An Economics for Humanity

PART 4
THE ECOLOGICAL FRAMEWORK

INTRODUCTION

The objective of human economics is to provide the theoretical basis for the maximization of human well-being, subject to ecological constraints.

The human framework provides concepts and tools to analyze human well-being, but it offers only a limited treatment of ecological constraints. Most importantly, it does not address thresholds, which in many cases should restrict output quantity.

In the ecological framework I further develop this theoretical basis by proposing an analytical approach to thresholds. I also discuss the maximization of human well-being under threshold constraints.

Let me begin with a necessary but contentious topic - the relationship between humanity and nature.

1. HUMANITY AND NATURE

In my view, human beings are a unique part of nature.

Human beings are part of nature in that they are physical entities, have evolved along with the planet's other life forms, and support their existence by converting low-entropy resources into high-entropy wastes.

Human beings are unique in that they possess acute self-awareness, high intelligence, advanced technical capabilities, and the resultant capacity to decisively impact the other life forms and the earth's environment.

Based on this view, I subscribe to the following ethical principles:

1. Every species, including humanity, has the right to consume so as to meet its vital needs - that is, to ensure its survival and to improve its physical health.

2. Humanity has the exclusive responsibility to protect the environment.

An important reason for choosing physical health as the standard of value and cost in the human framework is its connection with the first ethical principle above.

2. THE ECOLOGICAL ABSTRACTION

To address any complex reality, a theory requires an appropriate abstraction. An abstraction is appropriate when it ignores extraneous details and highlights the features for which the theory assumes analytical responsibility.

Nature is a complex reality. Human economics must therefore find an abstraction of nature that permits it to address ecological constraints in sufficient, but not excessive, detail.

Before presenting my suggested abstraction, let me distinguish between its physical and conceptual representations. The lack of such a distinction appears to be a barrier to productive discussion within the group.

Below is a highly simplified physical representation of the relationship between the economy and nature. The economy is depicted as existing within nature, or as being a subset of nature. The arrow indicates the transfers of resources and wastes between the two domains.

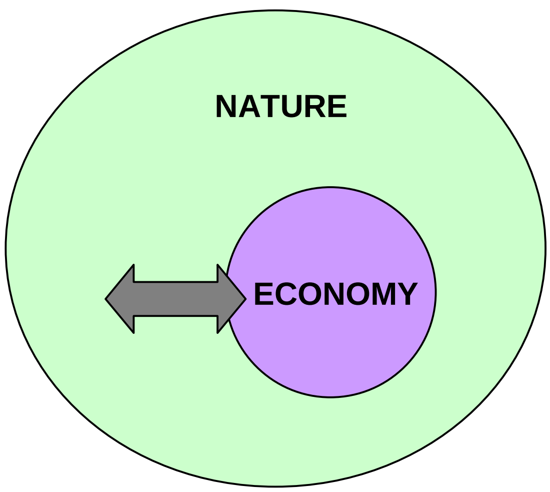

Figure 1: Nature and the economy - physical representation

This accurately depicts the physical situation, which standard economics has persistently ignored. Such a diagram is useful as an initial correction to the standard error.

Once we have recognized this error, however, we can assume the physical reality above and represent the economy and nature separately, as two distinct conceptual spheres. This makes diagrams more convenient to draw and shows the relationships with greater clarity.

In the ecological abstraction I separate nature and the economy for these reasons. This in no way implies that I reject the physical relationship represented above.

Below is my proposed ecological abstraction:

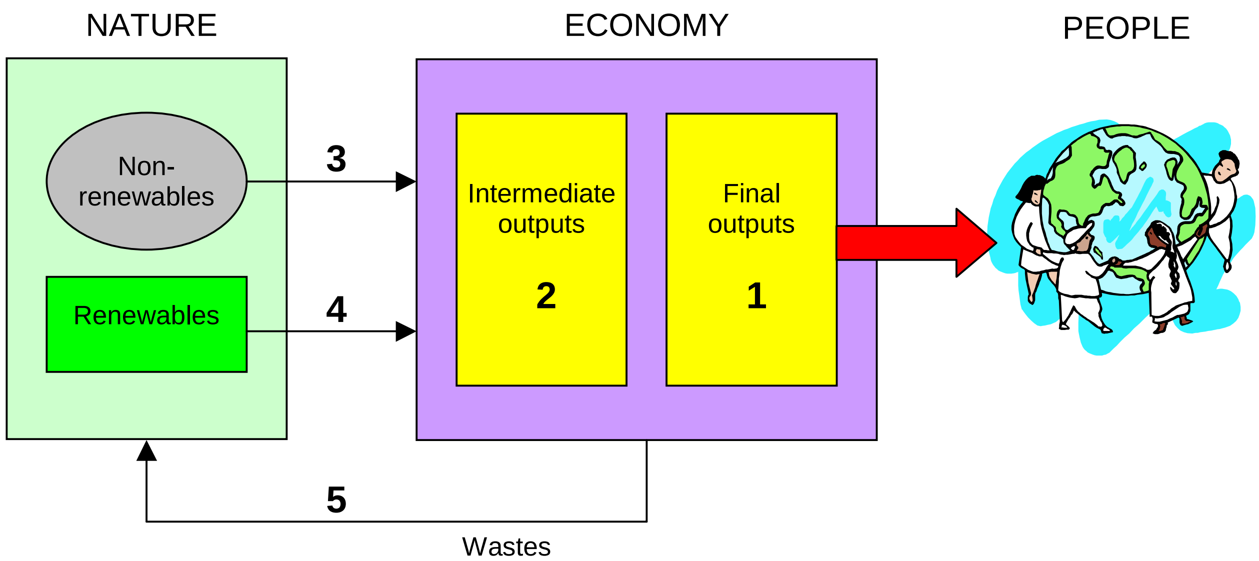

Figure 2: The ecological abstraction

Nature is seen as the source of two types of resource flows - nonrenewables and renewables - and as the recipient of waste flows. The economy is seen as the consumer of resource flows, the producer of intermediate and final outputs, the source of waste flows, and the provider of health benefits to human beings.

The two resource flows are separated because renewables can be exploited beyond the rate of natural regeneration, which means they are subject to thresholds. This is not true for nonrenewables, which are finite stocks of fuels and minerals. Nonrenewables can be excessively exploited in the ethical sense, but not in the ecological sense. Wastes can overload natural sinks and, like renewables, are subject to thresholds.

Intermediate and final outputs are separated because their optimum quantities are determined in different ways. Optimum quantities for final outputs are based on their direct contributions to health. Optimum quantities for intermediate outputs are based on their relationships to final outputs - that is, by their indirect contributions to health.

The resource and waste flows are not further subdivided in order to restrict the scope of the ecological framework. A more detailed abstraction would encroach on the physical sciences and expand the framework beyond its analytical requirements and aims.

The numbers in the diagram indicate the five critical quantities and flows in the nature-economy relationship. Human economics must find methods to determine their optimum values. This will permit us to establish rational limits to growth and to define a sustainable society.

3. ECOLOGICAL EFFICIENCY

Ecological efficiency is a relationship between a resource or waste flow and a final output. It is defined as the intrinsic value of the final output divided by the flow quantity used in its production, use, and disposal. This includes the flow quantity associated with the production, use, and disposal of all intermediate outputs in the final output's production chain.

Because final outputs may incorporate several resource flows and create several waste flows, more than one ecological efficiency may be associated with a final output.

Ecological efficiency is a ratio of mixed dimensions. Total health units are always in the numerator, but the denominator varies with the material nature of the flow. Examples:

Health units/board-feet of lumber	(Renewable flow)
Health units/tonne of iron	(Nonrenewable flow)
Health units/gigatonnes of greenhouse gases	(Waste flow)

Unless ecological efficiencies are associated with the same material flow, they are incommensurable and thus cannot be summed or compared.

An important objective, which follows from the ethical principles above, is that human beings must strive to maximize all ecological efficiencies. This means that for any combination of final output and flow, the intrinsic value - the health gains - of the output should be maximized, and the flow quantity should be minimized.

4. LIFE, DEATH, AND HEALTH

Life and death are ethical issues, hence beyond the scope of economic theory. This is why human economics does not address the question of how many people should live in a society, or how many deaths should be accepted to mine coal, build bridges, or produce steel.

Nevertheless, human economics cannot avoid the following question: how should a human death be treated if it results from production or consumption?

In the Canadian province of British Columbia, where I live, the government publishes statistics on the "potential years of life lost" from a number of causes - accident types, diseases, etc. This is a useful approach in that it gives added weight to causes of death that afflict the young more than the old.

For example, the potential years of life lost in car accident deaths is far higher than for prostate cancer deaths, because teenagers tend to die in cars, while older men tend to die of prostate cancer. In this sense, then, the average fatal car accident is "worse" than the average prostate cancer death.

This approach can be adopted by human economics. If a 30-year-old steelworker dies while constructing a building, and if this worker was expected to live to 75, then he or she loses the health that would have been gained from ages 30 to 75. This is referred to as "potential health units lost."   This loss is a labour cost, and must be added to the input cost of constructing the building.

Similarly, if 10,000 people in a society have shortened lives because of air pollution caused by economic production, then the potential health unit lost due to their early deaths must be added to the input cost of the associated outputs.

The principle applies to consumption as well. Some of the negative intrinsic and effectual value of cigarettes is based on the severe health degradation caused by smoking. For the most part, however, it is due to the stunning mortality associated with this addiction.

Note that there is a clear distinction between death and the forgone health associated with death. Death itself is an ethical issue; forgone health is an economic issue. A society might decide that a single death in production renders that production unacceptable. This is an ethical judgment that no economic quantification can override.

5. THRESHOLDS

a. Summary of the Issue

A threshold is an ecological discontinuity - the point where the flow of a renewable resource into the economy, or of a waste back to nature, triggers a sudden ecosystem collapse. In most cases, the physical sciences can determine only approximately when such a collapse will occur. Thresholds confront human economics with two distinct questions:

1. What, if any, is the ethical justification for risking a threshold collapse?
2. If such justification exists, how should the risk of collapse, and the consequences of the collapse itself, be analyzed?

The graph below summarizes the issue:

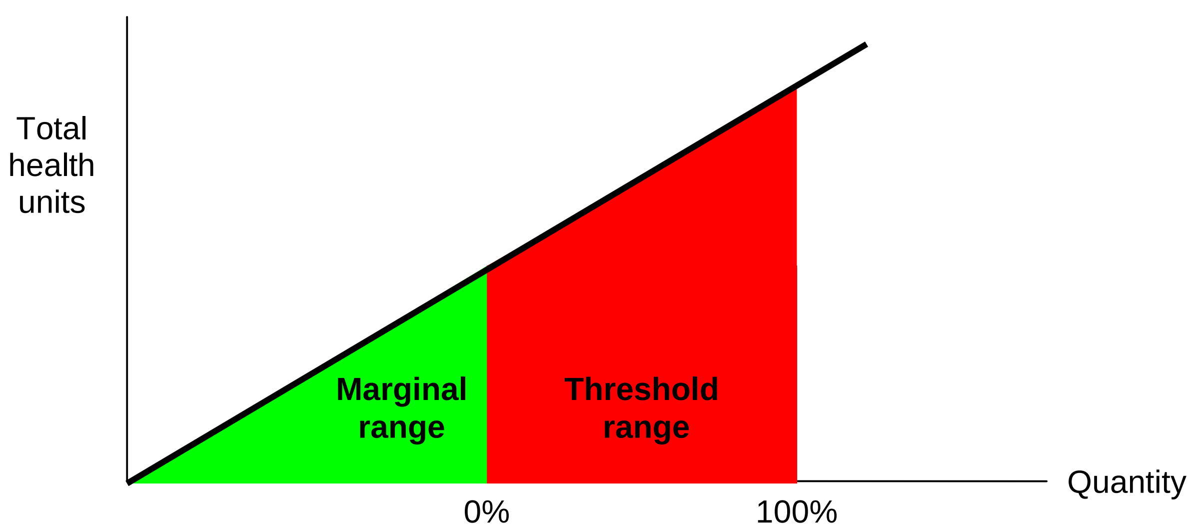

Figure 3: Marginal and threshold ranges

The graph indicates that total health increases linearly with the quantity of a final output. As quantity and health increase, so does the flow of a renewable resource or waste. For simplicity, assume that only one flow is involved, and that it is uniquely associated with this output. The flow itself is not shown - it is expressed in terms of the output that incorporates it.

Assume that the flow's ecological efficiency has been maximized, and that no alternative output can achieve the same health effect. We therefore have an unavoidable trade-off between health and threshold risk.

From the physical sciences we learn that the flow rate initially poses no risk of ecological collapse. This is called the marginal range, shown in green above. Within this range, the marginal analysis employed thus far is valid.

Science further informs us that a threshold range exists for this output and its associated flow. This is the red zone above, where the probability of ecological collapse increases from 0% to 100%. Marginal analysis, which assumes continuous change, cannot be used here.

As quantity increases within the threshold range, the probability of ecological collapse tends to rise more and more rapidly. That is, the probability increase from 0% to 100% will be exponential, not linear. This is not shown in the diagram, but is assumed below.

Based on the diagram, the problem can be restated as follows: should the quantity of this output enter the threshold range, and if so, how far should it go?

b. Ethical Considerations

Before addressing the questions above, let me pose another: can the risk and consequences of threshold collapse be expressed entirely in terms of human health, or is something more involved?

I believe that for most people, something more is involved. Nature is widely seen as having inherent worth, beyond its roles as humanity's source of raw materials and sink for wastes. If this is accepted, an ecosystem collapse destroys not only human lives and health, but also an inherently valuable realm of being.

There is a strong parallel here with another thorny ethical issue: abortion. Few people would argue that a human fetus is an object without inherent worth, to be aborted in the same way that tonsils or kidney stones are removed. The real question is: given the inherent worth of both the woman and the fetus, does the woman have the right to abort, and if so, under what circumstances?

Applying this analogy to thresholds, the question becomes: given the inherent worth of both human beings and nature, do human beings have the right to risk ecological collapse to gain health, and if so, under what circumstances?

A related question must also be considered: do human beings have the right to prevent others from entering a threshold range?

The answers to these questions may appear obvious: human beings have no right to risk ecological collapse, and they have every right to prevent others from doing so. This stance, however, has extreme consequences: it would prevent a society from incurring even the slightest probability of collapse for the most localized of threshold effects, forcing it to sacrifice the greatest of potential health gains.

Imagine, for example, that farming over a large area will incur a 1% probability of driving an indigenous flower to extinction, but that the farm products will significantly improve the health of millions of poor peasants. (Again, the assumption is that these health benefits are not obtainable in any other way.)

Does a well-founded ethical principle exist that justifies the sacrifice of such a large health benefit to humanity for such a small risk to nature? I have been unable to find one, but I look forward to the group's comments on this critical issue.

My answers to the questions that have been posed are based on the following three ethical principles. By "society" I mean any group or collectivity. Health loss means an actual or potential health loss, and includes loss of life.

Fundamental principle:

1. A society may incur a health loss for itself, but it may not impose a health loss on another society.

Secondary principles, based on the above:

2. ENTERING A THRESHOLD RANGE: A society that risks health loss from ecological collapse may enter the related threshold range.

3. PREVENTING ENTRY: A society may avoid entering a threshold range, but it may not prevent other societies from doing so.

According to these principles, there is no absolute prohibition against entering a threshold range, but the risk and consequences of ecological collapse cannot be imposed on an unwilling society.

The analytical method presented below assumes that the societies involved have made an informed and voluntary decision to incur the risk of ecological collapse in order to gain the potential health benefits.

c. Analytical Method

Because marginal analysis does not apply to thresholds, a different logic is required - one developed specifically to address risk and uncertainty. Statisticians have developed several decision-making criteria to deal with such cases. Among the best-known are maximin, minimax regret, and expected monetary value. (I will not address these in detail here. If you are interested, please look them up on the web or in a statistics text.)

Both maximin and minimax regret have been used to address environmental issues, but neither can incorporate the fact that the probability of threshold collapse tends to increase exponentially. Only expected monetary value permits this, making it is the most useful criterion for dealing with thresholds.

To apply any of these criteria, we list the alternative actions (flow levels) and the potential realities (actual threshold levels) we might encounter. For each combination of action and reality, we estimate the "payoff" that would result.

For the expected monetary value criterion, we additionally assign a probability to each reality, and then calculate the money we expect to gain from each action. As one statistics text puts it, "The expected payoff for this action is then the sum of the individual payoffs, weighted by their associated probabilities." (Statistics for Business and Economics, Paul Newbold, 1990, p. 842)

My suggested method retains the essential aspects of expected monetary value, but transforms this into expected threshold cost (ETC). The aim is not to estimate the monetary gain from business decisions, but the loss in human health from ecological collapse. An example is shown in the matrix below, using arbitrary units.

	5 (0.05)	10 (0.10)	15 (0.15)	20 (0.25)	25 (0.45)	**ETC**
Flow levels						
1	0	0	0	0	0	**0**
6	100	0	0	0	0	**5**
11	100	100	0	0	0	**15**
16	100	100	100	0	0	**30**
21	100	100	100	100	0	**55**
26	100	100	100	100	100	**100**

At left are the flow levels associated with the increasing quantities of an output. At the very top are the minimum flow levels that, according to the physical sciences, will cause threshold collapse, with the probability of collapse in parentheses underneath. At right is the expected threshold cost for each flow level. The expected health loss due to collapse - for present and future generations - is 100 units.

In this example, the marginal range is 1-4. At a flow level of 5 the probability of ecological collapse is greater than zero for the first time. This probability increases exponentially as flow levels increase. At flow levels of 25 and beyond, the probability of ecological collapse is 100%. The threshold range is therefore 5-25.

At a flow level of 1, there is a zero estimated chance of collapse, so the ETC is 0. At a flow level of 6, the probability of collapse is 0.05. If collapse occurs, the health cost is 100 units. Multiplying the probability by the potential cost results in an ETC of 5, as shown at right.

At a flow level of 11, we have passed the flow level of 5, with a 0.05 probability of collapse, and the flow level of 10, with a 0.10 probability of collapse. We have to account for the cumulative effect of these probabilities. We therefore multiply each by the potential cost and add the results, resulting in an ETC of 15.

This calculation is done for each flow level until we reach 26. The probability of collapse here is 100%, so ETC is 100 units. Flow levels greater than 26 will also have an ETC of 100 units. Note that, while flow levels increase linearly, ETC increases exponentially.

In figure 4 this threshold method is integrated with the marginal analysis introduced earlier.

At the top of figure 4 is the marginal analysis for the optimum quantity of a final output. This is similar to the graph introduced in the human framework, except that intrinsic value and labour cost have been omitted to minimize clutter. Ignoring thresholds, the optimum output level is Q_M, which is now referred to as the marginal optimum.

At the bottom of figure 4 is the threshold logic. The net effectual value curve is simply effectual value minus input cost from the marginal graph. This is the net gain we would achieve in the absence of a threshold range. The expected threshold cost curve is exponential, as explained.

The point where the two curves cross marks the new optimum. This is the quantity where the rising costs associated with threshold collapse first exceed the declining value associated with increased quantity. This point is called the threshold optimum (Q_H). The red arrow shows the decrease in optimum levels resulting from the threshold logic.

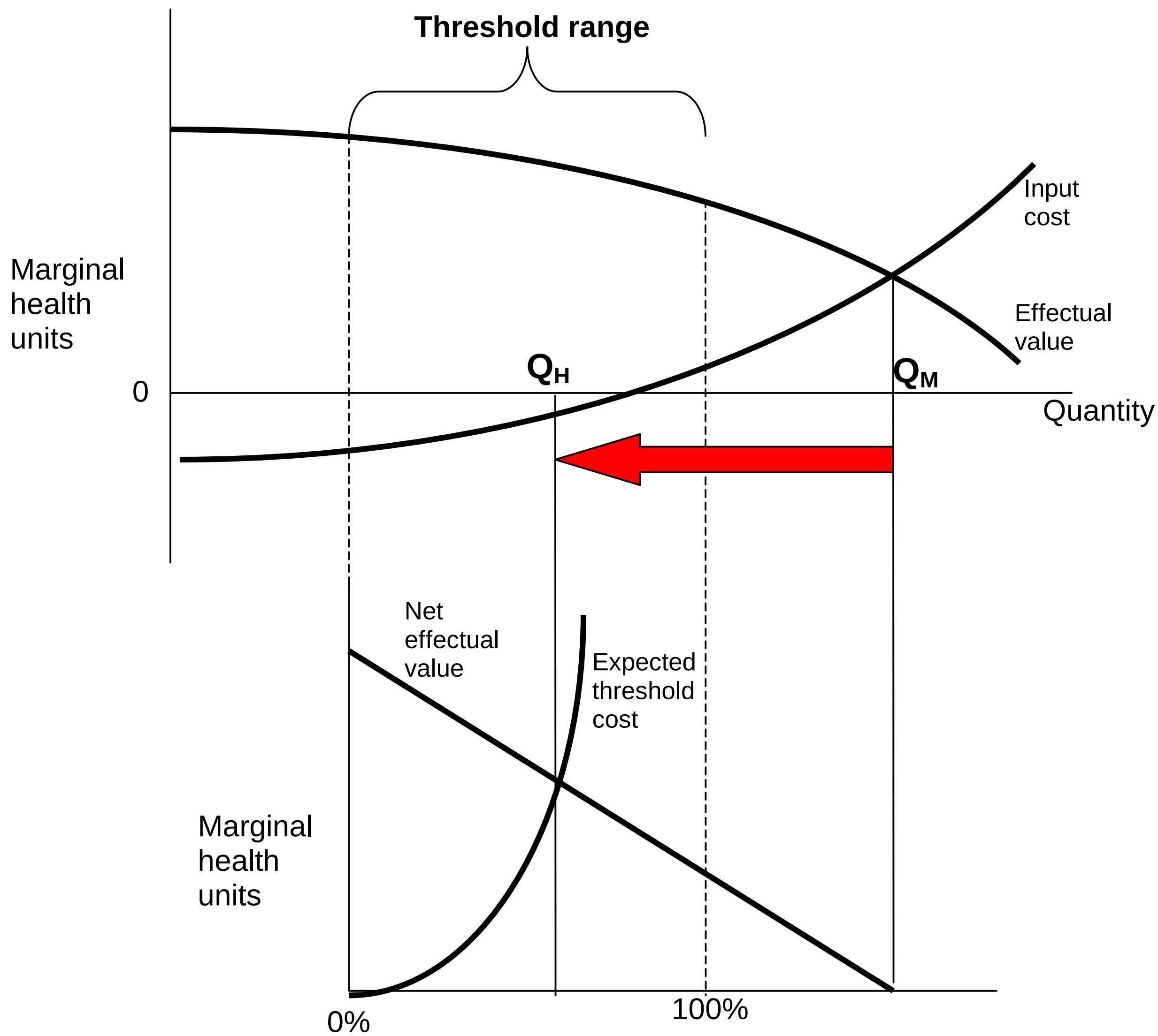

Figure 4: Threshold optimum for a final output

To see the consequences of applying this method, assume that a threshold is pervasive and that collapse would entail massive deaths and declines in human health. The expected threshold cost in this case will be a vertical line from the 0% point. The method will therefore prevent entry into the threshold range.

Conversely, if the collapse entails no health impact, the curve will be horizontal. The method will then permit quantity to increase beyond the threshold range, to the marginal optimum.

Reality is obviously more complex than depicted here. Several flows are typically involved in one final product, and one flow is typically involved in several final products. However, these complications can be addressed with straightforward extensions to the above method. At this stage we should focus on the ethical foundation, coherence, and usefulness of the method itself.

6. IMPORTS AND EXPORTS

One important issue has not yet been addressed: how should human economics deal with imports and exports? This is a critical consideration in an era of globalization. Pollution-intensive industries are increasingly being transferred to the Third World, while outputs with high intrinsic value are being shipped back to the overdeveloped countries.

My suggested principle here is that the consuming society takes credit for an output's consumption and bears responsibility for its production. The basis for this is that in a humane economy, consumption drives production and not vice versa.

In analyzing a society's economy, we therefore add the value and cost of imports to the value and cost of domestic production. We ignore the value and cost of exports.

Thus if a society imports a vehicle, it transfers the vehicle's intrinsic value, and the natural and labour costs incurred in its production abroad, to its own economic accounts. If it exports potatoes, it transfers the intrinsic value, natural cost, and labour cost of their production to foreign accounts.

7. OPTIMUM QUANTITIES AND FLOWS

It is now possible to outline the full logic for maximizing human well-being while respecting ecological constraints, and to derive the five critical quantities and flows.

I start with the current value and cost curves, as was done in the human framework, but without assuming that the optimum quantity has been reached. See figure 5 below.

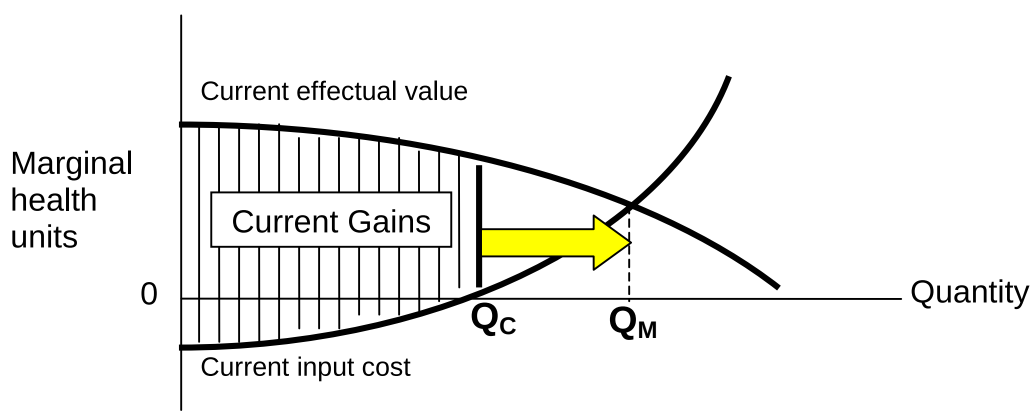

Figure 5: Increasing current gains

The shaded area indicates the current gains - the health benefits derived from the present consumption and production for this output. Q_C is the current quantity, and Q_M is the current marginal threshold.

If we leave the value and cost curves unchanged, gains can be increased by increasing output to the marginal optimum, as shown by the yellow arrow. If output quantity is currently greater than the marginal optimum, quantity must be decreased instead. In either case, the marginal optimum will result in health benefits referred to as maximum current gains.

This marginal optimum, when applied to all outputs in an economy, constitutes what Herman Daly and I call the ***economic limit to growth***. Further growth can only be justified if the value curves are shifted up, the cost curves are shifted down, or both. These changes are shown in figure 6 below.

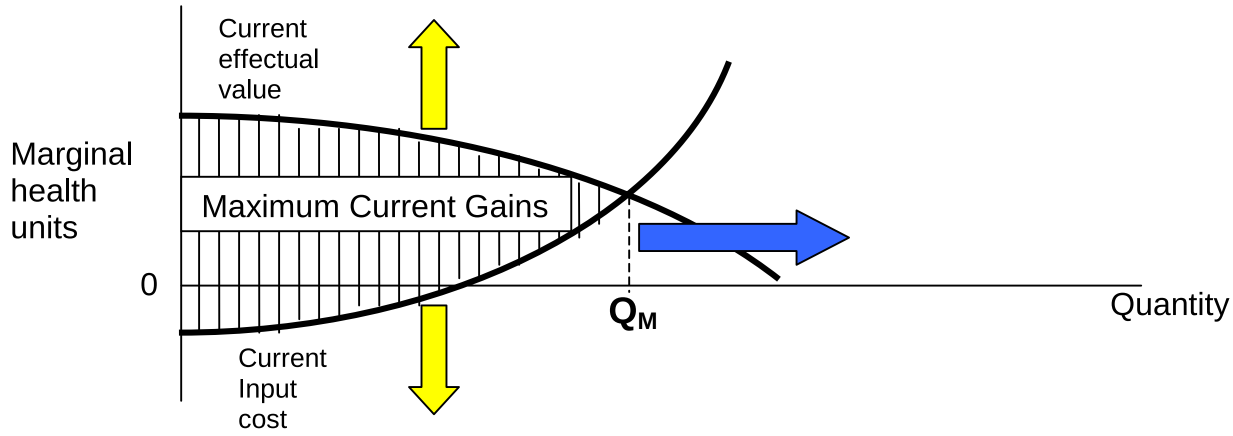

Figure 6: Increasing maximum current gains

The yellow arrow at top shows the result of improved distribution or consumption of the output, which increases effectual value. The yellow arrow at bottom shows the result of reduced labour or natural cost in producing the output, which decreases input cost. These shifts will drive the marginal optimum to the right, as indicated by the blue arrow.

If we continue these changes to their feasible maximums, we arrive at the result depicted in figure 7 below. The health benefits here are referred to as maximum marginal gains.

The optimum in figure 7, when applied to all outputs in an economy, constitutes the ***absolute limit to growth***. Growth beyond Q_M is never justified, even in the absence of ecological limits, unless we provide an ethical rationale for producing quantities beyond those required to satisfy our vital needs.

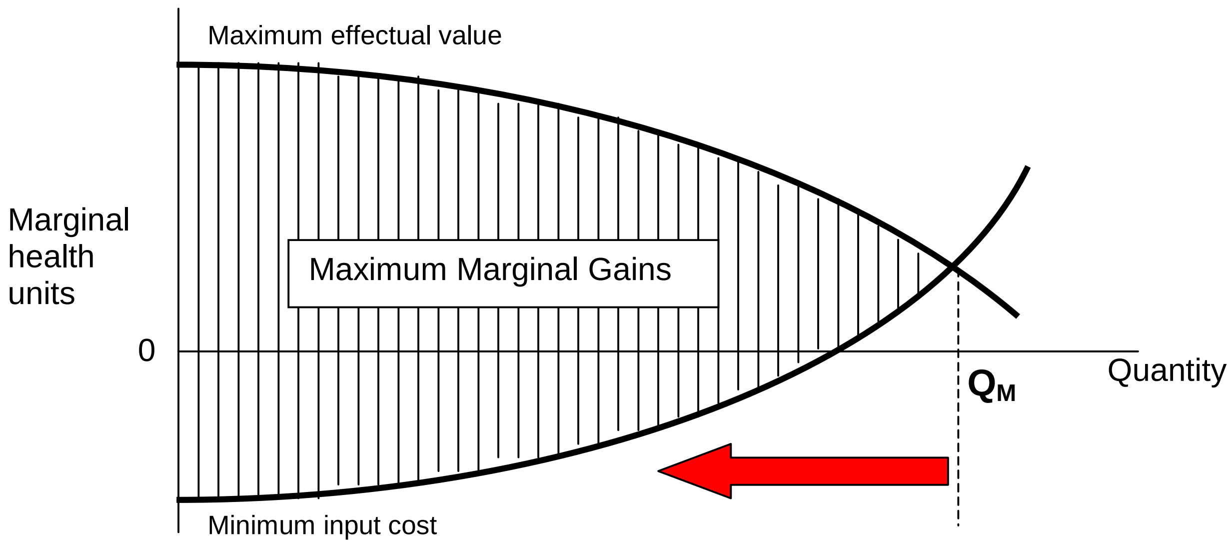

Figure 7: Decreasing maximum marginal gains

The last step is to apply the threshold logic. The result is shown in figure 8.

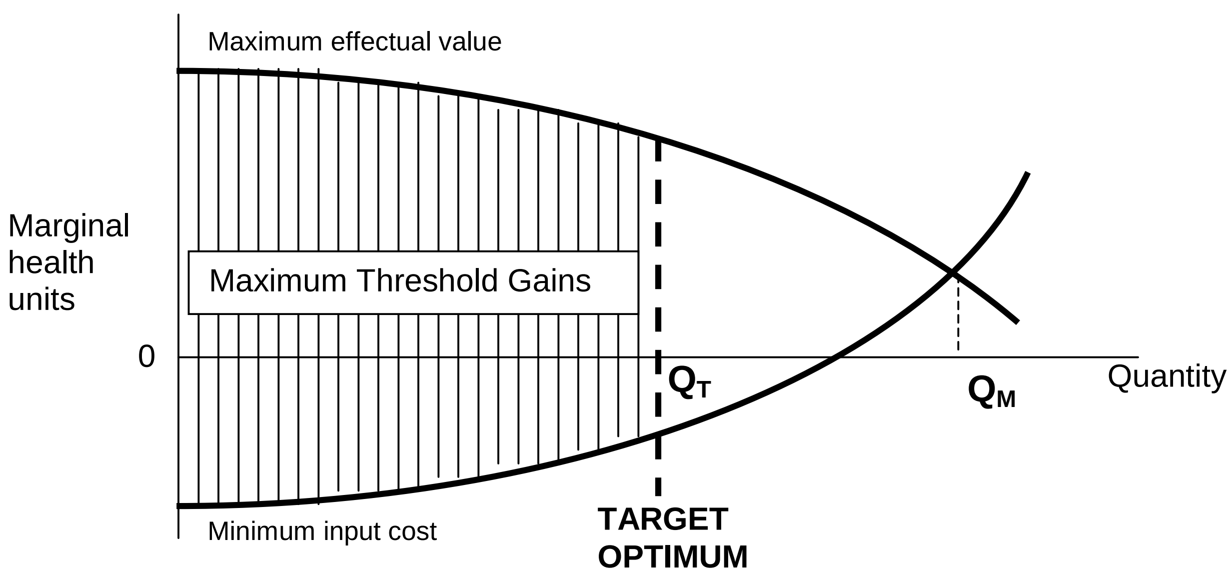

Figure 8: Maximum threshold gains and the target optimum

The target optimum is the output quantity that results in maximum threshold gains. This defines the maximum gains achievable when thresholds are taken into account. I call this the target optimum because this quantity, with its associated value and cost curves, constitutes the ultimate aim for each final output.

The target optimum, when applied to all outputs, constitutes the ***ecological limit to growth***. This is also the output level referred to in ecological economics as the economy's ***optimal scale***. (But see my criticism of ecological economics on this point below.)

We can now define the five critical quantities and flows.

1. The optimum quantity for a FINAL OUTPUT is the target optimum established above.

2. The optimum quantity for an INTERMEDIATE OUTPUT is the minimum quantity required to produce the target optimums of all associated final outputs.

3. The optimum flow for a NONRENEWABLE resource is the flow required for the optimum quantities of all associated final and intermediate outputs, at peak ecological efficiencies.

4. The optimum flow for a RENEWABLE resource is the same as for #3. Threshold effects have already been considered in establishing the optimum quantities for the associated final outputs.

5. The optimum flow for a WASTE is also the same as for #3. Again, threshold effects have already been considered.

In brief, we derive the optimum quantity of a final output by maximizing its associated health gains and applying threshold logic. We then work backwards through the production chain to find the optimum quantities of its associated intermediate outputs and flows.

Applied to the economy as a whole, this logic maximizes a society's well-being while accounting for ecological constraints. In other words, it achieves the objective of human economics.

8. DEFINING SUSTAINABILITY

Feasta's aim is to "explore and promote the characteristics – economic, cultural and environmental – that a society must have in order to be truly sustainable" (website). Feasta's definition of a sustainable system is "one which is capable of being continued unchanged for hundreds of years without causing progressive deterioration in any of the factors which make it up." (Feasta Review #1, p. 5)

This definition of sustainability has several deficiencies. Citing an unchanging system is a static, conservative posture that few outside the group are likely to share. The time period specified is arbitrary. Progressive deterioration for many resources cannot, in fact, be stopped - fuel supplies and mineral availability inexorably decline.

In my view, the concept of sustainability should be tied not to a social state, but to the maximum justifiable rates at which a society can consume the earth's resources. If a society stays within these limits, it is sustainable; if it exceeds them, it is not. This leaves a society free to change, and allows us to rationally set depletion rates. Let me explore this idea further.

Imagine the progression of human history, from the current generation to succeeding generations, into the indefinite future. Each generation has the right to consume so as to meet its vital needs and the responsibility to protect the environment. Now imagine a fixed quantity of a resource, such as oil. Assume that oil is irreplaceable for certain critical needs. How should it be distributed among the generations?

Equal distribution is logically impossible, because there is an unknown number of future generations. Distributing all the oil to the current generation is ethically indefensible: we only have the right to meet our vital needs, and we must protect the environment. Leaving it all for future generations is also indefensible: this does not allow the current generation to meet its needs, and it robs the future, because our health is the basis for their health.

Using the suggested approach, we would consume the quantity of oil required to reach the target optimums of all outputs in the economy, at peak ecological efficiencies. We would leave the rest for future generations.

To summarize: There is no better use for any resource or waste flow than meeting the vital needs of the present generation. When applied to present and future generations, this establishes the optimal temporal allocation of natural flows, and provides a rational basis for defining a sustainable society.

9. ECOLOGICAL ECONOMICS

I had intended to offer a detailed critique of Herman Daly's work at this point, but now feel that this is beyond the document's scope. I will instead offer a brief assessment of ecological economics.

Historically speaking, ecological economics has been a necessary reaction to the environmental ignorance of standard economics. Unfortunately, it has never progressed beyond this role. It has replaced the narrow perspective of capitalism with an equally narrow ecological perspective. At its core, it has retained most of the ideologically slanted concepts of the mainstream discipline.

The fundamental problem with ecological economics is that it has not rethought economics as a whole, from the ground up. Its focus on the ecological sins of standard economics has caused it to compress the pluralistic variety of economic reality into a single conceptual structure. This has resulted in errors which now impede our intellectual progress. Let me cite two.

1. The lack of a human framework means that ecological economics has no independent, human-based conceptions of value and cost. As a consequence, it has no basis for defining optimum outputs and flow levels. Although it uses the term, it has no conceptual foundation for optimal scale.

The best that ecological economics can do is to identity the largest economy that the underlying ecosystem can support. Optimal scale, however, should refer to the ideal economy for humanity, not just its maximum size for nature.

2. The lack of a functional framework means that ecological economics does not possess an analysis of capitalism. This has led it to perpetuate a serious error - the use of "capital" to refer to stocks of human and natural wealth.

"Capital" properly refers to the various forms of expanding exchange-value in a capitalist economy. Using the term for other stocks or wealth exacts a steep intellectual price - the conflation of separate conceptual realms and the inevitable confusion that ensues. This is of little consequence in popular discourse, where "capital" can be effectively employed as a metaphor. In theoretical work, however, such laxity is fatal.

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The human and ecological frameworks can help us define an economy that meets the goal of human economics: the maximization of human well-being, subject to ecological constraints.

Such a definition is useful in freeing us from the ideological influence of capital, and it will be critical if we attempt to build new social structures. However, to guide activism, influence public policy, and manage existing societies, more is required. We must understand not only our ends and constraints, but also the means provided by an economic system to achieve those ends. For much of the world, this implies a detailed examination of capitalism.

The final component of human economics is therefore the functional framework, which in my version addresses capitalism exclusively. This framework is based on the economic concepts of Karl Marx, as expressed in Grundrisse, Capital, and Theories of Surplus Value. I rely heavily on Marx because, in the history of economic thought, his are by far the most incisive insights into capitalism's inner workings.

Despite the current political climate, I am convinced that we must rediscover the economic side of Marx if we are to fully understand capitalism - a system that poses immense obstacles to our initiatives, but that also presents us with broad opportunities to realize humanity's economic aims.

I will offer the functional framework for publication on the Feasta website if this turns out to be appropriate in the context of the group's discussion.

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