THIS PROVISION OF TRA IS TO DELAY THE DEDUCTION FOR

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[12]IN THE ABSENCE OF GROWTH, THIS EFFECT WOULD BE ZERO.

INCURRED LOSSES RELATIVE TO THE TIMING UNDER THE PRE-TRA TAX CODE AND, THEREFORE, INCREASE THE PRESENT VALUE OF THE OVERALL TAX LIABILITY. THE EFFECTS VARY BY SUBLINE FROM NO EFFECT FOR THE PHYSICAL DAMAGE COVERAGES TO INCREASES OF 0.1% FOR PROPERTY DAMAGE LIABILITY AND 0.5% FOR BODILY INJURY LIABILITY COVERAGES. THE OVERALL EFFECT IS AN INCREASE OF 0.2% IN THE NEEDED PROFIT PROVISIONS.

THE EFFECTS OF THE CHANGE IN THE MARGINAL RATE FROM 46% TO 34% AND THE CHANGE IN DEDUCTIBILITY OF TAX-EXEMPT, DIVIDEND AND CAPITAL GAIN INCOME ARE ALL INCORPORATED IN THE CALCULATION OF AN EFFECTIVE[13] INVESTMENT TAX RATE FOR THE AVERAGE U.S. PROPERTY-CASUALTY COMPANY ASSET PORTFOLIO. THE CALCULATION OF AN EFFECTIVE INVESTMENT TAX RATE OF 24.1% FOR 1988 REFLECTS THE TAX ADVANTAGES OF TAX-EXEMPT BOND AND STOCK DIVIDEND INCOME APPLIED TO AN INVESTMENT PORTFOLIO OF 43% TAXABLE BONDS, 33% TAX-EXEMPT BONDS, 23% STOCK AND THE REMAINDER IN MISCELLANEOUS INCOME PRODUCING ASSETS. THE EFFECTIVE TAX RATE UNDER THE PRE-TRA TAX RATES WOULD HAVE BEEN 28.9%.

THE VALUE OF THE EFFECT OF THE CHANGE IN TAX RATES VARIES DRAMATICALLY BY THE LENGTH OF THE LOSS PAYOUT

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[13]THE EFFECTIVE INVESTMENT TAX RATE INCLUDES AN ESTIMATE OF AN IMPLICIT TAX OF 20.7% ON TAX-EXEMPT SECURITIES AND 0.1% FOR THE TAX DUE ON TAX-EXEMPT INCOME UNDER THE PRORATION PROVISIONS. THE ACTUAL INVESTMENT TAX RATE IS ABOUT 20%.

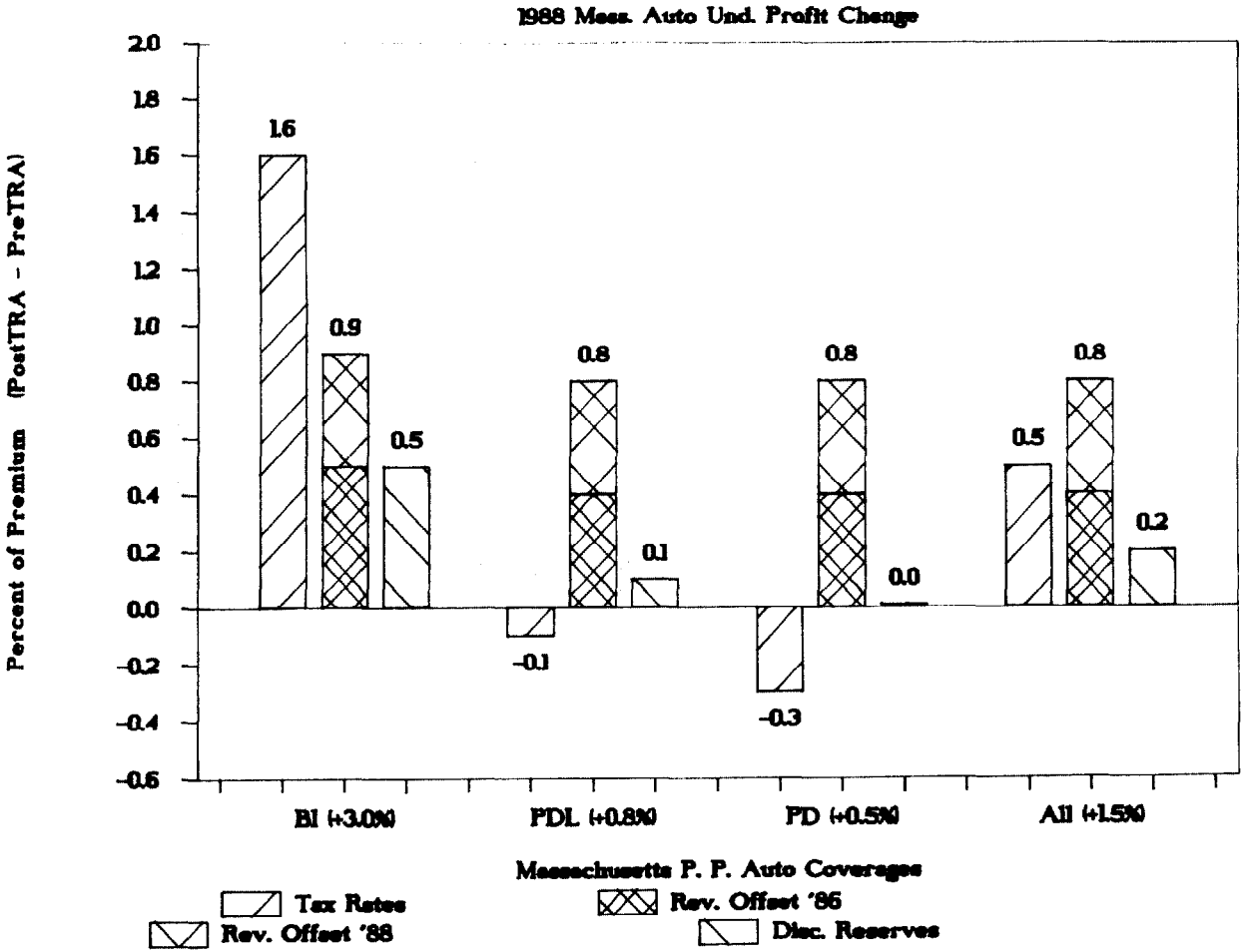
PATTERN. THE LONG BODILY INJURY LIABILITY LINE PROFIT PROVISION INCREASES 1.6% WHILE THE PROPERTY DAMAGE LIABILITY PROVISION DECREASES BY 0.1% AND THE PHYSICAL DAMAGE PROVISION DECREASES BY 0.3%. THE REASON FOR THESE EFFECTS IS TWO-FOLD. FIRST, THE TAX SHIELD GENERATED BY THE DEDUCTION FOR AN UNDERWRITING LOSS HAS DROPPED FROM 46% TO 34% OF THE LOSS. THAT TENDS TO RAISE THE TAX LIABILITY SUBSTANTIALLY ON LONG PAYOUT LINES.[14] SECOND, THE EFFECTIVE INVESTMENT TAX RATES DROP AS WELL, FROM 28.9% TO 24.1%, BUT NOT AS MUCH AS THE DROP IN THE MARGINAL RATE FOR THE TAX SHIELD. THUS, THE LONG LINES ARE AFFECTED BY BOTH CHANGES, IN PROPORTION TO THE LENGTH OF THE LINE, WHILE THE SHORT LINES SUCH AS PHYSICAL DAMAGE, ARE AFFECTED PRIMARILY BY THE DECREASE IN THE INVESTMENT TAX RATE. ON AN ALL AUTO BASIS, THE CHANGE IN THE TAX RATES AND DEDUCTIBILITY OF TAXABLE INCOME RAISES THE NEEDED PROFIT PROVISION BY 0.5%.

ON AN OVERALL BASIS, THE PROFIT PROVISION REQUIRED UNDER TRA HAS INCREASED BY 1.5% FROM WHAT IT WOULD HAVE BEEN UNDER THE PRIOR TAX CODE. THE VALUES OF EACH OF THE EFFECTS BY SUBLINE ARE SHOWN IN THE FOLLOWING GRAPH. IN SUM, THE EFFECTS ARE:

1.	TAX RATE CHANGES	+0.5%
2.	DISCOUNTING RESERVES	+0.2%
3.	RESERVE OFFSET (UPR)	+0.8%
4.	TOTAL	+1.5%

[14]THIS EFFECT IS IN ADDITION TO THE USE OF DISCOUNTED LOSS RESERVES TO CALCULATE THE ACTUAL TAX DEDUCTION.

1986 Tax Reform Act Effect



THE MASSACHUSETTS WORKERS COMPENSATION LINE OFFERS THE OPPORTUNITY TO UNDERSTAND HOW LARGE THE EFFECT MIGHT BE FOR THE CHANGE TO DISCOUNTED LOSS RESERVES FOR TAX PURPOSES.[15] NEW RATES WENT INTO EFFECT ON 1/1/88 THAT INCORPORATED BOTH THE CHANGES IN THE TAX LAW AND IN THE MASSACHUSETTS WORKERS' COMPENSATION LAW. THE RELEVANT FEATURE OF THE NEW MASSACHUSETTS LAW FOR THIS DISCUSSION WAS THE LARGE EXPANSION OF ESCALATED BENEFITS. THAT EXPANSION, TOGETHER WITH ALL OTHER CHANGES, IS EXPECTED TO PRODUCE A LOSS PAYOUT PATTERN IN WHICH THE AVERAGE PAID DOLLAR OCCURS NEARLY FIVE YEARS FROM THE EFFECTIVE DATE OF THE POLICY, ABOUT ONE AND ONE-THIRD YEARS LATER THAN THE AVERAGE FOR WORKERS' COMPENSATION COUNTRYWIDE. THE TABLE BELOW COMPARES THE AVERAGE PAYDATES FOR THE AUTOMOBILE LINES AND THE WORKERS' COMPENSATION LINES FOR MASSACHUSETTS AND COUNTRYWIDE. THE COUNTRYWIDE FLOWS ARE TAKEN FROM THE ACTUAL IRS ACCIDENT YEAR PAYOUT PERCENTAGES USED TO CALCULATE THE LOSS RESERVE DISCOUNT FACTORS.

[15]THE EFFECT OF DISCOUNTED LOSS RESERVES HERE APPLIES FOR NEW POLICY YEARS AFTER 1/1/87 AND, THEREFORE, IS INDEPENDENT OF ANY BENEFITS OF THE SO-CALLED "FRESH START" PROVISION FOR DISCOUNTING RESERVES FOR ACCIDENT YEARS PRIOR TO 1987.

	AVERAGE PAYDATE	
	MASSACHUSETTS (1/1/88 RATES)	COUNTRYWIDE (IRS REV. RULING)
AUTO PHS. DAM.	0.52 YEARS	0.69 YEARS
AUTO PD LIAB.	1.04	-
AUTO BI LIAB.	2.60	-
AUTO LIAB.	2.10	1.98
WORKERS' COMP.	4.88	3.56

THE FOLLOWING GRAPH OF THE CUMULATIVE PAYOUT PATTERNS FOR THESE MASSACHUSETTS AND COUNTRYWIDE LINES SHOW HOW DIFFERENT THEY ACTUALLY ARE BY YEAR.

THE LOSS RESERVE DISCOUNTING EFFECT BY LINE CAN ALSO BE GAUGED TO SOME DEGREE BY COMPARING THE IRS PROMULGATED DISCOUNT FACTORS FOR USE IN DISCOUNTING THE LOSS RESERVES AT THE END OF EACH ACCIDENT YEAR. SINCE THE IMPLICIT DISCOUNT FACTOR UNDER THE PRE-TRA TAX LAW WAS 1.0000, THE SIZE OF THE DISCOUNT FACTOR FOR THE END OF THE ACCIDENT YEAR BY LINE IS IN SOME WAY A MEASURE OF HOW GREAT THE CHANGE WILL BE IN THE TAX LIABILITY.

IRS REVENUE RULING[16]

YEAR ZERO DISCOUNT FACTORS (%)

AUTO PHYSICAL DAMAGE	95.9640
AUTO LIABILITY	89.1776
COMPOSITE SCHEDULE P	84.4514
WORKERS COMPENSATION	81.0030
OTHER LIABILITY	76.7789
MEDICAL MALPRACTICE	68.8804

AS AN EXAMPLE, WE CAN CALCULATE THE EFFECT OF THE LOSS RESERVE DISCOUNTING WITHIN THE OVERALL EFFECT FOR THE MASSACHUSETTS WORKERS' COMPENSATION LINE. USING THE SAME METHOD TO CALCULATE THE EFFECTIVE INVESTMENT TAX RATE AS THE COMMISSIONER USED IN THE 1/1/88 MASSACHUSETTS AUTOMOBILE RATES,[17] THE VALUES OF THE VARIOUS TAX EFFECTS ARE:

1.	TAX RATE CHANGES	+1.5%
2.	DISCOUNTING RESERVES	+2.7%
3.	REVENUE OFFSET	+0.8%
4.	TOTAL	+5.0%

[16]IRS REVENUE RULING 87-34, IRS BULLETIN 1987-17, 4/27/87.

[17]A DIFFERENT METHOD FOR CALCULATING AN EFFECTIVE INVESTMENT TAX RATE APPROPRIATE FOR POLICYHOLDERS WAS USED IN THE ACTUAL APPROVED RATES. SEE DERRIG [6].

THE RESULTS ARE QUITE DIFFERENT FROM THE AUTO BODILY INJURY LIABILITY LINE, DUE SOLELY TO THE DIFFERENCE FROM THE EFFECT OF DISCOUNTING RESERVES. THE FOLLOWING GRAPH ILLUSTRATES THE COMPARATIVE AUTOMOBILE AND WORKERS' COMPENSATION EFFECTS.

IT MIGHT BE USEFUL TO TRANSLATE THE ABOVE CALCULATION INTO DOLLARS TO GIVE SOME FEEL FOR THE MAGNITUDE OF THE EFFECT OF TRA. PRIOR TO ANY FAVORABLE REMAND DECISION[18], MASSACHUSETTS PRIVATE PASSENGER AUTOMOBILE 1988 PREMIUM IS EXPECTED TO BE ABOUT $2.2 BILLION. THIS MEANS THAT THE PREMIUM VALUE OF TRA IS ABOUT $33 MILLION. COUNTRYWIDE, THE 1987 PRIVATE PASSENGER AUTO NET PREMIUM WRITTEN WAS ABOUT $64 BILLION[19] WHICH, WITH GROWTH, SHOULD PUT THE COUNTRYWIDE PRIVATE PASSENGER AUTO TRA VALUE AT ABOUT $1 BILLION.

IF WE FURTHER ASSUME THAT THE TOTAL INDUSTRY ANNUAL TRA BILL WILL BE THE SAME AS OUR MASSACHUSETTS PRIVATE PASSENGER AUTOMOBILE AT ABOUT 1.5% OF PREMIUMS (PROBABLY AN UNDERESTIMATE, GIVEN RESULTS FOR THE MASSACHUSETTS WORKERS COMPENSATION LINE), THEN FOR A 1987 NET WRITTEN PREMIUM VALUE OF ABOUT $192 BILLION, THE COUNTRYWIDE ALL LINES TRA VALUE WOULD BE ABOUT $3 BILLION. THAT NUMBER IS CLOSE TO RECENT

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[18]THE SUPREME JUDICIAL COURT REMANDED BOTH 1987 AND 1988 RATES TO THE COMMISSIONER FOR REVIEW. RETROACTIVE RATE INCREASES OF 8.3% AND 7.7% WERE GRANTED ON MARCH 10 FOR 1987 AND 1988 POLICY YEARS RESPECTIVELY.

[19]BEST'S MANAGEMENT REPORTS, 12/28/87.

REPORTS OF THE ESTIMATED INDUSTRY TAX BILL FOR 1987 OF $2.8 BILLION. OTHER ANALYSTS[20] MIGHT APPROACH THIS PRICING PROBLEM IN DIFFERENT WAYS BUT I BELIEVE THAT THIS LITTLE IMPRECISE EXERCISE SHOWS QUITE CLEARLY THAT (1) THE PRICING CHANGE DUE TO TRA '86 IS NON-TRIVIAL AND ONE WHICH SHOULD BE OF GENUINE CONCERN TO RATEMAKING ACTUARIES AND (2) THE TRA '86 TAX BILL IS PROBABLY GOING TO BE MUCH LARGER THAN THE POPULAR PRESS ACCOUNT OF $7 BILLION OVER 1987-92 WHEN TRA WAS PASSED.

NO PROVISION FOR THE EFFECT OF THE ALTERNATIVE MINIMUM TAX (AMT) PROVISIONS ON COMPANIES HAS BEEN INCLUDED. THE AMT IS DESIGNED TO PRODUCE A LONG-RUN MINIMUM TAX RATE ON ALL INVESTMENT AND UNDERWRITING INCOME OF AT LEAST 10%. THE AMT CAN ONLY INCREASE THE FEDERAL INCOME TAXES THAT COMPANIES MUST PAY, SO THAT OMISSION OF CONSIDERATION OF THIS SUBJECT HAS THE EFFECT OF POSSIBLY UNDERESTIMATING THE NEEDED PROFIT PROVISIONS.

BIASED LOSS ESTIMATES

I HAVE INCLUDED THE RATING BUREAU'S MOST RECENT COMPILATION OF THE TRACK RECORDS OF ESTIMATING LOSS PURE PREMIUMS IN MASSACHUSETTS AUTOMOBILE FOR THE MAJOR PARTIES IN THE RATE HEARING PROCESS. IT SHOWS THAT, DESPITE THE

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[20]FOR EXAMPLE, THE RECENT ISO ANALYSIS PROJECTS SURPLUS IMPAIRMENTS OF ABOUT $3 BILLION PER YEAR IN THE ABSENCE OF PRICING CHANGES TO REFLECT THE INCREASED TAX LIABILITY OF TRA.

VENEER OF A REGULATORY PROCESS BENT ON DETERMINING THAT MARKET AND ACTUARIAL PRICES WILL BE THE SAME, THE PARTIES CONSISTENTLY UNDERESTIMATE LOSS COSTS. MOREOVER, THIS UNDERESTIMATION IS AT LEVELS FAR IN EXCESS OF THE EXPECTED TOTAL OPERATING PROFIT OF ABOUT 2% OF PREMIUM THAT THIS COMPLEX MACHINERY EXPLICITLY PUTS INTO THE RATES AS A RISK PREMIUM LOADING.

LOSS COST PREDICTIONS
PREDICTION ERRORS
1978-1986

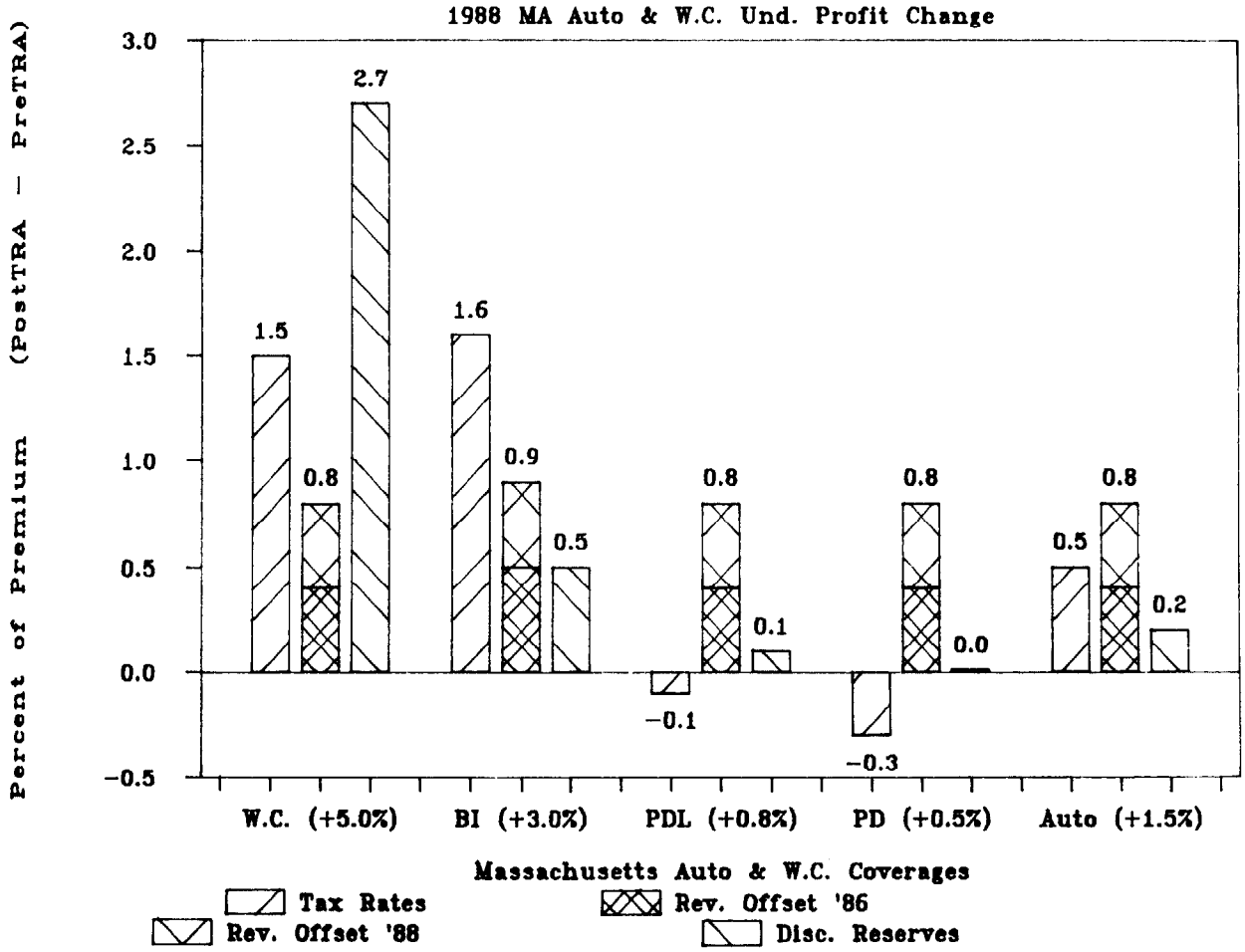
	AVERAGE ERROR	AVERAGE ABSOLUTE ERROR[21]
MARB	-5	7%
AC*	-12	12
DECISION	-12	12
SRB	-14	14

* 1980-1986 ONLY

BY USING ACTUARIALLY BIASED ESTIMATES, THE MASSACHUSETTS AUTOMOBILE INSURANCE RATE SETTING PROCESS HAS STOOD THE TRADITIONAL MARKUP/COMPETITIVE PROCESS MODEL ON ITS HEAD. THIS IS ILLUSTRATED BY THE ATTACHED GRAPH, A TWIN TO THE PREVIOUS GRAPH, LABELED MASSACHUSETTS ACTUARIAL VS NET PREMIUM. UNFORTUNATELY, INSURANCE COMPANIES IN MASSACHUSETTS CANNOT DEVIATE UPWARD FROM STATE-SET RATES OR EQUIVALENTLY RUN (-20%)

[21] IT IS NO ACCIDENT THAT, EXCEPT FOR MARB, THE AVERAGE ERRORS AND AVERAGE ABSOLUTE ERRORS ARE THE SAME.

1986 Tax Reform Act Effect



OR (-40%) OFF SALES. THE MARCH 10, 1988 REMAND DECISION INCREASING 1987 AND 1988 AUTOMOBILE RATES BY AN ADDITIONAL 8% PER YEAR GOES A LONG WAY TOWARD RECTIFYING THIS BIAS WHILE PROMISING A FULL REVIEW OF LOSS TRENDING METHODOLOGIES FOR 1989 RATES. STAY TUNED TO SEE WHAT HAPPENS.

THANK YOU FOR THE INVITATION TO BE AT THIS SECOND CAS RATEMAKING SEMINAR.

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    3. Solvency and Risk (OPTIONS)
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    5. Capital Market Considerations
    6. Reserving and Ruin

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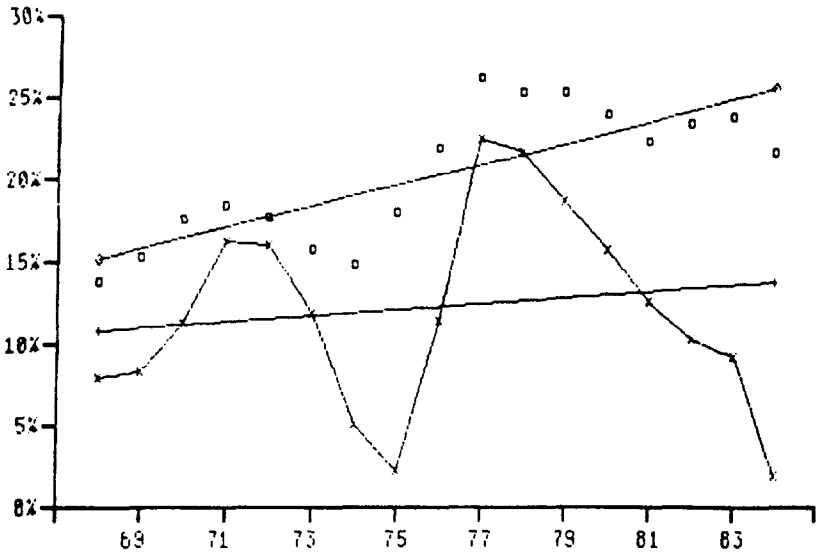
FIGURE IV

Property/Casualty Industry Returns on Net Worth, 1968-1984 and A Line-of-Best-Fit Reflecting Median Returns on Net Worth for All Industries, 1968-1984

Also Returns on Net Worth Effectively Allowed Under Traditional Approaches to Ratemaking, Shown Both as Individual Annual Returns and On A Line-of-Best-Fit Basis



Connected points reflect Property/Casualty industry returns on net worth as calculated by the Texas State Board of Insurance using data provided by the A.M. Best Company.

Lower line-of-best-fit reflects annual median returns on net worth for all industries as reported by *Fortune* magazine.

Unconnected points and upper line-of-best-fit reflect returns on net worth effectively allowed under traditional approaches to ratemaking, as calculated by the Texas State Board of Insurance.

SOURCE: DAVID ELEY 1986, "INVESTMENT INCOME IN RATEMAKING", JOURNAL OF INSURANCE REGULATION, 5:186.

MARK-UP MODELS

PREMIUM = (LOSSES + EXPENSES) x (1 + PROFIT)

FORMALLY,

$$P = \frac{L + E}{1 - \mu}$$

WHERE:

P = PREMIUM (ACTUARIAL)

L = LOSSES

E = EXPENSES

μ = UNDERWRITING PROFIT PERCENT OF PREMIUM

FINANCIAL MODELS

I. RATE OF RETURN MODEL

TOTAL RETURN = INVESTMENT RETURN + UNDERWRITING RETURN

$$R_E \text{ (EQUITY)} = R_A \text{ (EQUITY + RESERVES)} + R_U \text{ (PREMIUMS)}$$

(AFTER TAXES)

$$R_E = (1 - T_A)\, R_A\, (1 + KS) + (1 - T_U)\, R_U\, (S)$$

A. STONE MODEL

$$R_E = (1 - T)\,[R_F + (KS)(1 - R_U) + R_U\,(S)]$$

B. FAIRLEY CAPM MODEL

UNDERWRITING PROFIT = LOAN INTEREST + RISK LOAD + TAXES

$$R_U = -K\,R_F - KB_L\,[E(R_M) - R_F] + \left[\frac{T}{(1 - T)S}\right] R_F$$

C. INTERNAL RATE OF RETURN MODEL

NCCI & N.Y. COMP. BOARD

II. PRESENT VALUE MODELS

MYERS-COHN VERSION FOR MULTIPERIOD MODEL

1. PREMIUM = LOSSES + EXPENSES + FEDERAL TAXES ON ALL INCOME (AT PRESENT VALUES)

2. PV(PREMIUM) = PV(LOSSES + EXPENSES)
   + PV(FEDERAL TAXES ON INVESTMENTS)
   + PV(FEDERAL TAXES ON UNDERWRITING)

$$K_2P = K_1 (L + E) + T_2R_FK_3P + T_1 [K_4P - K_5 (L + E)]$$

K_1 to K_5 = PRESENT VALUE FACTORS

R_F = RISK-FREE RATE

T_1 = UNDERWRITING TAX RATE

T_2 = INVESTMENT TAX RATE

MASSACHUSETTS AUTO 1982 TO 1984

3. NUMERICAL EXAMPLE (1983 AUTO BI)

P = (L + E) - (INV) + (TAX INV + TAX UND) + (OP PROF)

\$82.07 = \$100 - 17.55 + (5.53 - 7.59) + 1.68

R_F = 14.2%, T_1 = 28%, T_2 = 46%

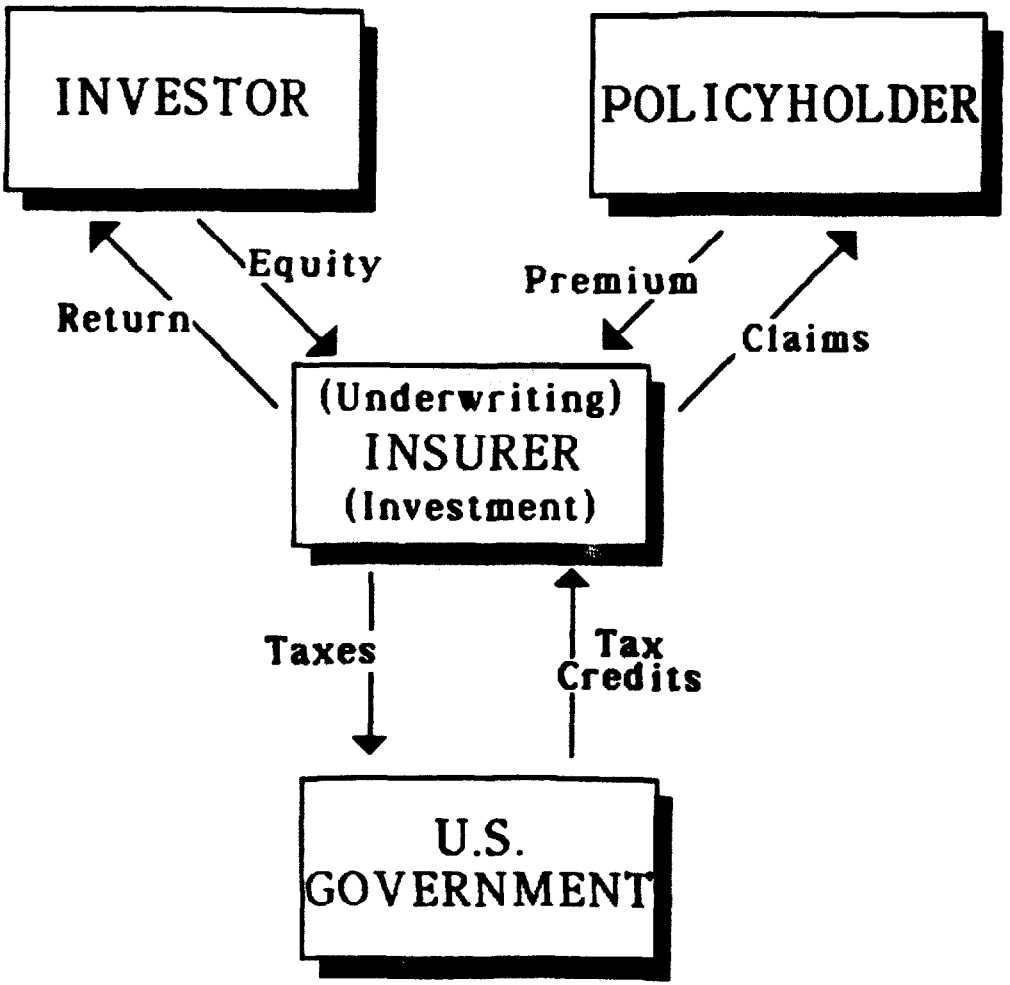
CANE WORKSHOP

RATEMAKING METHODS FOR EXPLICIT RECOGNITION OF INVESTMENT INCOME

SEPTEMBER 18, 1984
STURBRIDGE, MASSACHUSETTS

CANE WORKSHOP

CASH FLOW PARTICIPANTS



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BASIC RATE OF RETURN MODEL

I. METHODOLOGY - A SIMPLIFIED VERSION WITH NO TAXES

1. INSURANCE COMPANY RETURN

TOTAL RETURN = INVESTMENT RETURN + UNDERWRITING RETURN

$$R_E \text{ (EQUITY)} = R_A \text{ (EQUITY + RESERVES)} + R_U \text{ (PREMIUMS)}$$

$$R_E = R_A (1 + KS) + R_U (S)$$

K = RESERVES/PREMIUM

S = PREMIUM/EQUITY

RESERVES = (PREM + LOSS + LAE) RESERVES

2. INVESTOR RETURN

TOTAL RETURN = INVESTED EQUITY RETURN +
INSURANCE OPERATION RETURN

$$R_E \text{ (EQUITY)} = R_A \text{ (EQUITY)} + R_U \text{ (EQUITY)}$$

$$R_E = R_A + [R_A (KS) + R_U (S)]$$

CANE WORKSHOP

BASIC RATE OF RETURN MODEL

II. METHODOLOGY - A SIMPLIFIED VERSION WITH TAXES

1. INSURANCE COMPANY RETURN

TOTAL RETURN = INVESTMENT RETURN + UNDERWRITING RETURN (AFTER TAXES)

$$R_E = (1 - T_A)\, R_A\, (1 + KS) + (1 - T_U)\, R_U\, (S)$$

2. INVESTOR RETURN

TOTAL RETURN = INVESTED EQUITY RETURN + INSURANCE OPERATION RETURN

$$R_E = (1 - T_A)\, R_A + [(1 - T_A)\, R_A\, (KS) + (1 - T_U)\, R_U\, (S)]$$

$$= R_A + [R_A\, (KS) + R_U\, (S) - T_A R_A\, (1 + KS) - T_U R_U\, (S)]$$

WHERE ASSET RETURN = RISK-FREE RETURN + RISK PREMIUM

$$R_A = R_F + R_P$$

3. KEY PARAMETERS

R_E, R_A;	S, K, KS;	T_A, T_U
YIELD;	LEVERAGE;	TAXES

CANE WORKSHOP

BASIC RATE OF RETURN MODEL

III. METHODOLOGY - REGULATORY COMPANY RETURN

A. FOR REGULATORY PURPOSES WE CAN ASSUME A RISK-FREE RETURN ON ASSETS:

TOTAL RETURN = RISK-FREE EQUITY RETURN + INSURANCE OPERATION RETURN

$$R_E = R_F + [R_F (KS) + R_U (S) - T_F R_F (1 + KS) - T_U R_U (S)]$$

MASSACHUSETTS AUTO 1976-1978, 1980-1982

B. FOR REGULATORY PURPOSES BY LINE N WE CAN ESTIMATE THE INSURANCE OPERATING RETURN USING A CAPITAL ASSET PRICING MODEL (CAPM) BETA (B) AND MARKET RISK PREMIUM (M) TOGETHER WITH RESERVES/PREMIUM BY LINE (K_N)

$$R = R_F + BMK_N S$$

MASS. STATE RATING BUREAU 1981-1984

NAIC MODEL A

CANE WORKSHOP

INCLUSION OF INVESTMENT INCOME IN RATES

I. METHODOLOGY - A SIMPLIFIED VERSION FOR SINGLE PERIOD MODEL

1. PREMIUMS = LOSSES + EXPENSES - INVESTMENT INCOME ON CASH FLOW
+ FEDERAL TAXES ON ALL INCOME
+ OPERATING PROFIT

2. PREMIUMS = LOSSES + EXPENSES - RESERVES x INVESTMENT RATE
+ INVESTMENT TAX RATE X SURPLUS X INVESTMENT RATE
+ INVESTMENT TAX RATE X RESERVES X INVESTMENT RATE
+ UNDERWRITING TAX RATE X UNDERWRITING PROFIT/LOSS
+ OPERATING PROFIT

CANE WORKSHOP

INCLUSION OF INVESTMENT INCOME IN RATES

II. METHODOLOGY - MYERS-COHN VERSION FOR MULTIPERIOD MODEL

1. PREMIUM = LOSSES + EXPENSES + FEDERAL TAXES ON ALL INCOM
(AT PRESENT VALUES)

2. PV(PREMIUM) = PV(LOSSES + EXPENSES)
+ PV(FEDERAL TAXES ON INVESTMENTS)
+ PV(FEDERAL TAXES ON UNDERWRITING)

$$K_2P = K_1 (L + E) + T_2R_FK_3P + T_1 (K_4P - K_5 (L + E))$$

K_1 to K_5 = PRESENT VALUE FACTORS

R_F = RISK-FREE RATE
T_1 = UNDERWRITING TAX RATE
T_2 = INVESTMENT TAX RATE

MASSACHUSETTS AUTO 1982 TO PRESENT

3. NUMERICAL EXAMPLE (1983 AUTO BI)

P = (L + E) - (INV) + (TAX INV + TAX UND) + (OP PROF)
\$82.07 = \$100 - 17.55 + (5.53 - 7.59) + 1.68
R_F = 14.2%, T_1 = 28%, T_2 = 46%

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ACTUARIAL ISSUES

1. CHOICE OF MODEL
   - A. ECONOMIC VALUE AND DATA
   - B. ACCOUNTING VALUE AND DATA
2. AMOUNT OF RESERVES FOR INVESTMENT
   - A. TIMING OF CASH FLOWS
   - B. ACCOUNTING DATA
3. AMOUNT OF EQUITY (SURPLUS) FOR INVESTMENT
   - A. TOTAL
   - B. BY LINE
4. INVESTMENT INCOME
   - A. YIELD RATE
   - B. TAX RATE
5. REWARD FOR RISK-BEARING
   - A. DIRECT - TARGET RATE OF RETURN (DCF)
   - B. INDIRECT - OPERATING PROFIT (BETA)
6. CONTINGENCY FACTOR
   - A. LOSS AND EXPENSE BIAS
   - B. UNKNOWN CONTINGENCIES AND BIASES

CANE WORKSHOP

Ratemaking Methods for Explicit Recognition of Investment Income

Massachusetts Method
Car Company Examples

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Massachusetts Rating Bureaus
Boston, Massachusetts 02109
September 18, 1984

#2579

CANE WORKSHOP

Extended Car Insurance Company Example
Data

1. **Cash Flows**

Loss + Expense/Year	0	0.5	1	1.5	2.5	3.5	4.5	Sum
a. Average Line	0	.6535	0	.2376	.0792	.0198	.0099	1
b. Long Line	0	.3310	0	.2611	.1985	.1433	.0661	1

Premium/Year								
a. Pre-Paid	1	0	0	0	0	0	0	1
b. Installments	.3000	.6000	.1000	0	0	0	0	1

2. **Capital Flow/Prem/Year**

a. Policy Year: (Block @ 2 to 1)	.5000	.5000	0	0	0	0	0	1
b. Liabilities Avg:	.5000	.1733	.1733	.0545	.0149	.0050	0	.9210
(Flow @ 2 to 1) Long:	.5000	.3345	.3345	.2040	.1047	.0331	0	1.5108

3. **Tax Flows**

Underwriting/Year								
a. Economic	Same as Loss and Expense							1
b. Accounting	0	.5000	.5000	0	0	0	0	1

Investment/Prem/Year

Cumulative Premium - Cumulative Loss and Expense + Capital, all advanced one period when income is received and taxes paid.

4. **Investment Yield**
   a. Low Yield 6.00%
   b. Medium Yield 10.00%
   c. High Yield 14.00%

Investment Tax Rate
   i. Low Tax Rate 28%
   ii. High Tax Rate 46%

Underwriting Tax Rate
46%

5. **Underwriting Risk Adjustment For Investment Yield**
   a. No Risk 0%
   b. Low Risk -1.5%
   c. High Risk -4.5%

CANE WORKSHOP

Calculation of Underwriting Profit Provision

Myers-Cohn Present Value Model

	0	0.5	1	1.5	2.5	3.5	4.5	Sum	Variable
1. Discount Factors/Year									
a. Risk-Free 10.0%	1	.9535	.9091	.8668	.7880	.7163	.6512	-	-
b. Risk-Adj. 8.5%	1	.9600	.9217	.8848	.8155	.7516	.6927	-	-
2. Loss and Expense/Year									
a. Flow	0	.6535	0	.2376	.0792	.0198	.0099	1	-
b. Disc. Risk-Free (2a x 1a)	0	.6231	0	.2060	.0624	.0142	.0064	.9121	-
c. Disc. Risk-Adj. (2a x 1b)	0	.6274	0	.2102	.0646	.0149	.0069	.9240	κ_1
3. Premium/Year									
a. Flow	1	0	0	0	0	0	0	1	-
b. Disc. Risk-Free (3a x 1a)	1	0	0	0	0	0	0	1	κ_2
4. Invest Tax/Prem/Year									
a. Cum Prem	1	1	1	1	1	1	1	-	-
b. Cum Loss & Exp	0	.6535	.6535	.8911	.9703	.9901	1	-	-
c. Capital	.5000	.5000	0	0	0	0	-	-	
d. Inv. Bal (4a - b + c)	1.500	.8465	.3465	.1089	.0297	.0099	0	2.8415	-
e. Yield 10.0%	.0488	.0488	.0488	.1000	.1000	.1000	.1000	-	-
f. Tax Rate 46.0%	.46	.46	.46	.46	.46	.46	.46	-	-
g. Inv. Bal Tax (4d x e x f)/(Year-1)	0	.0337	.0190	.0078	.0050	.0014	.0005	-	-
h. Disc. Inv. Bal Tax (4g x 1a)	0	.0321	.0173	.0067	.0039	.0010	.0003	.0613	$\pi \kappa_3$
5. Underwriting Tax/Year									
a. Und. Tax Prem	0	.5	.5	0	0	0	0	1	-
b. Und. Tax Loss & Exp.	0	.5	.5	0	0	0	0	1	-
c. Disc. Und. Tx. Prem. (5a x 1a)	0	.4768	.4546	0	0	0	0	.9314	κ_4
d. Disc. Und. Tx. L & E (5b x 1b)	0	.4800	.4609	0	0	0	0	.9409	κ_5
6. Underwriting Profit									
a. P/(L + E)				$\kappa_1 - \tau \kappa_5)/(\kappa_2 - \pi \kappa_3 - \tau \kappa_4)$					
b. Und. Profit (2c,3b,4h,5c,5d)				(.9240 - .46(.9409))/(1 - .0613 - .46(.9314))= .9626					
c. Und. Profit (1 - 1/6b)				$1 - (.9626)^{-1} = -.0389 = \underline{-3.9\%}$					

Massachusetts Method

CANE WORKSHOP

Calculation of Underwriting Profit Provision

Myers-Cohn Present Value Model

	0	0.5	1	1.5	2.5	3.5	4.5	Sum	Variable
1. Discount Factors/Year									
a. Risk-Free ___%									
b. Risk-Adj. ___%									
2. Loss and Expense/Year									
a. Flow									
b. Disc. Risk-Free (2a x 1a)									
c. Disc. Risk-Adj. (2a x 1b)									K_1
3. Premium/Year									
a. Flow									
b. Disc. Risk-Free (3a x 1a)									K_2
4. Invest Tax/Prem/Year									
a. Cum Prem									
b. Cum Loss + Exp									
c. Capital									
d. Inv. Bal (4a - b + c)									
e. Yield ____%									
f. Tax Rate ____%									
g. Inv. Bal Tax (4d x e x f)/(Year-1)									
h. Disc. Inv. Bal Tax (4g x 1a)									$r\tau_2 K_3$
5. Underwriting Tax/Year									
a. Prem Flow									
b. Loss + Exp Flow									
c. Disc. Prem (5a x 1a)									K_4
d. Disc. Loss + Exp (5b x 1b)									K_5
6. Underwriting Profit									
a. P/L + E				$(K_1 - \tau_1 K_5)/(K_2 - r\tau_2 K_3 - \tau_1 K_4)$					
b. Und. Profit (2c,3b,4h,5c,5d)									
c. Und. Profit (1 - 1/6b)									

CANE WORKSHOP

Ratemaking Methods for Explicit Recognition of Investment Income

David Appel
Richard A. Derrig
Richard G. Woll

Sturbridge, Massachusetts
September 18, 1984

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