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The theoretical and empirical literature in economics has discussed alternative indicators of long-run resource scarcity. This article criticizes the use of economic indicators to determine whether resources are scarce.

A REVIEW OF THE LITERATURE

The literature on economic indicators of long-run natural resource scarcity can be divided into empirical and theoretical parts. In the empirical literature, Barnett and Morse (1963) analyze the changes in the amount of labor and capital needed to extract a unit of resource, and find that extraction costs declined by a factor of four between the latter part of the 19th century and the middle of the 20th century. This finding formed the basis for the argument that natural resource scarcity could not be determined by simply looking at physical quality and availability of resources; past effects and the future potential of technological change and substitution must be considered as well. Other economic indicators of natural resource scarcity have subsequently been developed and thoroughly analyzed. Despite doubts raised by the effects of the energy crisis, the superiority of these economic indicators as measures of resource scarcity has become a basic premise of the empirical literature.

Starting with Hotelling's (1931) model, and considering the quality of information available to resource allocators, the theoretical literature has explored the paths of several indicators, including costs, royalties and prices. The results indicate that prices and royalties may follow various paths, depending on a number of factors, including the size of the resource stock, interest rates, market structure, taxation policies, and substitute technologies. Moreover, changes in any of these factors will reset the paths. However, despite these theoretical findings, the empiricists have ignored these factors and continue to focus only on their economic indicators to identify scarce resources. But the superiority of this focus only on the indicators must be questioned given the difficulty both of determining all of the effects of the other factors on the economic indicators, and of distinguishing these effects from those actually caused by scarcity.

THE LOGICAL FALLACY

The theoretical models of Ricardo and Hotelling can be reduced to the following simple syllogism:

*Major Premise: If resources are scarce, and
Minor Premise: If resource allocators are informed of resource scarcity,
Conclusion: Then economic indicators will reflect this scarcity.(22)*

The empirical literature has looked at resource indicators (the conclusion) to deduce whether resources are scarce (the major premise), and empirical work has ignored the minor premise. In the theoretical literature there are no connections made between the nature of information possessed by resource allocators and the interpretations of the cost or price paths of resources.

In commenting on this critique, many economists have suggested that a true contribution to economics should help correct the problems, not simply point them out. A proper analysis would entail looking at economic indicators of resource scarcity while controlling for whether resource allocators are informed. However, to find out whether resource allocators are informed about scarcity, it is necessary to know whether resources are scarce, and this is the very question under investigation. Thus there is a logical fallacy. If allocators are well informed, then we should get information from them directly, rather than analyze indicators that are based on their actions.

HOW DID WE GO WRONG?

The empirical analyses of the 1970s that were based on Hotelling's model did not clearly reveal the implications of the model because they suppressed both the stringent assumptions of the model and the sensitivity of the results to a number of factors. Moreover, despite the fact that both the Ricardian model and Hotelling's model do not fit the historical record of the United States, they were still used in the difficult empirical analysis of natural resource scarcity.

CONCLUSION

While there have been changes in views about what constitutes science, two tenets have remained unchanged:

- 1) science feeds on the tension between theory and reality; and
- 2) individual scientific arguments must be logical.

The use of economic indicators to determine whether resources are scarce over the long run does not meet either of these two criteria of a scientific approach.