Special Article

Handling Time in Economic Evaluation Studies

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Background: *Time horizon and discounting are important issues in economic evaluation studies and have an impact on the priority of different programs.*
Objective: *Provides supporting rational and theories to propose the appropriate discount rate for both cost and effect and time horizon for conducting economic evaluation studies in Thailand.*
Material and Method: *Describe the theories that explain time horizon for both the cost of a study and its effect.*
Conclusion: *The recommended uniform discount rate for both costs and effects at the base case is 3% with a variance in range from 0-6% by sensitivity analysis. The time horizon should be long enough to capture the full costs and effects of the programs.*

Keywords: *Time horizon, Discounting, Economic evaluation guideline, Thailand*

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Time horizon refers to the time period over which cost and outcome data should be measured. The time horizon may be short or long depending on several factors such as the nature of disease, budget and so on. An analyst must specify the time period to be long enough to capture both relevant cost and outcome data in order to adequately interpret results[1]. The period of time that an intervention should be evaluated is still a vexing question[2-5]. An unresolved issue related to the time horizon is how to incorporate the effect of interventions on diseases such as the effect of cardiovascular therapy on diabetes. It is known that interventions that extend life will result in future unrelated costs and benefits to the specific disease being examined and have to do only with the aging process itself[6]. The US Public Health Service Panel on Cost-Effectiveness in Health and Medicine[3] recommended that individual researchers use their own judgment when deciding whether to include or exclude these costs and benefits. If these costs are small relative to the magnitude of the cost-effectiveness ratio, they can be excluded. On the other hand, if these costs are quite large, they recommend using a sensitivity analysis to assess the effect of these costs and benefits.

Based on WHO recommendations[7], Cost Effectiveness Analysis (CEA) should evaluate all interventions over a period of 10 years at full implementation. This time horizon might not be appropriate in some situations, especially for chronic diseases or vaccination. In this case, the time horizon for the analysis obviously needs to be longer. Analyses must include all health effects of the intervention that occur during the 10 years or subsequently. The general rule is that the time horizon should be long enough to capture the full effects of the intervention[6,8]. This rule is supported by a study review comparing different guidelines from various countries[9].

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The theory behind discounting

Why do we need to discount?[2,3,10,11]

For projects that continue longer than a one year period or with costs and effects that were incurred in different time periods, it is inappropriate to compare costs and effects. This is because their values are different in different time periods. In order to make them compatible, all values need to be adjusted to present values (present worth). Future values will be adjusted by a fixed rate called the "discount rate". Two well

known economic concepts related to discount rates will be mentioned here: time preference and opportunity cost of capital.

1. Time preference[12]

This idea shows that people have different utilities in different time periods. They prefer to have goods and services in the present rather than in the future. If society wishes people to postpone their consumption to the future, it has to compensate or pay a premium rate to people for waiting. The premium rate is called the social rate of time preference (SRTP).

The reasons why people prefer present consumption are pure time preference and wealth effect. The pure time preference is purely psychological. Individuals may have a pure preference for the present, for example, they are impatient. The wealth effect is that the quantity of availability of consumption goods will increase over time. In other words, people expect to have higher incomes in the future. Given a decreasing marginal utility of consumption, an investment which gives one unit of the consumption good in the future in exchange with one unit of the consumption good in the present is not acceptable. Investing in the future in a growing economy will increase consumption inequality over time. Since individuals have preferences for a uniform consumption over time, a delay in consumption or investment should be implemented only if its rate of return is large enough to compensate for this negative impact on welfare. By using the two reasons mentioned above, the social rate of time preferences can be calculated from the following equation.

$$s = p + (u)(g) \qquad (1)$$

s = Social rate of time preference
p = Pure rate of time preference
u = Rate of diminishing marginal utility or the elasticity of marginal utility
g = Expected growth in consumption per head

According to Sussman F and Scheraga DJ[13], it is difficult to determine the magnitude of the first term (p) because 1) while a positive (and larger) discount rate may reflect the way in which private individuals actually behave when planning lifetime consumption and saving decisions, it may not represent the way in which, as citizens, they would ask policy makers to behave on their behalf, 2) when an environmental problem such as climate change is concerned, it is difficult to justify a rate of time preference much above zero, and 3) using too low a discount rate in project evaluation could lead current generations to sacrifice their consumption in return for small increments in future generation consumption. However, a number of economists agree that a pure time preference (p) is nonzero since it places a lower weight on damages or benefits to future generations.

The second term (ug) relates to the rate of diminishing marginal utility and growth in consumption over time. For developing nations, which may be experiencing high growth in income, (and hence consumption) at approximately 5 % to 8 % annually, discount rates as high as 10% to 16% may be reasonable[13]. Gollier C[14] stated that the larger the growth rate, the larger the socially efficient discount rate. A problem arises, however, when the growth rate is not known with absolute certainty. He also suggests a negative growth rate due to the scarcity of environment and resources.

Due to the complexity of the calculation of the social rate of time preference, other alternatives, such as saving rates, may be used as a proxy for the social rate of time preference. The average saving rate can be the social rate of time preference because the saving rate means that people save more money and consume less. Nevertheless, the weakness of saving rates is that people have different rates of time preference.

Generally, the rate of time preference is considered by many economists to be implicitly revealed in the market by interest rates on low-risk, long-term investments such as government bonds or approximately 2% to 5% in real (inflation-adjusted) terms[15]. In Thailand, most research in economics uses the social rate of time preference as a substitute for a discount rate because investment is a resource allocation for both present and future consumption. Tubpun Y[16] introduces the use of the return of government bonds for social rate of time preference because they have the lowest rate for long-term saving. Although the return is quite low, they represent the minimum value of social rate of time preference.

2. Opportunity cost of capital

Resources are scarce and there are many potential uses for any given pool of resources. Therefore, the true cost of using resources for any purpose, consumption, or investment can be described by the benefits forgone in their next best use. Resources used for a health program could be invested elsewhere such as in another health program, in the manufacturing sector, or in other public sector activities like education and high yield real returns. Thus, the opportunity

cost of the health care program is the foregone returns from investment in another health program, manufacturing, or education[17].

This idea shows that discount rate is a social opportunity cost. Basic economic theory expresses that a society or a country has limited resources which can not satisfy all the people in both the government and private sectors. When resources are used from society, there will be less available resources for other sectors. Therefore, a discount rate reflects forgone options of social capital.

The social opportunity cost of capital can be obtained from the real long term rate of return on equity capital. However, this rate may be too high for public project appraisals because public projects are less risky than private projects. Sometimes, the social opportunity cost of capital can be derived from the long term government bond rate.

The social rate of time preference and the social opportunity cost of capital can be the same rate only if a capital market is perfect competition. In practice the possibility that these two rates are equal is very unlikely. An analyst may find it difficult to determine the discount rate for a project. One way to solve this problem is to introduce a weighted discount rate. A new discount rate can be formed by using the social rate of time preference and the social opportunity cost of capital[12].

$$w = (h_1)(q) + (h_2)(s) \qquad (2)$$

w = Social weight discount rate
h_1 = The share of investment in national income
h_2 = The share of consumption in national income
s = Social rate of time preference
q = Average real rate of return on private capital

Should discount rates be equal for both costs and effects?

Discounting is performed to adjust future costs and effects for their differential timing. Discounting future costs and benefits in Cost-Benefit Analysis (CBA) is not controversial. However, discounting health effects such as life years saved (LYS), Quality Adjusted Life Years (QALYs) in CEA and Cost-Utility Analysis (CUA) respectively, has become controversial. The main argument against discounting health effects is that health, unlike wealth, cannot be invested to produce future gains[18]. Therefore, some advice from various authors suggests that health effects should not be discounted or if discounted, the rate should be very low, at 1.5%-2%[18,19].

There are several arguments in favor of both uniform and differential discount rates as described below.

1. Arguments in favor of a uniform discount rate

1.1 The consistency thesis

The US Public Health Service Panel on Cost-Effectiveness in Health and Medicine[3] points to the consistency argument of Weinstein and Stason as an important foundation when recommending the use of similar discount rates for both costs and health effects. They illustrated the consistency argument by comparing several hypothetical programs with varying timing of costs and health effects. The crucial assumption underlying their reasoning is that life years are valued the same in relation to dollars in the present as in the future. Thus, a constant steady-state relation between dollars and health benefits is assumed and opportunities for purchasing health benefits with dollars do not change over time. This implies that programs with the same cost and benefits at different points in time should receive equal priority. The only way to achieve this result is to use a uniform discount rate for both costs and health effects[3,20-22].

1.2 The paralyzing paradox

Another argument, the paralyzing paradox, purposed by Keeler and Cretin (1983) presents that under certain conditions, if program costs and effects are discounted at different rates, but rather a lower discount rate for effects when compared to that for costs, the infinite postponement of the programs would be the preferred option. This is because the cost-effectiveness (CE) ratio of any program is better if we delay program implementation. This can be illustrated by a simple example. Assume that a program costs $10,000. Costs will be discounted by 10% and effects will not be discounted. The CE ratio for this year will be $10,000 per QALY. After 1 year, the CE ratio will be $9,090 per QALY ($10,000/1.10). If the value of effects (QALY) is not discounted, then the CE ratio of the program is improved for every year it is delayed. This still persists if QALY are discounted at any rate below 10%. Therefore, without further restrictions, the program would be postponed indefinitely[3,21,22].

However, the relevance of these arguments have been challenged by a number of authors who have shown that these arguments largely rely on assumptions made about the nature of decision making and the relationship between health and money.

2 Arguments in favor of differential discount rates

2.1 Criticisms of the consistency thesis

The requirement of the consistency thesis is that health and money can be exchanged at a rate that remains constant over time. Some authors argue that health cannot be exchanged with money. Health can be exchanged for health only, in the sense that money spent today in order to save lives tomorrow could have been invested in research to save even more lives. This implies that lives are "produced" by monetary payments and not "exchangeable" for money. This is implicitly an argument for a lower discount rate for health benefits[22]. Also, health benefits can change over time due to two situations: 1) the improvement of technology in the future, which leads to a cheaper payment to save lives and 2) it becomes more costly to save lives due to environmental or other factors. This is an argument for different discount rates for costs and health effects[22]. Van Hout[5] argues that the discount rates for costs and effects should be based on the separate and probably different growth rates of wealth and health and the diminishing marginal utilities related to this growth. Therefore, the assumption of similar growth rates is debatable.

2.2 Criticisms of the paralyzing paradox

The assumption behind the paralyzing paradox is that both the benefits produced by certain costs and the population remain stable, and thus it is possible to obtain additional benefits by incurring higher costs. The theoretical foundation of Keeler and Cretin may be correct, but the following arguments can be made. First, the option of infinitely postponing health programs is not relevant for policy making because the budgets have to be spent. Also, the question that policy makers are confronted with is not whether to implement a program now or delay it, but rather which program to implement now[21,23]. Secondly, the political character of public decisions regarding the allocation of resources cannot be ignored[22]. Therefore, this paradox has no relevance in the real world, and it would appear to be difficult to maintain its validity[22].

Comparisons of the international economic evaluation guidelines

Smith DH and Gravelle H[24] conducted a thorough search for primary literature, textbooks, official and semi-official sources, and government bodies on recommendations for discounting. Sixteen different sources were identified. Of those, one indicated the discount rate for Disability Adjusted Life Years (DALYs). The remaining 15 identified sources recommended discounting for both costs and effects. Most (13 of 15) recommended a specific rate or range of discount rates. Ten resources recommended equal discount rates for both costs and effects. Only one source from the UK recommended a lower but still non-zero discount rate for health effects, but this has been changed recently[23]. Eight sources recommended that the analysis should include a 0% discount rate. The range of discount rates is between 1% and 8%. The specific rates most frequently recommended are 3% and 5%. None of the sources recommended that the rate should depend on the length of the time horizon.

Additionally, 28 health economic evaluation guidelines showed that 24 countries specify a uniform discount rate for both costs and health effects except for France, which recommends a 2.5%-5% discount rate for costs and effects, the Russian Federation, which recommends a 5% discount rate for cost and does not mention effects, Scotland, which states 6% and 1.5% discount rates for costs and effects respectively, and the British Medical Journal, which recommends a 3%-6% discount rate for costs and 0% or one lower than that used for costs as a discount rate for effects[25].

Recommendations for Thai Health Technology Assessment (HTA) Guidelines

Based on rational, theories, and information from the other international guidelines provided above, the authors purpose recommendation regarding time horizon and discounting for conducting health economic evaluation in Thailand as follows:

1. The time horizon should be long enough to capture the full costs and effects of the intervention. No other well-known international guidelines specify the appropriate time horizon that is needed for conducting health economic evaluations except for WHO, which recommends that CEA should evaluate all interventions over a period of 10 years at full implementation. From a practical perspective, a 10 year period might not be able to capture the overall costs and effects of some diseases or preventive programs. Therefore, the time horizon of the Thai health economic evaluation should be long enough to capture the full costs and effects of the intervention. In doing this, the study may use modeling techniques and/or epidemiologic data to estimate future costs and effectiveness with appropriate discounting rate to subsidize the budget needed.

2. Cost and outcome should be discounted because of economic concepts related to discount rate.

These concepts are time preference and opportunity cost of capital. The time preference implies that people have different utilities at different times. They prefer goods and services in the present rather than those in the future. Society has to compensate or pay a premium rate to people for waiting. The opportunity cost concept shows that the discount rate is the social opportunity cost. Basic economic theory expresses that a society or a country has limited resources that can not satisfy all the people. When resources are used from society, there will be less available resources for other sectors.

3. Discounting costs and outcomes should be done using the same rate. Two arguments that imply a uniform discount rate for both costs and effects are the consistency thesis and the paralyzing paradox. Although both arguments have received criticism from various authors, the current practice of discounting in health economic evaluation still seems to be based on these two arguments. Additionally, as shown in the most well-known accepted international guidelines, a uniform discount rate for both costs and effects is implicitly recommended. Furthermore, the National Institute for Health and Clinical Excellence (NICE), which once used differential discount rates for costs (6%) and effects (1.5%), has recently changed their recommendation of their discount rate to 3.5% for both costs and effects. Therefore, the application of the same rate for discounting costs and effects in Thai health HTA guidelines is recommended.

4. The appropriate discount rate for cost and outcome at the base case is 3% and an analyst should perform sensitivity analysis using a uniform discount rate ranging from 0-6%.

5. Calculations for discounting are straightforward as shown in the formula below.

$$PV = FV * (1/(1+r)^t)$$

PV = present value; FV = future value

r = the discount rate; t = the duration or time at year t

$(1/(1+r)^t)$ is called discounting factor.

Conclusion

The recommended discount rate for costs and effects at the base case is 3%. A sensitivity analysis should be conducted by varying its range from 0-6%. The time horizon should be long enough to capture the full costs and effects of the intervention of the implemented programs.

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การจัดการกับเวลาในการประเมินความคุ้มค่าทางการแพทย์

อัญชลี เพิ่มสุวรรณ, กันต์สินี กันทะวงศ์วาร, ปิยะลักษณ์ พุทธวงศ์

กรอบเวลาและการปรับลดเป็นประเด็นสำคัญในการประเมินทางความคุ้มค่าทางการแพทย์ ซึ่งมีผลกระทบต่อการจัดลำดับความสำคัญของโครงการต่าง ๆ ที่เปรียบเทียบกัน บทความนี้ได้นำเสนอเหตุผลและทฤษฎีสนับสนุนสำหรับอัตราลดของต้นทุนและผลลัพธ์ และกรอบเวลาในการประเมินความคุ้มค่าทางการแพทย์ในประเทศไทย อัตราลดของต้นทุนและผลลัพธ์ที่แนะนำในกรณีพื้นฐานทั่วไปคือ ร้อยละ 3 และเปลี่ยนช่วงอัตราลด ร้อยละ 0-6 โดยใช้การวิเคราะห์ความไว กรอบเวลาควรมีระยะเวลายาวนานเพียงพอให้ครอบคลุมต้นทุน และผลลัพธ์ของโครงการ