

The Framework and Problems of Knowledge Economics

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Abstract

This paper formally proposes Knowledge Economics as a new theoretical system. Knowledge Economics investigates the laws through which knowledge creates economic value; it is a discipline that studies the efficient utilization and allocation of resources and the generation of economic value under the premise of nearly unlimited growth of data resources. Knowledge Economics abandons the “limited resources” assumption inherent in traditional economics and explores the laws governing resource utilization, resource allocation, and value creation based on nearly unlimited data resources. Knowledge Economics possesses its own distinctive research paradigm, research framework, and corresponding fundamental questions. From the perspective of the varying status of data resources, Knowledge Economics encompasses the linked economy stage, the digital economy stage, and the knowledge economy stage. This paper also provides specific examples, related methodologies, and their functions for research questions corresponding to Knowledge Economics, clarifies that the knowledge economy represents the direction of economic system development, and posits that the knowledge economy in finance is financial technology.

Full Text

The Economics of Knowledge: Framework and Fundamental Issues

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Abstract: This paper formally proposes a new theoretical system called knowledge economics. Knowledge economics studies the principles through which knowledge creates economic value, examining the effective utilization and allocation of resources to generate economic value under conditions of nearly infinite

data resource growth. The discipline abandons the “limited resources” assumption of traditional economics to explore the laws of resource utilization, allocation, and value creation based on virtually unlimited data resources. Knowledge economics possesses its own distinct research paradigm, analytical framework, and corresponding fundamental questions. From the perspective of data resources’ evolving status, knowledge economics encompasses three stages: the link economy, the digital economy, and the knowledge economy. This paper provides specific examples, related methodologies, and their applications for research questions in knowledge economics, clarifies that the knowledge-based economy represents the direction of economic system development, and establishes that knowledge economics applied to finance is financial technology.

Keywords: big data, data elements, data resources, economics

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1 Introduction

Economics is the discipline that studies the optimal allocation of limited resources, with the standard definition being “how society uses scarce resources to produce valuable commodities and distribute them among individuals.” Its core tenets are material scarcity and efficient resource utilization. The field has evolved into two major branches—microeconomics and macroeconomics—and has played a tremendous role in human social development, becoming the principal science guiding national macroeconomic decision-making, enterprise management, and individual wealth management. In terms of research objects, economics examines “various economic activities and corresponding economic relations at different developmental stages of human society, as well as their operational and developmental laws.” This involves numerous specialized domains, giving rise to corresponding subfield economics such as finance and public finance, as well as regional and world economics based on different scope perspectives.

Throughout its development, economics has formed different paradigms constituting various schools, such as classical economics and evolutionary economics. The discipline has also continuously adjusted its assumptions (e.g., the rational actor assumption) and integrated with other fields to create new branches like behavioral economics, physical economics, and neuroeconomics. Overall, these developments have not altered economics’ most core idea: “resource scarcity” [?]. This fundamentally determines the resource assumptions underlying human social development, with research paradigms, models, and methods ultimately serving this overarching assumption. This assumption has been reasonable throughout human history, as limited resources have formed a primary driver of societal evolution and, to some extent, promoted human evolution itself.

However, the resource assumption has its limitations: when resource structures change and the composition of resources in economic development shifts, the assumption may no longer hold. This scenario has gradually emerged in socio-economic forms driven by information technology and the internet, manifesting unique characteristics that can be summarized in three points: First, data has become an important resource in the economy. Second, data has become a core resource in the economy. Third, data has become the expression of resources in the economy. These three points are manifesting to varying degrees in the current economy. For instance, the first is gradually becoming reality, while the second and third are reflected differently across industries. Nevertheless, when these points become dominant phenomena, economics must extend its research objects to include data as a “resource.” These three points constitute the “axiomatic assumptions” of knowledge economics.

Within the current economics framework, numerous studies have examined the economic problems or social phenomena of “data becoming a resource” [?], but they do not fundamentally alter the basic assumption of “limited resources” in economics. Instead, they apply the experiences, paradigms, and methods developed under this assumption to the new scenario of “data becoming a resource,” recognizing no essential difference between data and other resources. This is precisely the essential reason for the emergence of knowledge economics: it posits a “qualitative” difference between data and other resources, a difference that transforms the fundamental assumption of economics—namely, that data is a resource that grows exponentially (with a base greater than 1), and exponentially growing resources are nearly infinite, meaning any given value can be surpassed in logarithmic time.

This is the core of knowledge economics: its research object is a “nearly infinite” resource. Whether knowledge economics can provide beneficial guidance and reliable results for practical problems depends on the coverage of this exponential growth pattern of data resources. In practice, the laws and predictions derived from knowledge economics have been validated earliest in internet industries and certain financial sectors, with related forecasts and judgments gradually being confirmed.

Traditional economics considers limited resources where resource consumption formed by productivity composition and individual growth is nearly exponential, while resource supplies from natural storage, social production, and public authority credit (e.g., money) are limited or linearly growing. Data as a resource changes this pattern: resource supply is nearly infinite, while resource consumption is limited, constrained by computing power, modeling methods, artificial intelligence development levels, management capabilities, and other factors [?].

Knowledge economics attempts to address the issues brought by data as a resource and as an infinitely growing resource, redefining resource allocation methods and constructing new research paradigms to study new problems, thereby forming a framework distinct from traditional economics to face an entirely new future society. The remainder of this paper is structured as follows: Section 2

introduces the definition and scope of knowledge economics; Section 3 presents the research framework, paradigm, and stages of knowledge economics; Section 4 clarifies that financial technology is the knowledge economics of finance; and Section 5 concludes and discusses future developments.

2 Definition and Scope of Knowledge Economics

Knowledge economics is the discipline that studies the effective utilization and allocation of resources to generate economic value under conditions of nearly infinite data resource growth. The foundation of knowledge economics is the near-infinite growth of data resources. This foundation is not termed an “assumption” because the exponential growth pattern of data resources is definitive—humanity’s accumulated data volume exhibits a clear exponential growth trend. Although some data have not yet entered the resource category, we can assume their proportion is either fixed or decreasing, meaning the overall volume of data as resources remains exponentially growing. This foundation determines that knowledge economics’ research paradigms and methods differ fundamentally, and likewise, the value creation process in knowledge economics—borrowing the production function concept from traditional economics—features a different production function.

Knowledge economics remains a branch of social science, which considers the “effects” and “values” of human society as the fundamental purpose of disciplinary research. Since the traditional economics framework cannot be directly extended to knowledge economics, we must clarify knowledge economics’ value within the broader domain of social sciences: the core requirement of generating value. Simultaneously, knowledge economics retains the “economics” concept, borrowing “resource allocation” from economics while adding “effective utilization,” all aimed at “generating value.” The meaning of value is multifaceted, determined by the different stages of knowledge economics.

Based on perspectives of data resource formation, knowledge economics divides its research questions into three stages: the internet economy stage, the digital economy stage, and the knowledge economy stage. These stages are all components of knowledge economics, with research questions forming a coherent lineage that collectively constitutes the scope of knowledge economics research.

The internet economy is the construction stage where data becomes a resource, transforming data into an important resource. During this process, the direct impact of data growth concerns how to obtain data, store data, and use data to expand further data [?]. The internet (or network) serves as the primary means for effective resource utilization, encompassing various technical development languages, web design, communication networks, and visualization components, as well as economic-level models such as network growth laws, complex network theory, evolutionary theory, and link structure. These economic-level technical models manifest primarily as network models or mathematical graph theories and methods. In this process, links are the main carriers of data in the internet

economy, hence the internet economy is also called the “link economy,” which considers resource utilization and optimization allocation within links.

The digital economy is the new stage following full development of the internet economy. Data becomes an important resource and gradually a core resource, meaning data begins to serve as the primary and leading resource for value creation [?]. While the term “digital economy” appears frequently, its essence lies in the value creation driving force formed by digital technology, which fundamentally stems from data becoming the core resource. When data becomes the core resource, its allocation and utilization affect the efficiency of other resource allocations. Resource utilization in the digital economy relies on current ABCD technologies (Artificial Intelligence, Blockchain, Cloud Computing, and Big Data), which interact with the digital economy: on one hand, their emergence and development are driven by the changing role of resources in the transition from internet economy to digital economy (from important to core resources); on the other hand, they provide critical tools for data resources to generate value, enabling value mining amid exponential data growth.

The knowledge economy is the final stage of knowledge economics research. It faces the contradiction between the uncertainty of potential value from exponential data growth and the certainty of limited mining capabilities. Resolving this contradiction fundamentally depends on the application of “knowledge”—knowledge becomes the core of data resource utilization and allocation. The name “knowledge economics” originates from this. Knowledge serves as the carrier of data, the carrier of data mining methods, and the carrier of value allocation, achieving unity at this stage. Generating value from exponential data growth requires full utilization and allocation of data resources, while knowledge application requires specific conditions, models, and methods—these are the basic questions knowledge economics must study at the knowledge economy stage.

3 Research Framework, Paradigm, and Stages of Knowledge Economics

As an emerging science, knowledge economics employs sufficiently broad tools, including various digital technologies, models, and existing economic methods. However, its research questions and fundamental assumptions differ from traditional economics, requiring adherence to knowledge economics’ definition to form the following basic characteristics: First, data must be considered as a resource or reflect the characteristics of “data as a resource” during research—this is the prerequisite for knowledge economics research. Second, data must be able to generate value and be considered as a factor during research. Knowledge economics studies the laws of value generation from data, making value generation another research prerequisite. Here, value includes not only traditional profits but also corresponding social value. Third, knowledge must be able to function in different forms during research. Knowledge possesses dual attributes of data and data production. Under the above two prerequisites, exploring laws essentially means exploring knowledge’ s modes, patterns, and

methods of action.

Based on these characteristics, knowledge economics' basic research framework can be defined as: the laws through which data as a resource generates economic value, i.e., the economic role and patterns of knowledge. The specific research framework can be expressed as:

Data Resources + Knowledge Application = Economic Value (Formula 1)

Under this framework, different research paradigms can be formed for different data resource stages, industry domains, and problem characteristics. A paradigm refers to the methodological process formed by combining the research framework with industry-specific problems. Here, we illustrate using different data resource stages.

At the internet economy stage, where data becomes an important resource, the basic questions concern: value evaluation of data resources, interaction between data resources and other resources, and similarities and differences between data resource value formation methods and those of other resources. At this stage, knowledge is gradually introduced into the research paradigm as a mode of data resource value. Taking the financial industry as an example, the interaction between data resources and other resources manifests as algorithmic correlation, organizational correlation, and causal linking, correspondingly forming graph analysis, complex network analysis, and explainability tools. A simple analytical approach involves determining the influence (i.e., weight) of different link positions, thereby identifying value formation paths and factors that can be applied to help market entities obtain value in other contexts.

At the digital economy stage, where data becomes the core resource, the basic questions concern: measurement of data-derived value, data resource production (value) models, standardization of data resource economic value, data value influencing factors, optimization models, and pathways. At this stage, knowledge enters the research paradigm as an explicit factor, with related basic questions actually reflecting different characteristics of knowledge as an explicit factor. Using the financial industry as an example, data resources become the core production factor for financial institutions. The value of financial institutions—all businesses that reduce uncertainty to varying degrees—depends on data resources, with data even becoming the sole dependent resource. At this stage, the primary question is how to use data to reduce uncertainty across different dimensions to reshape the financial industry's value creation model, which is also the inevitable direction of financial industry development at the current stage.

At the knowledge economy stage, data becomes the representation of resources, and digital spacetime has formed. Related basic questions expand into different spatiotemporal contexts, becoming: methods of resource data representation (e.g., blockchain is one such method), value of resource data representation, analysis of resource-data-value relationships, value production models, and value pathway trends. At this stage, knowledge is the direct research object, and data

as resource representation has become higher-order knowledge. Therefore, the above questions actually represent exploration of knowledge' s economic value and methods, conducted across different spatiotemporal contexts and their interconnections, such as digital spacetime, social spacetime, or value associations between digital and social spacetime. Future economic models will be influenced by these basic questions and gradually develop corresponding production models. Again using the financial industry as an example, future finance will operate simultaneously in social spacetime, digital spacetime, and their value associations, with all the above questions manifesting in future finance.

Many traditional economics questions persist in this framework but with differences. Here are two examples:

Example 1: Resource allocation. Traditional economics considers resource allocation across different sectors, forming related theories while examining individual and overall allocation efficiency such as Pareto optimality. However, under the knowledge economics framework, data resources are no longer limited. Resource allocation must therefore be elevated in dimension, conducted through "knowledge value," specifically manifested as knowledge efficiency across different industries, enabling analysis of which industries have greater investment value or the future development directions of specific market entities. Current research results in this area, including industry evaluations, enterprise development predictions, investment value, enterprise resource allocation, and investment opportunities, have all been validated, demonstrating that the new knowledge economics framework aligns with reality.

Example 2: Price mechanisms and transmission. Traditional economics involves price mechanisms and research in many subfields. However, in the knowledge economy, price formation differs by stage. For instance, in the internet economy (link economy), price mechanisms primarily manifest through link dynamics, with traditional market supply and demand affecting prices through link dynamics, though often inconsistently, causing supply-demand relations to lose their influence. Based on this logic, knowledge economics' price mechanisms can explain phenomena such as long-tail markets and platform economy price monopolies, meaning regulation in specific domains must also follow knowledge economics frameworks and logic.

4 The Knowledge Economics of Finance: Financial Technology

The Financial Stability Board (FSB) defines financial technology as "technology-driven financial innovation." Literally, the combination of Finance and technology seems reasonable, but this definition fails to capture the essential characteristics of fintech [?]. Since finance' s inception, it has experienced much innovation, and grasping how these innovations affect finance' s essence is key to defining fintech.

Given that knowledge economics' premise is that "data is an important resource,

a core resource, and a representation of resources,” combined with the impact of data as a key element in fintech, this paper attempts to provide a perspective for understanding fintech: fintech is the result of applying knowledge economics specifically to the financial industry, or equivalently, the knowledge economics of finance is fintech. If we view fintech as a discipline, this perspective provides its broadest and most solid foundation.

Specifically, the link (internet) economy stage in finance manifests as the allocation of traffic or link resources, bringing big data and related technologies. Its essence is the repositioning of information (data) elements in finance, whose value—reducing uncertainty—becomes greater and more efficient, thereby presenting many new financial business forms and characteristics. Most financial enterprises currently operate at this stage, though some pioneering institutions have moved beyond it. For enterprises at this stage, fintech plays an empowering role, meaning these enterprises passively introduce, replicate, and embed technology.

The digital economy stage in finance manifests as the reshaping of data value, focusing on the reshaping process and models. This requires artificial intelligence and blockchain technologies to provide new models and methods for analytical intelligence and organizational intelligence. Financial institutions’ value begins to actively utilize, trade, and share uncertainty, ultimately mapping knowledge economics’ basic questions onto finance: data resource allocation and value pathways. A small number of pioneering financial institutions have entered this stage, where fintech plays an enhancing role, meaning enterprises actively apply fintech.

The knowledge economy stage in finance manifests as data becoming the representation of resources, where the core of financial resources is ownership, preferences, and relationship mapping. When data can represent these resource cores, it means the financial industry has become fully knowledge-based and successfully transcended social and digital spacetime, enabling financial knowledge to obtain value simultaneously in both spacetimes. Current financial enterprises find it difficult to reach this stage, as it requires external institutional mechanisms and enterprise endowments. At this stage, fintech brings capacity creation, becoming a direct value creation model.

5 Conclusion and Development

This paper introduces the background, framework, paradigm, and basic logic of knowledge economics, and uses fintech as an example to illustrate the results of applying knowledge economics to different industries. Knowledge economics abandons traditional economics’ “limited resources” assumption, considers the impact of exponentially growing data resources, and constructs a corresponding framework and research paradigm. The knowledge economics of finance is fintech.

Knowledge economics is a newly born discipline that will continuously develop

with human society and evolve with the transformation of humanity' s three spacetimes. As its basic questions and related research deepen, it can provide ideas, solutions, and directions for social development, economic growth, industry regulation, enterprise value creation, and individual well-being.

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