Model Variances in Assessing the Present Value of Future Medical Care

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Abstract  This research investigates four alternative models for computing the present value of future medical care and illustrates the valuation differences among the alternatives. The four models are the life expectancy model, the expected med cost model, the expected present value model, and the no tax expected med cost model. Models 1 through 3 integrate tax liability on the basis of an allocated award. Valuation comparisons among the models are presented for variations across the most critical valuation parameters including, age, base level of medical care, and real future medical care growth rates. Results show only modest differences, less than 2.0%, across the first three models when the med cost growth rate approaches the before tax interest rate for all age and base level med care comparisons. Differences among models 1 to 3 increase as the net before tax discount rate departs from approximately zero. Differences of 5% to 8% result with approximate minus one and minus two net discount rates, respectively. At a plus one approximate net discount rate, the differences among models one to three are less than 2%. Omission of taxes in model 4 results in substantially lower present values with the differences increasing as the years of loss and the base level medical care increase.

Introduction

For severely injured parties, future medical care often constitutes the greatest component of economic loss in a personal injury case. Catastrophic injuries often result in life care plans projecting future medical care needs in the hundreds of thousands to millions of dollars. The economist’s task in assessing the present value of future medical care requires integration of the elements of projected future medical care needs with projected rates of growth, discount rates, tax liabilities on interest to be received on the invested award, and statistics of mortality. There are three alternative models for the integration of mortality statistics into the valuation process. These models are the Life Expectancy Model, the Expected Future

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Medical Care Model, and the Expected Present Value Model. This is the first research to introduce the Expected Present Value Model. The literature regarding the modeling of the present value of medical care has been limited to the Life Expectancy and the Expected Future Medical Care Models. Slesnick was one of the first to introduce some of the complexities of valuing medical care but did not address the unique IRS rulings regarding tax effects on the valuation. Anderson and Roberts (1989), Syderhoud and Chun (1996), and Ireland (1989) introduce the unique tax modeling issues of medical care, but are limited in scope to single illustrations and general discussions of the structure of the medical cost present value modeling.

In the sections to follow these models are presented along with a model of losses without taxes. Numerical illustrations of differences among the models are presented for variations across the valuation parameters, number of years of loss (age of the injured party), annual base level of medical care needs, and growth rate of future medical care. With the exception of the no tax analysis, all tax liabilities are integrated assuming that medical care is identified with specificity, i.e., an IRS allocated award. The paper concludes with a summary of findings.

Present Value Models of Future Medical Care

In many cases a life-care plan defines for the economist the base medical care costs, frequency, and needs. The economist integrates growth rates, mortality statistics, and tax liabilities on interest to be received on the invested award in computing the present value of future medical care. The two most frequently employed methods of valuation are the Life Expectancy and the Expected Medical Cost Present Value Models. The Life Expectancy Model, Model 1, front loads future medical care costs into the years of remaining life expectancy by weighting each year’s future medical care with probability one to the period of life expectancy. The Expected Medical Cost Present Value, Model 2, spreads the projected med costs over the prospective remaining years of life, assumed here to age 100, by weighting each year’s future medical care costs by the probability of surviving to that year. When the discount rate equals the projected growth rate, valuations from the two models are identical. Front loading medical costs in Model 1 will result in smaller (larger) present values than Model 2 when the growth rate is greater (less) than the discount rate. Model 3 is the Expected Present Value Model of future medical care. This Model differs from Model 2 in that the present values of alternative years of survival are weighted by the probabilities of death in each future year. For example, if the injured party is age 70, there are 30 possible present value series associated with living to age 71, 72, 73, etc. out to age 100. This model is identical to Model 2 only if the discount rates are equal for the two models. Since discount rates are the after tax rates for each future year, there is little reason to assume equality of discount rates across the two models. The final model presented in this research is the No Tax Expected Medical Cost Present Value Model, Model 4.
This model is identical to Model 2 with the exception that future expected medical costs are discounted at the before tax discount rate instead of the after tax discount rate. Model 4 reflects valuations in those states that preclude testimony regarding taxes on any of the economic elements of loss. Exclusion of taxes increases the discount rate and therefore produces the lowest present values. The differences between models 2 and 4 are the present values of the future tax liabilities on interest to be earned on the invested award in the future. In all the illustrations to follow, it is assumed that the injured party is filing jointly, taking two personal exemptions, and has itemized deductions excluding future medical care that equals the joint filing standard deduction. Future medical care tax write-offs are computed on the assumption that future medical care write-offs are excluded until the future time at which future cumulative medical care exceeds the present value award, i.e., the present value award is an IRS allocated award. Interest earned on the invested award is assumed to be the only source of future taxable income.

Model 1 - Life Expectancy Model

\[ PV_{LE} = \sum_{t=1}^{LE} \frac{MC_t}{\prod_{j=1}^{t} (1 + r(1 - \tau_j))} \]

Model 2 - Expected Future Medical Care Model

\[ PV_{E(MC)} = \sum_{t=\text{Current Age}}^{\text{Age 100}} MC_t \frac{PS_t}{\prod_{j=\text{current.age}}^{t} (1 + r(1 - \tau_j))} \]

Model 3 – Expected Present Value Model

\[ E(PV) = \sum_{t=\text{current.age}}^{\text{Age 100}} PD_t \sum_{t=\text{current.age}}^{\text{Age 100}} MC_t \frac{PS_t}{\prod_{j=\text{current.age}}^{t} (1 + r(1 - \tau_j))} \]

Model 4 – No Tax Expected Present Value Medical Cost Model

\[ PV_{No Tax} = \sum_{t=1}^{\text{Years to age 100}} \frac{MC_t \cdot PS_t}{(1 + r)^t} \]

Where
- \( LE \) = Life Expectancy in years
- \( MC_t \) = Medical Cost given survival to year \( t \)
- \( r \) = Before tax interest rate on US Treasury Debt
- \( \tau_t \) = Marginal tax rate on interest earned in period \( t \)
- \( E(MC) \) = Expected future medical cost
- \( PS_t \) = Probability of survival to period \( t \)
- \( PD_t \) = Probability of death in period \( t \)
Illustrations and Results

In this section present value differences among the four different present value models are illustrated for injured parties currently aged 10, 30, 50, and 70. Varying the age illustrates the effect of having a greater number of years of projected loss and illustrates the effect of varying tax liabilities on the invested awards. For each age, base medical costs are varied from $25,000, $50,000, $100,000, and $200,000 to illustrate the tax effects associated with varying levels of present value awards by age. Finally, real growth rates in future medical care costs are varied from 0%, 1%, 2%, and 3% for a 30 and 50 year old injured party with $50,000 in base medical cost needs to illustrate the effect changes in net before tax discounts rate may have on the model comparisons.

Illustrations of variations among the models for varying base level of medical care at ages 10, 30, 50, and 70 are presented in Figures 1, 2, 3, and 4, respectively. In each of these figures the real growth rate in medical care is 1%, the projected rate of inflation is 4%, and the real interest rate is 1.25%. These values were selected to reflect the approximate zero historical net before tax discount rate for valuing medical care over the past 40 years. The specific value of inflation is relatively unimportant because it is common to the before tax discount rate and the nominal growth rate in medical costs. Figures 5 and 6 illustrate differences among the four models for net discount rates of approximately +1%, 0%, -1%, and -2%. In each of the figures, percent differences of each model’s present value are compared to those derived in Model 2. For example, a +2% for Model 3 reflects that the present value from Model 3 is 2% larger than the present value from Model 2.

![Figure 1](image-url)
Figure 2
Alternative Valuations of the Present Value of Future Medical Care - Age 30

Figure 3
Alternative Valuations of the Present Value of Future Medical Care - Age 50
Figure 4
Alternative Valuations of the Present Value of Future Medical Care - Age 70

Figure 5
Alternative Valuations of the Present Value of Future Medical Care - Age 30
In each of the three after-tax model analyses, the modeling for tax liability on future interest to be earned on the invested award is limited to a maximum marginal rate of 25% as the models allow for the introduction of tax free municipal investments at that point. Mortality statistics by age are taken from the U.S. Life Tables 2003 for males. Current marginal tax break points, personal exemptions, and the standard deduction for joint filing are all indexed to the projected rate of inflation of 4%, and the current tax deductibility of medical care in excess of 7.5% of adjusted gross income is assumed to prevail for all future years. Valuations for all models were computed via an iterative program in which present values were increased or decreased after each iteration until the final years balance in the invested account reached plus or minus $0.01.

A quick review of Figures 1 though 4 reveals very similar valuations among Models 1 through 3. Differences between the front loaded Life Expectancy Model and the Expected Future Medical Care Model are virtually zero. Model 3, the Expected Present Value Model is approximately 2% greater than Models 1 and 2 across all ages and across all levels of base medical care. These results are not entirely unexpected. Differences among the models derive from the convexity or con-
cavity of the cumulative present value functions of the medical costs. The parameters of the models in Figures 1 through 4 results in slightly concave to slightly convex cumulative present value functions. As the base med costs increase and as the years of loss increase, the cumulative present value functions move to convexity as the tax liability on interest increases. The increase in tax liability occurs early in the period of loss before the tax deductibility of the allocated med costs begins. Once, medical costs become tax deductible the tax liability falls to zero for the remaining years of loss. The increasing tax liabilities are well illustrated with the results from Model 4. Tax liabilities are greatest when the injured is young (greater years of loss result in larger present values) and when the base year medical cost is greatest (larger medical costs result in larger present values). Exclusion of taxes will result in under estimations of the present value of losses compared to Model 3 of approximately 14% at $25,000 base medical cost and increasing to 30% at $200,000 base medical cost for the injured party aged 10, 7% to 20% for the injured party aged 30, 3% to 14% for the injured party aged 50, and 0% to 6% for the injured party aged 70. The decline in percentage error by age results from the declining years of future medical care needs and related decline in the present value of future medical care.

Illustrations of model valuation differences for varying real growth rates in future medical care from 0% to 3% are presented in Figures 5 and 6. Figure 5 and 6 valuations are for a 30- and a 50-year-old injured party, respectively with base medical care needs of $50,000. At 0% real growth in medical costs, the life expectancy present value is greater than the expected present value and the present value of expected medical costs, but the difference is less than 2% for the 30-year-old and 3% for the 50-year-old. As the real growth rate in medical costs increases, the life expectancy present values decrease relative to the Expected Future Medical Care Present Value Model models. As illustrated in Figures 1 through 4, there is very little difference among Models 1 through 3 at a plus one real rate of interest. The Life Expectancy Model is approximately equal to the Expected Future Medical Care Model and the Expected Present Value Model is approximately 2% greater than either model. At plus 2% real growth rate in medical costs, the Life Expectancy Model falls below the Expected Present Value Model by approximately 4% for both the 30- and 50-year-old and the Expected Future Medical Care Model falls below the Expected Present Value Model by approximately 2%. At plus 3% real growth rate in medical costs, the Life Expectancy Model falls below the Expected Present Value model by approximately 9% for both the 30- and 50-year-old. For both the 30- and 50-year-old the expected present values are approximately 3% greater than the Expected Future Medical Care Model valuations.
Summary and Conclusions

Valuations of medical costs in personal injury litigation pose unique tax and mortality issues in assessing economic loss. This research investigates the potential for valuation differences arising from alternative modeling of mortality statistics and includes comparisons with the no tax valuations for those states where tax integration is excluded. Tax integration as an allocated award is assumed throughout the research and illustrations, and the interest to be earned on the invested award is assumed to be the only source of taxable income to the injured in the future. The after-tax models examined are the Life Expectancy Model, the Expected Future Medical Care Model, and the Expected Present Value Model, and the No-Tax Model is the Expected Future Medical Care Present Value Model without taxes.

When the projected growth in future medical care is approximately equal to the before tax discount rate, there is surprisingly little difference among the tax adjusted model valuations across a broad range of years of loss and base level of medical care. The Life Expectancy Model is virtually identical to the Expected Future Medical Care Model and the more complex Expected Present Value model is only 1% to 2% greater across the parameters of age and base level of medical care. Omission of taxes on the other hand results in significant undervaluation which increases with the magnitude of the present value award (large base medical costs and large number of years of loss). For a 10 year old injured party, underestimation of the present value of loss can exceed 24% to 26% of the after-tax present value award when base medical care exceeds $100,000, and exceeds 11% to 20% at the lower base medical care levels of $25,000 and $50,000, respectively. For fewer years of loss, e.g. ages 30, 50, and 70, these percentage underestimations are halved for each 20 year increment in age.

Each 1% change in the net before tax discount rate results in a corresponding change in the Life Expectancy Model relative to the Expected Future Medical Care Model and Expected Present Value Model of approximately 2% - 3% for a 30- and 50-year-old. The difference between the Expected Future Medical Care Model and Expected Present Value Model is a more modest 1% change per change in the before tax net discount rate with the Expected Present Value model increasing by 1% for each percent decrease in the before tax net discount rate.

In summary, the similarity of the three after-tax models for the zero net before tax discount rate and the absence of sizeable departure for plus or minus 1% means that there should not be significant bias across varying economic testimony of loss resulting from which model the economist utilizes to integrate mortality statistics into the valuation.
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