A Primer on Economic Analysis

Standard economics includes several excellent tools which can be used by an alternative framework. In this document I briefly describe the most important of these, plus the terms and concepts which underlie them. The following are covered:

- Total and marginal quantities
- Value
- Cost
- Optimizing a single activity
- Choosing among alternative activities

A. TOTAL AND MARGINAL QUANTITIES

You decide to build a brick wall in your garden and have a load of bricks delivered to your house. You place one brick, then a second, then a third, and then you have a tea break. After a spirited pep talk from your spouse, you continue your labors at a constant pace. Ignoring the break, the number of bricks you have placed over time can be graphed like this:

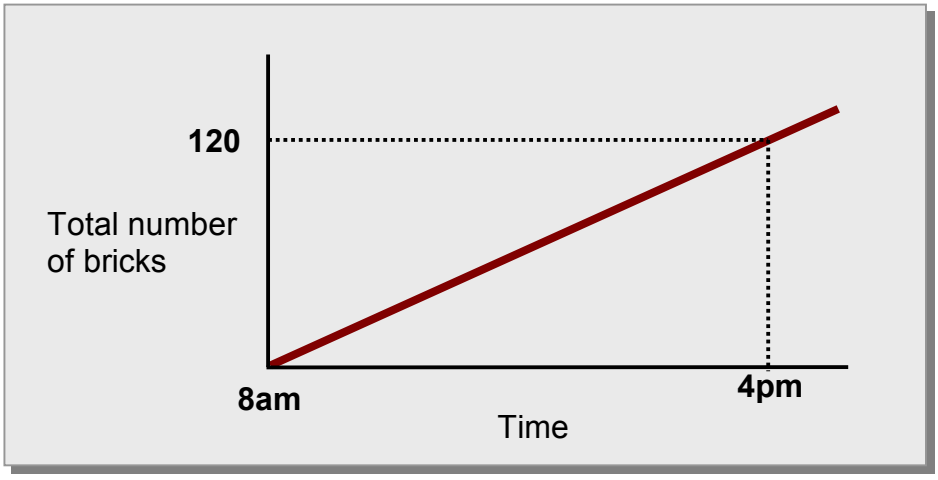

Figure 1: Total quantity, constant pace

The dark line depicts a TOTAL quantity. At 4:00 pm, after several tea breaks, you have placed a total of 120 bricks. This number can be read directly from the graph, as shown by the dashed line.

Now let's assume you want to track the rate at which you work. At the end of each hour, you record the number of bricks you've placed. Working at a constant pace, you would place 15 bricks an hour. After plotting all eight hours, your graph would look like this:

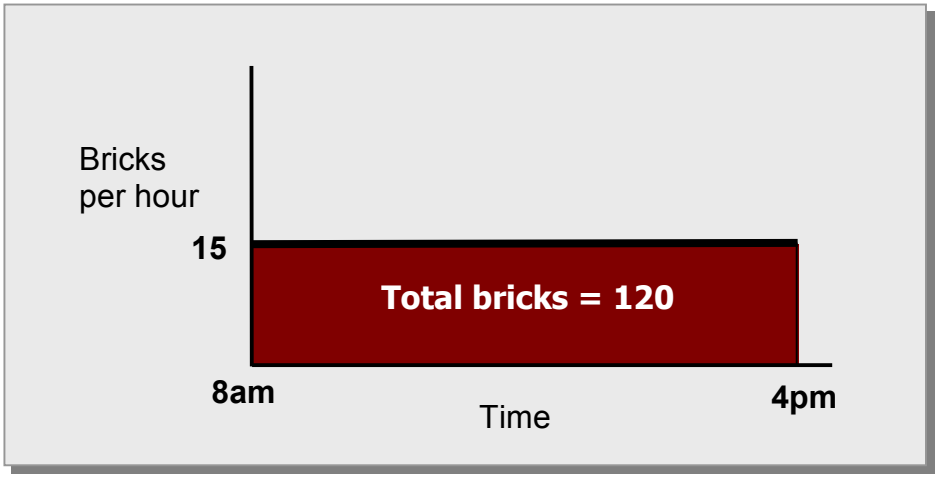

Figure 2: Marginal quantity, constant pace

The number of bricks you placed in the last hour you worked is known in economics as a MARGINAL quantity - the incremental number at the end, or margin, of an activity.

Note that it is not possible to read the graph directly to find the total number of bricks placed over the day. To determine this, we have to multiply the number of bricks per hour by the number of hours worked: 15 bricks/hour * 8 hours = 120 bricks. This can be represented graphically as the AREA under the heavy line.

Now let's be a bit more realistic. We'll continue to ignore breaks so that our lines are smooth, but we'll assume that you get increasingly tired as the day progresses. You start off placing bricks at a rapid pace, hoping to impress your spouse with a completed wall by noon, but the heat and exertion soon slow you down. Here's how your progress might look:

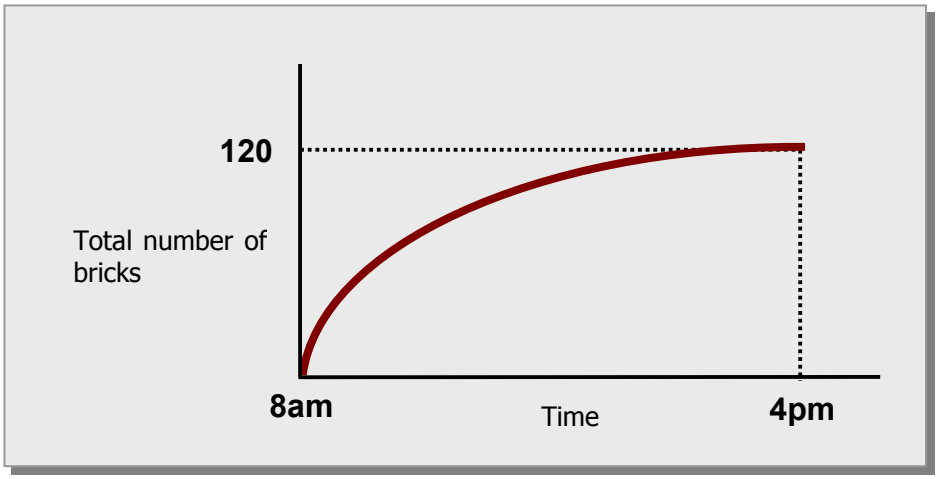

Figure 3: Total quantity, diminishing pace

Converting this to marginal quantities, we have:

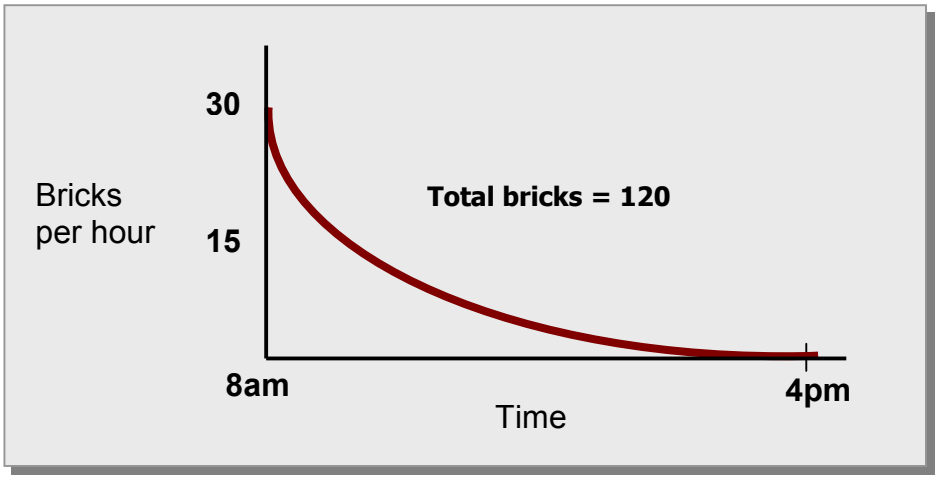

Figure 4: Marginal quantity, diminishing pace

The conversion from total to marginal quantities is accomplished by taking the slope (rate of change) of the total curve, and plotting this rate on the marginal curve. The top curve has a sharply positive slope at left, and you can see that the corresponding marginal quantity in the bottom curve is high. At right the total curve has a zero slope, and the marginal quantity is also zero.

The calculation for total bricks is a little tricky for the marginal graph, but I have consulted the calculus gods and they tell me it is indeed 120.

Marginal analysis - using marginal quantities to analyze economic phenomena - assumes that changes are smooth rather than abrupt. This is the reason I assumed no tea breaks above. Many ecological phenomena, however, have thresholds and are subject to sudden breakdowns. We have to be extremely careful not to push marginal analysis beyond its limited sphere of applicability, especially in the environmental realm. Having said that, it is a powerful method and we should not hesitate to apply it where it fits.

B. VALUE

In the broadest sense, value is what human beings need or desire in an object or service. Water has value because it is essential to life; a bicycle because it can transport us; music because it gives us pleasure.

The direct usefulness of an object or service to a human being is called its USE-VALUE. In an economy like capitalism we also desire things because they can be exchanged for other things we desire more. This indirect usefulness is called EXCHANGE-VALUE: the capacity of one object or service to be exchanged for another.

Something can have use-value without having exchange-value. Readily available water, rocks, and sand can be useful to people, but cannot be exchanged for anything else.

The reverse is not true - something cannot have exchange-value without having use-value. Even if something has been produced with great effort, it cannot be exchanged unless someone else finds it useful.

Use-value can be subjective or objective. Subjective use-value depends entirely on the consumer. That is, the strength of an individual's desire for something translates directly into the quantity of use-value for that individual. Use-value is objective when it depends on a criterion external to the individual consumer.

With water the distinction between subjective and objective use-value is hidden because we both desire it subjectively and need it objectively. With cigarettes the distinction is obvious. If we treat use-value as subjective, then someone's desire for cigarettes means they have use-value for this individual. If we treat use-value as objective, and if we use the criterion of freedom from disease, then for most individuals cigarettes do not have use-value.

C. COST

Cost is the inverse of value. While value refers to the desirable attributes of a thing, cost refers to the sacrifices human beings must make to obtain this value.

In standard economics, cost is equated with opportunity cost, which is the "value" (frequently undefined) that must be sacrificed to do or produce something. According to one source, "... the opportunity cost of an action is the value of the forgone alternative action." (*The MIT Dictionary of Modern Economics*.) For example, if you expend a certain amount of effort to clean your house, you sacrifice the clean car you could have achieved with the same effort.

The Economics of Needs and Limits accepts this logic in a limited way, but uses a different concept, called input cost, to determine the sacrifices made to obtain value.

D. OPTIMIZING A SINGLE ACTIVITY

To MAXIMIZE an activity is to extend it as far as possible, without considering any but the ultimate constraints. You maximize physical exercise by continuing to peddle a stationary bike until you collapse from exhaustion. An economy maximizes the production of carrots by continuing to churn them out until the required resources are used up, even if everyone is sick of rabbit food.

To OPTIMIZE an activity is to extend it as far as is reasonable, based on the consideration of non-ultimate constraints. You optimize physical exercise by peddling until the pain of exhaustion exceeds the perceived gain in muscle strength and lung capacity. An economy optimizes carrot output by stopping when the cost of their production exceeds the appetite for their consumption.

A fundamental assumption in any economic theory, based on observation and experience, is that marginal value eventually decreases as an activity continues. Exceptions are difficult to imagine. If you continue long enough you can die from consuming carrots and peddling a bike, and you can even be smothered by excessive love. Value is shown as the downward-sloping line in the graph below.

The converse assumption is that marginal cost eventually increases as an activity continues. Again, exceptions are rare. Cost is shown as the upward-sloping line below. The marginal units on the vertical axis are appropriate units for the activity under consideration.

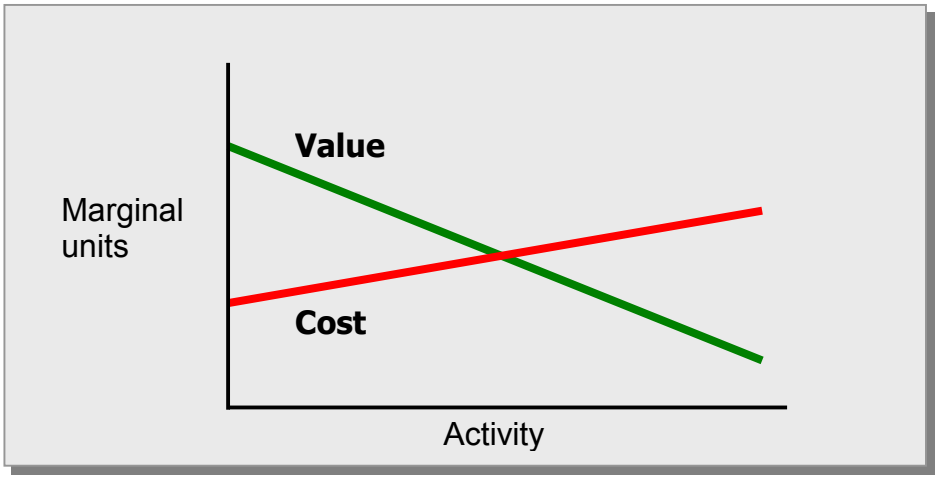

Figure 5: Diminishing marginal value, increasing marginal cost

Using marginal value and marginal cost we can determine the optimum extent of an activity:

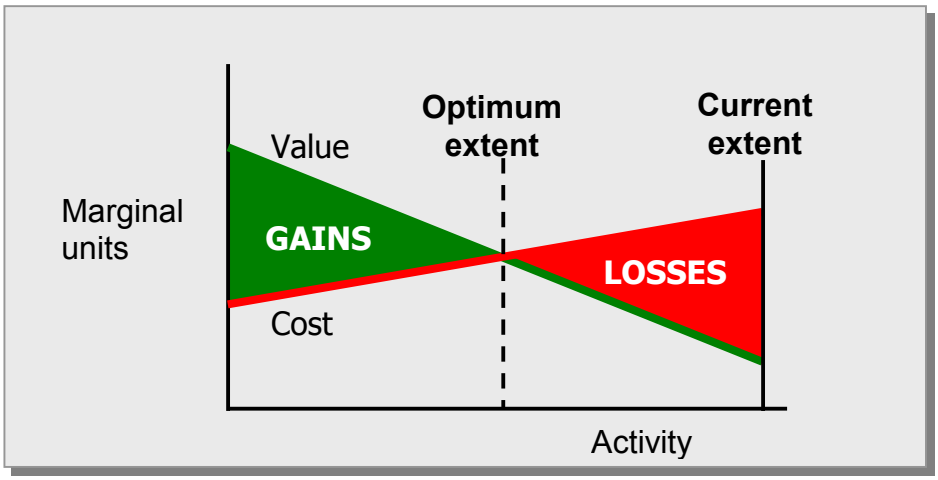

Figure 6: Optimization

It clearly makes sense to perform this activity, because there are gains to be achieved. As we begin, marginal value is much greater than marginal cost. As we continue, this difference narrows, until we reach the optimum point. After this point, marginal cost exceeds marginal value, and our continued activity results in losses.

At the current extent of the activity, at right, losses have accumulated to such a degree that they almost equal the gains. If we continue much further, we will have negated all the gains and will be have achieved a net loss.

To summarize our conclusions:

1. We should initially engage in this activity
2. We should continue until the optimum point
3. We should not go further than the optimum point

Our general conclusion is that ANY activity, so long as it is subject to decreasing marginal value and increasing marginal cost, has an optimum point and thus a rational limit.

E. CHOOSING AMONG ALTERNATIVE ACTIVITIES

You've just moved into a house. Your friends were kind enough to help carry the furniture, but they're gone now and there's stuff all over the place. This prompts a question: what, among the multitude of alternative activities, should you do first? Your spouse has an analytical bent and provides the correct answer: you should look for the coffee maker. You both need caffeine, and you need it now.

After coffee, you consider what to do next. Standing up to drink wasn't much fun, so you look for chairs. A nap in a few hours would be nice, so you next look for the bed. Then maybe some food, the TV, and, since you're concerned about gum disease, tooth brushes and dental floss.

What you and your spouse have done is make rational choices among alternative activities, based on your needs and tastes. The economic rule that encapsulates what you did intuitively is this: among alternative activities, for a given amount of effort, you should next perform the one that will provide you with the greatest net marginal value.

To demonstrate, assume we have to choose between two activities, which have the marginal value and cost curves shown below:

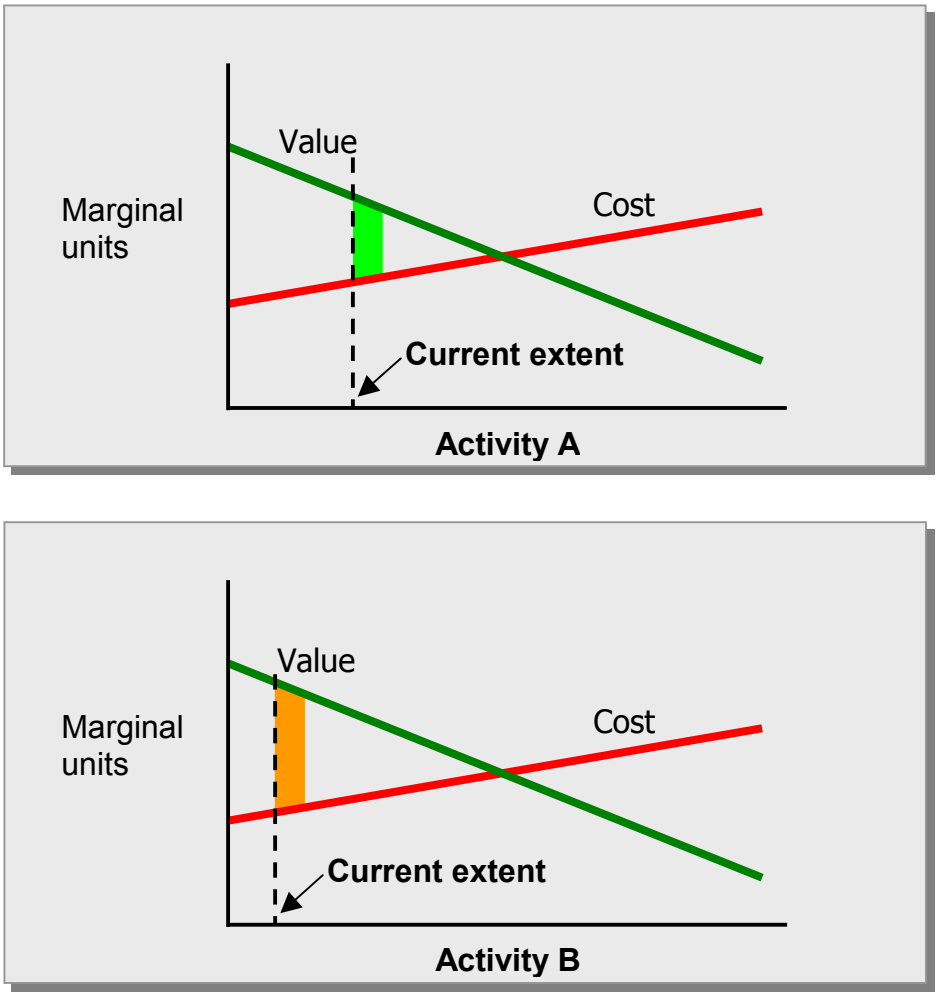

Figure 7: Choosing between two activities

The dotted lines show the current extent of the activity - the amount of exercise we have done, the amount of coffee we have consumed, etc. If we choose activity A at this point, we will achieve the gain shown in the green area at the top. If we choose activity B, we will achieve the much larger gain shown in the orange area at the bottom.

Clearly, we should next choose activity B. Further, if we want to expend more effort, we should continue to choose B until its net marginal value is less than A, after which we should shift to A. We should then shift between A and B until the optimum point is reached for both. This method can be extended to any number of alternatives.

Your spouse is impressed by this analysis, but has a better idea: you're not moving anywhere for at least five years. Take a nap.

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