

Health Economics

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Week – 02

Lecture 08- Demand for Health: Grossman model-I

Welcome, friends, once again to our NPTEL MOOC module on Health Economics. This is one of the modules demanded by NPTEL, especially for master's students who are heading toward a specialization in health economics. This module has given systematic directions with theoretical and mathematical approaches to address a number of decision-making issues. We are at this moment addressing the second unit and its lecture number 8, emphasizing one of the foundational models on health economics by Grossman, who has defined demand for health systematically. But how is this one explained without the connecting dots of the previous?

Regarding the previous lecture, what do we think of Grossman because of the previous lectures? In the previous two lectures, we discussed utility generation from health, demand for healthcare, and trade-off between, especially emphasizing the trade-off between health and consumption of other goods, production function for health, lifestyle choices, and health. The latter part of the previous lectures is on the price responsiveness of the demand curve of healthcare, where we have attached some experiences of randomized experiments of different authors. You can check it out, and it will be interesting.

In this lecture, we will discuss the concept of health and Grossman's idea of health demand. There are three important goals of health demand as conceptualized in Grossman's work. Grossman is very famous because of his pioneering contribution to his work on healthcare, especially when referring to health investment. We will be discussing this in detail. The first question that lies with us is whether health is a choice. When we say this, it is health that you have, something that you choose, or a mix of these two.

By birth, with the virtue of God, we usually carry a standard of health. With the successive rise in the age indicators or the years of age of the person, we are discounting several parameters for healthcare. But it depends upon whether you have carried your health rightly or you actually compromise with some of the things with the present need. In the present time, you might be a winner, but that does not mean you are actually encasing as an investment for the future. These two pictures clarify everything.

Out of our time, we usually put our time maybe for home, staying at home, or some of the riskier activities, which may be called driving. Driving might land you on a different level,

but it depends on which kind of driving you are taking up. It has been observed in several evidence that people drink and drive or relax with a cup of hot coffee. They take the drive for long hours, and that is maybe restoring for the future. Therefore, we have highlighted the green cup with green to inform you that that is good work and that your health consequences are considered good.

Being in home, of course, is blissful, but the other consequences of being at home are not discussed now. We are just trying to map which activities are good or bad. In a second aspect, we can differentiate between our habits, smoking, non-smoking, and non-smoking behavior. One will be one of the formal ones, leading to bad consequences. Therefore, health is a choice that is considered, but it is subject to the kind of activities we are taking off.

Grossman's specially defined health with the notation as H mention this is a choice and people can choose H level. People have the ability to control their level of health. Hence, the successive periods are considered to be cherished. We are simplifying one by one to define how Grossman has clarified human capital. But at this moment, we are just trying to mention what is called human capital without just referring to Grossman's theory.

We wanted to give you a theoretical background of human capital and how health is considered to be human capital. So far, in economic literature, economic growth is defined as occurring through physical capital or the investment in physical capital and its development and contributions to our rise in growth rate. Even the investment in labor or the growth of labor has accumulated efforts for economic growth. However, most of the literature has neglected the idea of human capital, which is usually considered to be residual. Even in Solow's work, you will see residual.

Even in new growth theory, you will find residuals where directly or indirectly you will find, especially new growth theory by Romer, etc. You will surely find some relevance of education and other human capital investment. However, the foundational work we used refers to Baker (1967). Human capital, what is this exactly? It is a collection of productive skills embedded in a person which can be used to further earning-generating activities, especially in the labor market, and to augment household consumption options since it continuously adds earning sources. Hence, investment in human capital is possible through investment in schooling or investment in training during the job.

However, the investment cost, like direct outlays on market goods or opportunity cost of the time, also counts a lot when opting for or attempting optimal investment in human capital. So, the pioneering work of Gary Baker and Ben Porath of 1967 and 1967 is worth mentioning. I am sure that if you read the original work of Gary Baker and Ben Porath, it will be good for you. Let us understand health versus other human capital. A person's talk of knowledge affects his market and non-market productivity.

Health affects the participatory time in working activity. This is what we are carrying

forward in our other slides in terms of Grossman's idea. Human capital includes health and information about wages and potential job offers. Several authors have thought of health as human capital. However, Grossman was the first to develop a whole model of the demand for human capital.

We will be discussing this. Another obvious question is why we need a model for demand for health. A Model, as we know, is a systematic representation based on the initial experiences or the facts, figures, and the genesis of events that led to a simplified format to predict or the project for other situations, especially in the long run. Therefore, the model presents things better. Likewise, typical models in film or any product model, etcetera, carried certain concepts and certain evidence to market things better.

Hence, Grossman's model in healthcare has given a better direction. When an individual demands for medical care, what he seeks is health. It seems logical to study the demand for health before the demand for healthcare. The demand for health is very important, and we will discuss it. As I mentioned, Grossman's idea of health demand is presented in three important directions.

He considers the roles of health. Grossman mentioned that there are three important roles in health. The first one is health as a consumption good. Health is simply helping the individual to grow in terms of consumption needs. We have defined this function from our previous lecture, especially utility and health. Individual utility at period t (U_t) is a function of H and X at time t . Here, H for the level of health and commodities other than health that may be considered as a composite of goods is represented by X . Also, t is mentioned for a time period. There will be a trade-off when we are consuming more of our resources or allocating more to other commodities. There will be an inverse relationship between allocating resources on H or X . To maximize your consumption, you have to make a trade-off. Though there are interlinkages in our models as well, there are complications for sure, and Grossman simplifies these complications.

Single-period utility

First role of health in Grossman Model is as a consumption good.

As from lecture 'Utility and Health,' individual's utility for the period t is:

$$U_t = U(H_t, X_t) \leftarrow$$

where:

- H_t is the level of health,
- X_t is a composite good that represents everything else.

Trade-off between H and X:

- Snacks may increase X , and it poses threat to Health.
(Here X is X_B)
- Exercise increases both X and H . (Here X is X_G)

One investment is not a typical commodity, as we already mentioned; it is a kind of investment that is added further in the next generational model or in the next set of times as an additional set of consumption to the consumer. Hence, there are multiplier effects as well. So, all these details are simplified, and we will present them. As we mentioned, trade-offs occur between H and X. Let us start with an example here: snacks.

Snacks may increase your level of X. However, it poses some health challenges and may be considered bad commodities (X_B). In certain other periods, consumption of X may add better value. In this case, X is denoted as X_C . We are referring to time constraints within a single period. We have started with a single-period utility function through Grossman.

We are explaining time constraints and how you have limited time and have to allocate to the best. However, the consumer might not actually know it, cannot able to guess it correctly, how the constraint is actually taking the consumer to be compromising in terms of attaining best utility. We will be connecting all sort of understanding to our optimal function as well. Somewhere we will be discussing what is called optimal day or optimal utility etc.

We will be discussing this. Let us start the constraint function once again. Usually we do it in our budget constraint optimization, constraint optimization function. We used to have a budget constraint in our constraint function, but now time is another component that has to be taken care of. What we have written here in the first point is, time is how it is going to be helping the individual to optimize. We know that 24 hours we have only in total.

Out of that we are supposed to allocate on working period (T^W), then playing time (T^X), then health consumption (T^H), then end sometime for period a person is sick where other component cannot be made (T^S). If Θ is total time available, $(\Theta - T^S)$ will be our productive hours. We will be discussing this productive hours where a person is supposed to be working and will add more value. So, T^W as I already mentioned you each hour spent on it produces income which can there be used to purchase other goods and that contributes to H and X both.

The T^S , however, is not going to contribute at all that is basically the time for sleeping or for time consumed due to sick. At this moment we are only focusing to simplify our model as sick time, we are only mentioning sick time. Specially in Grossman model, sick time is emphasized and that is basically a lost time. We are mentioning how if it is unproductive time, then how far this is optimally used.

Let's see further. In details, we have working time, playing time. Again one confusion might have arise in my previous word that when we have mentioned as playing time or leisure time as X. We have taken leisure time. We are clearly saying that leisure time we have taken and leisure time might be also productive, but we are only trying to especially in Grossman model lost time is emphasized which is unproductive.

That is basically sick time. An individual used to have these hours for sure in their daily

functioning. All three as I already mentioned, all three are different than this.

We are going to differentiate between H and X once again. H stands for health related consumption, X stands for other, a composite goods that will be other than health. X is a flow variable created and consumed each period, whereas H is actually a stock variable, accumulates and deteriorates from period to period. There are different interpretations as well. Level of H reflects the complete history of past inputs and decisions pertaining to health.

By contrast, enjoyment from today's other good is forgotten by tomorrow. It will contribute to tomorrow's X. In any given period t that is time before individual has allocated any time or money on X starts out at 0. However, if we are referring to H investment or H spending, we are comparing with $(t-1)$ period because health is not just carried in at 0 period.

It has a time lag and that has to be counted. Let us treat H_{t-1} as a given during period t since she cannot go back into past and change her history of health decisions which determine H_{t-1} . In this slide, we have discussed in terms of consumption. We are discussing in terms of production. For both H and X, there are two distinct categories of inputs in order to produce X and H.

So, inputs are market goods and personal time. Time inputs are defined in previous slides also. What is called market inputs? Basically M, if you are taking short note for M, M stands for market input for health such as healthcare, exercises, equipment etc. Whereas if you are counting other goods and its market inputs, we have used J term like video games etc. These are considered to be other goods.

Here it looks. The production function looks like given below in picture. Production function for H and production function for X at period t .

Production of H and X

- Production function of H_t
- Production function of X_t

$$H_t = H(H_{t-1}, T_t^H, M_t)$$
$$X_t = X(T_t^X, J_t)$$

M: Market inputs for health (e.g., health care or exercise equipment)

J: Market inputs for the 'other goods' X (e.g., jigsaw puzzles or video games)

However, it is also again mentioned. We also need to redefine our market budget constraint. This we have considered $(t-1)$ period and included time as a constraint function. Individuals cannot spend more than earning. If w is the wage rate, that wage rate we are

mentioning is rupee per unit of time.

So, T_t^W That is T^W is total time for working. Then total income out of the total time or working time, working time we have taken this as the notation and per unit hour or unit of time is deriving wage rate of w . Hence, my total income (Y^T) would be, of course, equal to wT^W . In any period, an individual can spend her income on two items, which we already said, either on health or in other goods.

The Grossman model does not specify how wages are determined. We are not discussing the Grossman model regarding market equilibrium and setup, etc., and how the inputs market defines whether w is efficient enough. However, presumably, the individual's education and other factors determine this wage rate, which the individual derives. The market budget constraint is mentioned here. As mentioned in this Y^T , we know that the total income is over here. And how is it equalized? It includes the wage rate per unit of time, our spending, and the total income derived from the wage rate, which is T^W times the wage rate.

So, total income is derived. How is it allocated? Allocated either on healthcare products or on other goods. So, as its market price, we have also mentioned P_M for healthcare and P_J for other goods. That will define the budget constraint function. When nothing is saved for the future, it is evident that this will not hold; it will be equalized.

Market budget constraint

$$p_M \cdot M_t + p_J \cdot J_t \leq w \cdot T_t^W = Y_t$$

If individual cannot save for future,

$$p_M \cdot M_t + p_J \cdot J_t = w \cdot T_t^W = Y_t$$

This is what we have mentioned in the next equation. So, this is all about how a person allocates his budget for different products in different periods. And especially in the first rule, we have not counted different time periods. We have only discussed about t , how income is allocated. However, we have also mentioned how $(t-1)$ for healthcare matters, and so far, H_T is concerned about production.

Therefore, the first rule is in terms of consumption. Hence, we have only counted the budget function in that particular period. In the second rule, we emphasize production, productive time, and how health contributes to producing productive time. If a person is already healthy and enough to have very little sick time, then additional improvements in

health yield little additional productive time. If a person is very unhealthy, even small improvement in health can yield substantial decrease in sick time. So, what is the meaning of it? We say that when a person is already healthy and up to have very little sick time, then additional improvement in health yield little additional improvement in productive time.

Basically, when a person is actually healthy and continuing without time allocation for his work and even if little sick, still every additional time which the person is allocating is hardly adding any extra productive hours or time. Whereas the person is getting unhealthy whenever getting little healthy time, the productivity increases substantially. Hence, every small improvement in health can yield substantial decrease in sick time. So, sick time versus productive time is emphasizing the second rule. The third we will discuss in the next lecture, but second this one let me clarify a bit.

Otherwise, we can carry forward to the next lecture. I will just show it what are there in my component. What are there? Three rules of optimal day, production possibility frontier, standard model, Grossman model etc. All details are there. You might get a disconnection. If I just continue and break it in between, I think I have to leave it to the next class after this slide.

So, I will be emphasizing this first. I will just give you the basic background. We have already discussed this. Once again emphasize that how productive time and sick time are defined. We know that when person have sick time, it will be out of your total hours, we have to subtract the productive hours.

Hence T^p or productive hours, T^s stands for sick time. So, these three as I already mentioned in the previous slides, in the preceding slides, so above productive hours. So, the 24 hour is here, out of that rest are left without priority hours. And it is also evidential in the healthcare production function for the productive time etc. There are diminishing marginal returns to productive time as well from health.

We are going to emphasize how this works. I will clarify this slide, then we will carry forward to the next lecture. We will start from this lecture in the next one. What is sick time and productive time? On the vertical axis, we have discussed T^s and this is H_t and minimum health a person must be carrying. Grossman mentioned that with a caption that illness avoidance curve, how it works and even clearly emphasize what is called economic definition of death. The individual has no productive time left and cannot generate any more health.

That is basically called economic definition of death. That does indicate that the person remains at the minimum of health. Once the minimum benchmark level of health is attained, if that is not attended, the person is considered to be dead. At that below to that level, the person cannot function and cannot add any productive hours. So, the purpose of reducing sick time is to have more productive time for producing more H and X . So, more the

productive hours we have, more the health and even X products are generated.

Hence when out of the 24 hours, we have made a rigidity line here, the line starts from here, there is an inverse relationship between health and sick time. Inverse function is eventual only because we have to reserve a minimum level of health and once out of 24 hours, once your sick time reduces, the rest of the time will be allocated for health, which is considered more productive. Hence the relationship between these two, it is not typically starts from this place or from 0 because health minimum cannot be at 0 level, it has to be a minimum level. Hence our productive hour starts from a minimum level and it is down level. So, accordingly we will be clarifying how our production function looks like and how Grossman defined the important three roles and accordingly we will also define what is called optimal day, even we will define through the production possibility frontier etc.

I think it is better to revisit this topic once again in our following lecture. I will start with the sick time versus productive time from the next lecture. Here, I have to stop and I am expecting you to attend for the next lecture. Thank you.