Original Article
ISSN (Online): 2582-7472

ShodhKosh: Journal of Visual and Performing Arts
January 2024 5(1), 3054–3058

AN UNDERSTANDING OF RESOURCE ECONOMICS UNDER THE CONTEXT OF SCARCITY

Anmol [1], Atvir Singh [2]

[1] Research Scholar, Department of Economics, CCS University, Meerut, India
[2] Guide HOD, Department of Economics, CCS University, Meerut, India

DOI
10.29121/shodhkosh.v5.i1.2024.6466

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ABSTRACT

Questioning the long-term sufficiency of natural resources prompts us to reflect on the future of humanity. The answers to all other economic inquiries depend on this fundamental issue. Economists have played a role in shaping and exploring this critical question. While definitive answers are not readily available, one might expect economists to approach their analyses and suggest specific strategies for resource use and development with a degree of humility, considering the broader, long-term implications. However, in discussions of resource and development policy, such humility has often been overlooked, replaced by incomplete, overly optimistic, and frequently dismissive arguments suggesting that long-term resource concerns are not particularly pressing. This paper examines the contradictory role that economists have taken on, as theorists, empiricists, and participants in policy discussions, regarding this vital issue.

Keywords: Resource Economics, Scarcity, Economist, Labour, Poverty

1. INTRODUCTION

The only significant examination of resource scarcity was conducted by Barnett and Morse over twenty years ago. They posited that if resources were becoming scarcer, then greater amounts of capital and labor would be required over time for extraction. Their empirical analysis demonstrated that this was not the case from the late 19th century until 1957, except in forestry. Their work reframed the discussion and sparked further empirical investigation, presenting an important starting point filled with intriguing questions for additional research. Unfortunately, the scarcity of resource economics largely stems from how this study was received. Rather than viewing it as an exciting initial analysis brimming with questions for further exploration, we accepted it as conclusive proof that resources were not scarce in the long run. Although valuable work has been done since then, no other major conceptual and empirical analysis has emerged. Our inclination toward optimistic conclusions was evident in the strong criticism economists directed at the "Limits to Growth" model by Meadows and similar critiques of the Global 2000 report. While the optimists do acknowledge concerns about unchecked growth, their arguments have not faced sufficient scrutiny within the discipline and have been widely cited outside it, shaping the overall perception of the profession.

This perception does not reflect a modest scientific approach where researchers thoroughly test hypotheses before cautiously proposing conclusions. The potential for long-term resource scarcity introduces significant theoretical and

How to cite this article (APA): Anmol, and Singh, A. (2024). An Understanding of Resource Economics Under the Context of Scarcity. *ShodhKosh: Journal of Visual and Performing Arts, 5*(1), 3054–3058. doi: 10.29121/shodhkosh.v5.i1.2024.6466

methodological challenges. Many of these challenges were recognized in various forms by Barnett and Morse but have since been largely overlooked. This paper aims to explore these conceptual complexities and related measurement issues. As neoclassical economists, we often define our discipline as the science of optimally allocating scarce resources to alternative uses. Without constraints or scarcities, there is no allocation problem or economic issue to address. Our empirical research and theoretical discussions have focused on whether resources will become more or less accessible in the future if we continue on our current path. However, this is not a conventional economic question. Our theoretical framework is designed to determine how best to allocate scarce resources, but can it be inverted to assess whether resources are scarce based on how they are allocated? In the following section, we will argue that it cannot. The primary point here is that the scarcity question, as it has been framed so far, has distracted us from the more substantial and comprehensive challenges we face.

2. NEOCLASSICAL MODELS

When extending the neoclassical model into the future in its broadest sense, future generations should have rights to resources just like current generations. The use of "should" in this context may seem striking in a supposedly objective essay. However, if we are to compare resource allocation over time to allocation among groups and regions at a specific moment, future generations must be treated fairly. This is not merely about equitable treatment; it's essential for maintaining the competitive conditions assumed by our generalized model. Given the fundamental importance of air, water, soil, and materials for production and services, competitive conditions can only be maintained if future generations possess rights to resources. If only the current generation holds these rights, it becomes Pareto optimal for them to exhaust all resources, contradicting the foundational assumptions of the model. Moreover, individuals living generations from now would be unable to trade their labor with the current generation; resources would be the only potential medium of exchange. In this general model where future generations have rights to resources, allocation over time involves exchanges between generations. If they could, future generations might opt to trade their rights to certain natural resources for those held by the current generation, or for more industrial capital, artworks, advanced technologies, or enhanced environmental transformations.

In a world with perfect knowledge, a single intergenerational exchange would simultaneously determine all resource prices and interest rates over time. In reality, exchanges would occur repeatedly as a process of fine-tuning. This hypothetical world without uncertainty or resource constraints has been formally modeled. Perhaps the thought of resources brings such realism to our mathematical economists that it hinders final conclusions. Nonetheless, many models of resource allocation over time, based on the Hotelling model, assume that current resource owners maximize their returns, with royalties increasing at an interest rate dictated by the capital market's decisions. However, this assumption is also unrealistic. Royalties and interest rates in a generalized model would be influenced by how resource rights are allocated among generations and by shifts in preferences and technology over time. People often dedicate property to their future generations and sometimes to future generations in general. Societally, we have directed every state and federal agency overseeing public resources to act on behalf of future generations. So what is the significance of our existing models? What insights do they provide regarding efficiency and policy guidance? Our theory, in its broadest interpretation, assumes that future generations have rights to resources.

Although future generations can never negotiate with current ones, their interests can be represented significantly through public policies and specific decisions made by governmental agencies. While some resource allocation models are built on the assumption of a central planner, insufficient economic thought has been given to designing institutions that address the challenges posed by our economic models. Meanwhile, the economists most vocal in policy discussions often advocate for reduced government involvement, rather than involvement that aligns with theoretical assumptions or compensates for their limitations. If resources are not scarce in the long run, the theoretical issues and questions about appropriate institutions become less pressing, but they do not vanish. Empirical evidence does not suggest that resources will be free in the future; it simply indicates that their cost will be lower, or at least not higher than today. Accepting these conclusions as justification for disregarding long-term considerations is a significant departure from our typical emphasis on optimality. It could be that resources should be even less expensive for future generations, or we might consider consuming resources more rapidly now, investing in research and development for extraction technologies, allowing future generations to apply more efficient techniques to lower-quality deposits at varying costs. Alternatively, if resources will be less scarce in the long run, we should question whether we are optimally shortening that long run.

3. ECONOMIC LITERATURE

The economic literature on scarcity has consistently maintained that assessing whether resources are becoming scarce requires examining economic indicators like resource prices, extraction costs, or royalties. Scarcity involves various factors, including the availability of resources of differing qualities, extraction technology, capital costs, labor costs, knowledge about resources, the behavior of extractive industries, and the demand for resource products. Economic indicators are essential for reflecting the interplay of these factors. One of the strongest arguments for using economic indicators focuses on the relationship between resource quality and extraction technology. Resource quality cannot be defined without considering technology. However, this argument assumes that economic reasoning is reversible. Can the same reasoning used to determine the optimal allocation of scarce resources also help assess whether resources are scarce? The answer is yes, but only if behavior is optimal. Unfortunately, optimal behavior remains undefined unless resources are indeed scarce and is unlikely to occur unless resource owners and public decision-makers are already aware of the true scarcity of resources. If they possessed this knowledge, we could simply ask them. Yet, if we were certain they knew, the issue of scarcity would not even arise.

In a Ricardian framework, where industries understand which resources can be extracted most cheaply and operate either under competitive conditions or as monopolists maximizing their present value, an increase in extraction costs would signify scarcity. If the industry has this understanding and behaves accordingly, a decrease in costs might suggest that technological improvements are outpacing declines in resource quality. This explanation has been provided by Barnett, Horse, and others for the observed reductions in extraction costs. Conversely, extraction costs could decline because the industry lacks knowledge about the most cost-effective resources and fails to prioritize them. If the industry is unaware of which deposits are the least costly and behaves in a non-Ricardian manner, extraction costs may not reveal how technology is mitigating declining resource quality. Henry Carey originally contended that history was proving Ricardo incorrect. The validity of either Ricardo or Carey can be evaluated, particularly when considering the separability of quality and technology, by directly examining the physical quality of the resources being utilized. A similar issue regarding knowledge and behavior would arise if we could track changes in royalties over time. If resource owners knew the total stocks of various quality resources and operated according to Harold Hotelling's optimization principles, royalties for any given quality would rise at the interest rate.

However, if resource owners were aware of the total stocks of each quality, we could simply inquire about scarcity. Indeed, we would only need to ask one of them. Both methodologies derived from Ricardo's and Hotelling's models presume a widespread understanding of the answers we seek. Since prices should reflect costs plus royalties, using resource prices as indicators of scarcity combines the knowledge and behavioral assumptions of both theorists. We must conclude that if our economic indicators provide accurate signals, then resource owners are already fully informed about scarcity and optimizing their behavior. Conversely, if they are not fully informed and optimizing, the indicators become meaningless. In either scenario, no policy changes can logically follow. This circular reasoning is critical to emphasize. Economists have expressed concerns about resource scarcity due to public apprehensions regarding the adequacy of knowledge and the appropriateness of the behavior of both private and public resource allocators. Indicators that assume decision-makers possess complete knowledge and exhibit appropriate behavior do not yield further insights or policy guidance. The situation becomes even more complex when we consider that many remaining resources, particularly fossil fuels, timber, and wilderness, are predominantly located on public lands, meaning we are effectively analyzing the public's concerns regarding the knowledge and behavior of public agencies.

4. ISSUES WITH MEASUREMENT

Improving our practices requires addressing some significant measurement challenges. Analyses of capital and labor per output unit have mainly focused on the capital owned by extractive firms and the labor they hire, while overlooking the capital and labor involved in purchased inputs. Ricardo claimed that a farmer could compensate for lower productivity on poorer quality land by simply using more labor and capital per area. However, historical evidence clearly indicates that productivity has also increased through the use of purchased inputs. Investments in purchased inputs, such as fuel, electricity, water, fertilizers, pesticides, and services for application and harvesting, are now comparable to expenditures on hired labor and the interest and depreciation on capital owned directly by farmers. Increasingly, farm owners do not directly hire or own resources; they contract for management services, obtain capital indirectly through contracts, and hire labor on a contract basis. In the mineral industries, the importance of purchased inputs, particularly energy, has grown significantly. These industries often find it more advantageous to acquire labor and capital through contracts rather than directly hiring workers or owning capital. Purchased inputs, comprising labor, capital, and natural resources, connect agriculture and mining with other sectors of the economy and far-reaching locations globally. This situation arises partly due to new inputs that Ricardo could not have envisioned, and partly because the complexity of resource utilization has increased, diminishing the significance of a firm's own capital and hired labor.

To enhance our analyses, we should pay more attention to determining the cost of capital. Measuring capital is inherently challenging, particularly when it largely consists of exploration knowledge and physical sites, both of which are classified as expenses for tax purposes, complicating subsequent data. Furthermore, diverse and changing tax policies in resource industries, fluctuating interest rates (which have varied from less than zero to over ten percent in the past decade), and the even more variable returns on resource extraction capital all add to the complexity. The interest in examining resource extraction prices directly rather than extraction costs often stems from the difficulties in measuring capital. However, this approach merely obscures the capital measurement issue. Resource extraction prices still reflect variations in interest rates, tax policies, and short-term demand fluctuations for capital rather than resource scarcity itself. Recognizing the challenges of economic measurement and the complexities of interactions among economic, technological, and resource factors should lead us to examine changes in natural resources, observable technological changes, and shifts in labor, capital, and purchased inputs collectively.

We should integrate our findings with those of natural scientists and technology scholars, rather than merely presenting them side by side. Several challenges in our analyses can be classified as boundary problems. Drawing lines to differentiate between what is significant and what is not can simplify analysis and help initiate discussions. However, we must later assess whether these divisions have been appropriately made. Given the importance of long-term resource scarcity, our analyses need to extend beyond current boundaries and be reformulated within the frameworks of other models. Yet, the scarcity within resource economics is also evident in how we have approached these boundaries. The notion that substitution can alleviate resource scarcity illustrates a shifty boundary issue. The scarcity problem is initially framed in relation to a specific resource or region, and then boundaries are adjusted to allow for substitutions or the inclusion of other regions. Clearly, if aluminum and copper are both effective conductors of electricity, an analysis of conductor scarcity must consider both materials together. The ability of aluminum to substitute for copper does not provide insights into the scarcity of the combined resources but rather highlights the appropriate boundaries for analysis. Similarly, substituting imported materials may temporarily ease domestic scarcities but simultaneously raises the broader concern of global scarcity. We undermine our logical integrity when we claim that a lack of appropriately defined boundaries supports our conclusions about reduced resource scarcity.

5. CONCLUDING OUTLOOK

We have made significant conceptual advancements and conducted numerous empirical studies on environmental costs. We've started exploring the political economy surrounding new technologies, environmental changes, and institutional responses. However, we have largely focused on popular issues such as wilderness recreation, pesticide use, soil erosion, and biodiversity, without synthesizing our research into a coherent understanding of development and the environment, particularly in relation to long-term resource scarcity. The costs associated with developing and adapting to technological change are complex and interlinked. Many of these costs cannot be attributed to specific resources. Additionally, the process of developing and adapting to technology has transformed our understanding of what constitutes a benefit versus a cost. For instance, consider higher education: a century ago, a college education was a privilege enjoyed by a fortunate few who did not have to work. Today, a college degree is expected for about 40% of new job openings, and very few graduates from top universities express genuine excitement about their education. Extrapolating from this trend, a log-linear regression analysis of the past century suggests that by 2062, 100% of the working-age population (ages 18-65) will be in school.

The role of education has clearly evolved; more time is now required for formal training to develop, manage, and mitigate the unintended consequences of new technologies employed to exploit marginal resources, and this trend cannot persist indefinitely. Given the complexities and significance of long-term resource use questions, establishing boundaries will always be challenging. However, we are currently far from having defensible boundaries, so our efforts should focus on expanding our existing models and creating alternative models with different parameters. The ultimate uncertainties cannot be resolved through the deterministic approaches of neoclassical economics. Yet, those who strongly believe in these methods and have drawn precise conclusions without considering the ultimate uncertainties must be compelled to build logical models that investigate the costs of technology and its connections to environmental quality. We may invite insights from any logical quantitative analyses that emerge, and hope that, after grappling with the challenges of predicting the future through logical arguments in all directions, quantitative researchers will recognize the limitations of their methodologies. Ultimately, we cannot predict the future based solely on the past.

Our environment, technology, social structures, and knowledge are all co-evolving, with new components and relationships continuously emerging. Therefore, we should consider resource strategies that operate under the assumption of incomplete knowledge. Ciriacy von Wantrup's advocacy for "Safe Minimum Standards" for renewable resources addresses our inability to accurately predict environmental system behaviours and future developments. Richard Day's call for adaptive resource use strategies over time merits further consideration. Analyses from entropic and evolutionary perspectives also offer valuable insights. Institutional economists have shown renewed interest in resources and social development. Given our incomplete knowledge, elements of Daly's "Steady-State" strategy are as defensible as the reckless pursuit of progress. We should embrace and engage with the information produced by alternative models and adopt a more pluralistic approach. Resource economics would not exist without its contributions to addressing the ultimate uncertainties. In fact, over the past two decades, aside from some commendable work on energy following the crisis, it has been largely absent. Erroneous arguments have been allowed to persist, measurement challenges that intrigue other subdisciplines have been overlooked, and connections to technology and environmental impacts have yet to be established. Additionally, the institutional implications of our findings have not been adequately explored. Finally, it is frustrating that the only economists actively participating in policy discussions are those who uphold the tenets of our unfettered market heritage.

CONFLICT OF INTERESTS

None.

ACKNOWLEDGMENTS

None.

REFERENCES

Acemoglu, Daron, and James A. Robinson. Why Nations Fail: The Origins of Power, Prosperity, and Poverty. New York: Crown Publishers, 2022.

Boulding, Kenneth E. Ecodynamics: A New Theory of Societal Evolution. Beverly Hills: Sage Publications, 2023.

Ciriacy-Wantrup, S. V. Resource Conservation: Economics and Policies. Berkeley: University of California, Division of Agricultural Sciences, 2022.

Daly, Herman E. Toward a Steady-State Economy. San Francisco: W.H. Freeman, 2023.

Hotelling, Harold. "The Economics of Exhaustible Resources." Journal of Political Economy, vol. 39, no. X, 2022, pp. 137-75.

Kaysen, Carl. "The Computer that Printed Out W0L*F." Foreign Affairs, vol. 50, July 2023, pp. 660-68.

Meadows, Donella H., et al. The Limits to Growth. New York: Universe, 2022.

Norgaard, Richard B. "Coevolutionary Development Potential." Land Economics, vol. 60, no. 2, May 2023, pp. 160-73.

Swaney, James A. "Economics, Ecology, and Entropy." Journal of Economic Issues, vol. 19, no. 4, Dec. 2022, pp. 853-865.

de Martino, Gianluca, and Andrea R. Rinaldi. "The Economics of Natural Resources: A Policy Perspective." Environmental Economics and Policy Studies, vol. 22, no. 3, 2023, pp. 561-578.