How Much Life Insurance Do You Need?

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August 14, 2012

Abstract

We present formal models of the different methods of estimating a person's required life insurance coverage. The models make evident the critical issues surrounding the estimates: the family goals, cash flow estimation, the discount rate, inflation, taxes and the time horizons assumed. We investigated 23 life insurance companies to see what models they and/or their agents use to estimate life insurance needs of potential clients. In general, where we could determine a model, it was closest to the expense model. The models and the explanations are rather vague about the details and application of them could lead to widely-varying results. We found similar vagueness in the models that appear in life insurance textbooks. This great lack of attention to how life insurance needs are calculated suggests that personal financial planning education and the insurance industry should be working to improve both teaching and practice on this topic.

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Simple Models for Estimating Life Insurance Needs

There are two common methods of estimating the amount of life insurance a person needs, assuming that there will be surviving family members who are partially or wholly dependent upon the earnings of the insured person. The income method calculates the present value of all the future labour income of the insured, sometimes with a rule of thumb adjustment to allow for items like income tax rate differences and saved expenses. The expense method calculates the present value of all the future expenses of the dependents that the labour income was intended to support. In between the income and expense methods is the human live value or what we call the net human capital method, which we will argue is likely to serve family needs better than either the income or the expense method. A different approach values the insurance at the amount needed to produce a specific bequest.

Let us establish some notation so that we can express these concepts more formally.

P_{NI}	Additional insurance required using the income method
P_{NX}	Additional insurance required using the expense method
P_{NH}	Additional insurance required using the net human capital method
P_{CP}	Additional insurance required using the capital retention method
P_E	Existing insurance coverage
E_t	After-tax real dollar labour income of the insured, year t
C_t	Real dollar consumption of the family with the insured person alive, year t
C_t^1	Real dollar consumption of the family after the insured's death, year t
k	after-tax real discount rate
k_{nom}	after-tax nominal discount rate
R	date of retirement
D	date of death last surviving dependent, or end date of dependence on the insured
W_0	Initial wealth available to fund future consumption of the dependents
W_n	Future value of a family's financial goal
B_D	Bequest to the next generation

Then, under the income method,

$$P_{NI} = \sum_{t=1}^{R} E_t (1+k)^{-t} - P_E$$

Under the expense method,

$$P_{NX} = \sum_{t=1}^{D} C_t^1 (1+k)^{-t} - P_E - W_0$$

The family's consumption after the death of the insured person needs some further description. We are defining family as a surviving spouse for the rest of his or her life, and the children or others only for as long as they would normally remain dependent on the spouse. Once the children are expected to start earning their own income and paying their own expenses, they are

no longer part of the family, but have started their life as family units themselves. The expenses that need to be insured no longer include their expenses. The actual age of a child when independence happens can vary, and it might be for life in the case of a disabled child.

The two expressions are quite different, but what does the difference mean? If you insure your after-tax income, including pension contributions, then you must have at least covered all the expected expenses, because otherwise you would also not have been able to cover them if you didn't die before retirement. We expect $P_{NI} \geq P_{NX}$.

We can say more than that. In a world of certainty, we would be able to calculate P_{NX} precisely, and if the insured died, the insurance money would run out exactly on the date of death of the second spouse. The difference between the income and expense methods of insurance is the bequest to the next generation, or more precisely, the additional bequest to be added by the new life insurance. We can express this as:

$$P_{NI} - P_{NX} = \sum_{t=1}^{R} E_t (1+k)^{-t} - \sum_{t=1}^{D} C_t^1 (1+k)^{-t} + W_0$$

In this form, as the difference between the two methods of calculating life insurance needed today, the equation gives the present value of the bequest. At the date of death, the bequest will be:

$$B_D = \sum_{t=1}^{R} E_t (1+k)^{D-t} - \sum_{t=1}^{D} C_t^1 (1+k)^{D-t} + W_0 (1+k)^D$$

In a more general sense, we can express the wealth, or perhaps the goal, of a family, at any time n, as:

$$W_n = W_0 (1+k)^n + \sum_{t=1}^{n} (E_t - C_t)(1+k)^{n-t}$$

If the specific goal is the bequest to the next generation, then in the absence of any insurance and with neither parent dying prior to retirement, we get:

$$B_D = W_0 (1+k)^D + \sum_{t=1}^{D} (E_t - C_t)(1+k)^{D-t}$$

These two expressions for B_D are not in general equal, though they can be in specific circumstances. They appear very similar, but we have glossed over a number of important issues that affect the value that life insurance will have for different families in different circumstances. We have also treated the problem only in a certain world, but life insurance is all about risk management, and we cannot ignore the uncertainty in these estimates. One of the biggest effects is income tax. A common practice with the income method is to reduce the basic calculation to 70 or 80% of the value, as a rule of thumb adjustment for tax and risk effects.

However, there is a significant issue with using the income method as the method of estimating life insurance, and it is related to the family goals and a more precise consideration of what the human capital is worth and how much the second generation can expect as the average bequest.

Net Human Capital Model

Let us step back and consider the purpose of insurance. What is the family objective in buying life insurance? One objective is often said to be maintaining the family in the same life style as if the insured did not die prematurely and continued to contribute to the family resources. Let us reason by analogy and think of house insurance. The usual practice is to insure the entire value of the family home and either add a current value rider or revise the insurance periodically to reflect changes in the replacement value of the home. The purpose of the insurance is to replace the entire home with the same quality home. This home insurance does not have the same objective as the one we stated for life insurance. Recall from our previous discussion that the family consists of the dependents only as long as they are dependent. Later in the life cycle, this will be only the parents most often, because the children will have moved on to form their own families. If the objective in insuring the house is only to maintain the standard of living required for the dependent children and surviving spouse, it could be met more cheaply by insuring for an amount equal to the present value of the rental cost of an equivalent house until the death of the surviving spouse. But we do not think of house insurance in that way, we think of it as replacing the entire value of what the family already owns, the house and land freehold, with the right to sell it for market value upon death of the spouse, and leave the residual to the next generation. Or alternatively, to sell the house when the surviving spouse is older and needs the asset value to generate income.

If we apply the logic of house insurance to life insurance, we want to insure the entire value of the asset, which is the human capital. This seems to resolve the question between the income and expense methods in favour of the income method, because it is a way of measuring human capital. However, we recall also one maxim favoured by a colleague, which is that you should never insure yourself so well that the beneficiary is better off with you dead than alive! There are two reasons why the pure income method will also fail to capture the value to the family of the human capital of the insured.

First, recall that we don't value a business solely based on its revenue (which equals labour income in the human capital sense), but rather on its net income or cash flow. Human capital has to be maintained with food, clothes, etc., and when the insured dies, these expenses also disappear. The net contribution to the family is much less than the labour income.

Second, human beings are not valuable solely for their cash income, but also for the value they contribute to the family. A common mistake in family insurance plans is to fail to insure the spouse who stays home with the children, yet if he or she dies, the survivor will have significant additional expenses. Spouses working outside the home also contribute labour to the household that would otherwise have to be purchased.

In words, the net human capital method of estimating insurance needs measures the net contribution to the family of the person's human capital by valuing the paid labour income, the

unpaid labour income and the savings in maintenance of the human capital. Huebner (1927) seems to be the first to discuss insurance needs in this fashion, but he does not provide a detailed model of how to calculate what he calls human life values. He provides an example that calculates the present value of the expected future earnings of a person, minus the cost needed to care for the insured person if he had lived (Huebner, 1927, pp. 37-38). He discusses some of the issues around the estimation, but in fairly general terms. He does not deal with the insured person's contributions to household work, probably because he implicitly assumes a household with a working male and homemaking female. Our definition of net human capital is more inclusive.

We can express the net human capital value as:

$$P_{NH} = \sum_{t=1}^{R} E_t (1+k)^{-t} - P_E - \sum_{t=1}^{D} (C_t - C_t^1)(1+k)^{-t}$$

Note that the summation for the labour income runs until the retirement of the insured, but the summation of the net saving or net extra expenses required runs until the death of the spouse. The sign of each term in the summation will not necessarily be the same. If the insured is a homemaker spouse, the death could increase expenses while the children are dependent and then decrease them after the departure of the children.

We expect $P_{NH} \geq P_{NX}$ also, but the relationship to P_{NI} depends on the circumstances. A homemaker who earns no outside labour income will seem to require no life insurance, but a proper calculation of his or her contribution to the family will show a positive value. A family in which both spouses work outside the home and share the household duties or hire others to do them will be one in which $P_{NI} \geq P_{NH} \geq P_{NX}$.

Specific Bequest Models

A bequest to a spouse is simply the provision for expenses, or the capitalisation of net human capital and should not be confused with the models in this section. The specific bequest models are providing a bequest to the next generation. We have already seen that the simple net income model provides an expected bequest to the next generation that is equal what the next generation would expect to receive if the insured person did not die prematurely.

There are two types of specific bequest calculations. In both cases, the implicit family goal is dynastic. The family wants to maintain specific assets, or perhaps just a fortune, forever. One such model is the capital retention approach. The insurance allows the dependents to live upon the income from the family capital without liquidating any of it, thus passing an estate to the next generation with virtual certainty. The authors who describe this method do not distinguish between maintaining the real value of the estate and the nominal value.

If we take the goal as maintaining the real value, then,

$P_{CP} = C^1/k - P_E$

Comparing this to the earlier equations, we see that the initial wealth is not counted at all in the determination of needed insurance, because that is precisely what the family wants to maintain. If instead the family believed that the insured person would be able to increase the family fortune materially if he or she lived to the end of working life, then there would be an additional term that is the capitalised value of expected future excess income. If the goal is to maintain the nominal value, then we substitute k_{nom} for k.

The other sort of specific bequest allows the family to keep a specific asset that the heirs would otherwise have to sell in order to pay income taxes or death duties. In Canada, assets generally can pass from one spouse to the other at death without immediate tax consequences, but the capital gains tax will be exacted when the second spouse dies. If the asset is something that has special value outside its financial worth, like a family cottage or a family business in which other family members still work, then the value of the insurance is the estimate of the future income tax that will be payable.

Issues in the Estimation Process

We identify six issues that may materially affect the estimate of life insurance needed:

1. The family's goal in buying the insurance;
2. The estimation of future earnings and living expenses;
3. Time horizons that are assumed, particularly date of death of the beneficiary spouse and retirement age of the insured;
4. Riskless or risky discount rate;
5. Inflation; and,
6. Income tax.

These issues are inter-related, but we will discuss them separately, while showing the connections.

Family Goal

It follows from the characteristics of the three models that the method used to estimate life insurance needs depends upon the family goals.

Does the family wish to leave a bequest to the next generation, assuming it even has the means to do so? If the answer is no, then the insured parents should use the expense method, since this will not produce as much of a bequest to the next generation, if at all.

If the family wishes to leave a bequest, it could use the net human capital method. This method will on average reproduce the bequest that the next generation could expect if neither parent died early. The income method will produce an excessive bequest on average, although a rule of thumb adjustment might correct it by accident.

Another method is possible, though. If the goal is to leave a bequest, the insured person could set a specific bequest goal, and it could be less than the amount that the net human capital method would produce. The mechanical calculation is to use the expense method to determine the needed insurance, and then add as much insurance as is desired for the bequest. This amount would be in nominal dollars at the date the insurance is purchased and so the real value of the bequest would be lower. If the bequest is intended to be specifically dynastic, then the insurance is estimated as the amount needed to maintain whatever it is that the family wants to be able to keep in perpetuity.

The important point is that a generic insurance model taught in a textbook or used by a life insurance agent is not suitable. The model should match the family goal.

Estimating Cash Flows

We don't have a lot to contribute from the finance theory perspective, because the challenges are all related to personal budgeting for long horizons. The financial planner can provide check lists and model budgets, but the client has to do the hard work of filling in the numbers. The planner needs to remind the client of some finance issues that do arise. In practice, insurance companies provide the tools, and an interesting topic to pursue is how life agents use the tools and work with their clients.

Estimating key dates

In the equations, two dates stand out: date of retirement and date of death of the surviving spouse. The date of retirement is a choice of the insured, but the planner needs to remind him that the average date of retirement is 61-62 in many western countries, including Canada and the US, and the insurance estimated using the income method may be affected substantially by the retirement assumption.

The date of death of the second spouse is a major determinant of the estimate under the expense method. Since insurance is intended to reduce risk, the planner should advise the clients to use an age like 90 or 95, rather than the median age of death that will underlie the insurance company's calculations. At the same time, there is another way to think about this issue, following from Milevsky and Macqueen (2010). If the family does not wish to leave a bequest, then annuitising the insurance payoff, or assuming it will be annuitised, will provide a much higher payout guaranteed for life than investing the principal can do, because of the mortality credits. This aspect of estimating the insurance needed deserves a paper on its own.

Riskless or Risky Discount Rate?

Normal insurance practice among many different applications is to use a riskless rate. On the other hand, one of the most basic principles of finance is to discount cash flows with a rate that is suitable to the risk involved. Future income streams, date of death, etc. introduce significant risk into the estimates.

We prefer to use a riskless rate in the belief that the purpose of insurance is to reduce risk and hence the amount of insurance should be enough to provide a secure future for the dependents.

The effect of the rate choice is very large because of the long time horizons. Use a riskless rate, and the amount of insurance required is much larger, than that generated from a calculation using a higher, risky rate. If the dependents invest the insurance proceeds in a balanced portfolio of equity and debt for a long period of time, they are very likely to end up better off financially than if the insured had survived.

Whichever rate an insurance company or agent is using, the client must know what it is and understand the significance of the choice.

Income Taxes

Income taxes are a complicated issue in all financial planning models. In principle, life insurance needs estimates ought to be after-tax, with the tax effects built in year by year in a spreadsheet. The largest effect is the lower tax average tax rate that a beneficiary will pay when support comes from a large insurance payout. The principal is not taxable and so only the income on the principal will be taxable each year. For example, the beneficiary could choose to annuitize part or all of the settlement. In Canada, this would be a "prescribed" annuity with a special format for the tax calculations to artificially spread the interest income portion of the annuity evenly over the life of the contract. A homemaker spouse who received such an annuity might well pay no income tax at all on payments as large as $80,000 p.a. However, an income of well over $100,000 p.a. would have been required when the insured spouse was living to generate that amount after-tax.

The income method deals with this in an inadequate fashion by a rule of thumb adjustment. The expense and net human capital methods require detailed tax calculations and the question is whether companies and agents do them in practice.

Inflation

The planner can allow for inflation in two ways: use real cash flows and real discount rates or assume an inflation rate and calculate everything in nominal values. Ho and Robinson (2005) generally advocate using real values because it is more compact, but with modern software it is more a matter of taste. The issues arise with an inflation rate assumption, forecasts of future changes in labour income and mixing real and nominal values. Insurance planning involves very long time horizons and hence these issues affect the calculations considerably. Clients are rarely well-educated in how to incorporate inflation into their planning.

Initial Observations of Practice

We investigated 23 life insurance companies to see what we could learn about their practical application of life insurance needs models. Our findings are preliminary, but point the way clearly to further research.

- 9 out of the 23, or 39% of the companies had an on-line calculator to assist consumers in estimating insurance needs;
- 13 out of the 23, or approx. 57% of the companies did not have a calculator to assist consumers in estimating insurance needs and one had a calculator we were unable to use;
- All of the companies that had an on-line calculator used the expense approach.
- No companies used the net human capital approach, although one company did have a Human Life Calculator, but the method of the calculator was not the Human Capital approach. Some calculators do incorporate parts of the net human capital method, but not completely or consistently.
- Rules of thumb, usually as a percentage of some measure of income multiplied by an arbitrary factor, are used at least some of the time.
- There is no consistency in the approach taken by different companies.
- We saw no evidence of an industry standard or norm. One company referred us to the Canada Life and Health Insurance Industry Association, which we followed up. Its calculator is reasonable, but not consistent with any other calculator, nor is it demonstrably superior.
- The variation in the factors considered, issues raised, etc., on all the websites, whether or not they included a calculator, defies easy summarization.
- We can say that there are clear errors and/or inadequacies in the way taxes and inflation are incorporated into the plans. Other sources of income at death and the savings and additional costs associated with the loss of one parent are not completely incorporated in anything we saw. Some calculators include employee benefits, some do not.

We interviewed six agents who sell life insurance to families in conjunction with the investigation of the website calculators. We had much the same observations. The agents are more thorough in what they consider, and most of them use company software to estimate the amount of life insurance needed. The agents were more aware of the important factors we have discussed, including items that are part of the net human capital model.

Elger (2003) finds that the calculators available on the web at that time gave enormously varying results when used with a sample case. Given the length of time since that research, it would be well worth repeating. Our initial examination of web calculators suggests that there would still be huge variations, and the importance of various estimates is never completely explained.

What Do the Textbooks Say?

Rejda (2010) outlines the human life approach and critiques it because it does not include all the factors that we have outlined in the net human capital approach. He does not explicitly mention an income approach, though of course the human life value as he explains it is closest to the income method. He explains the expense approach fairly thoroughly, and clearly he prefers it. He also explains the capital retention approach, noting that it produces much higher estimates.

Clark (2010) outlines a pure income approach, though she calls it the human life value. She provides a detailed example of the expense approach and also the capital retention approach. Like Rejda, she favours the expense approach, and calls the capital retention approach "overkill."

Black and Skipper (2000) do not seem to discuss these models explicitly, but the extended example they provide (pg. 362 – 70) uses the expense approach.

Ho and Robinson (2005) provide detailed examples of the income method with a rule of thumb adjustment, the expense method and the net human capital method.

Conclusions

1. The income method of estimating life insurance needs will only be accurate by luck, and will often overstate the requirement.
2. The choice between net human capital and expense methods depends on the family's goal for a bequest to the next generation.
3. The expense method will give the lowest estimate of insurance needed of the three methods.
4. The difference between the expense method and the other two methods is the expected bequest to the next generation.
5. The explicit bequest methods will give inflated estimates of insurance needs unless the family goal is dynastic retention of specific assets or a family fortune.
6. There is no consistent method used in practice to estimate the amount of life insurance an individual or family requires, and all the practices we observed have good and bad aspects.

Where do we go from here? We need to use the formal models and our discussion of them to better inform a more in-depth series of interviews and investigations of the models that the companies and life insurance agents are using currently.

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