Economic Power: A Perspective from the Entropy Theory of Value

Jing Chen
School of Business
University of Northern British Columbia
Prince George, BC
Canada V2N 4Z9
Phone: 1-250-960-6480
Email: chenj@unbc.ca
Web: http://web.unbc.ca/~chenj/

James K. Galbraith
Lyndon B. Johnson School of Public Affairs
The University of Texas at Austin
Austin, TX 78713-8925, USA
Phone: 512-297-6544
Email: galbraith@mail.utexas.edu
Web: http://www.utexas.edu/lbj/faculty/james-galbraith/

Abstract

The economics of power relations may be analyzed and illustrated with an entropy theory of value. In practice, the most important method to enhance economic valuation and power is to reduce the number of providers, creating monopoly or oligopoly. Governments enjoy many forms of monopoly, and they grant monopolies, through land titles, patents, charters, intellectual property rights, regulation, and industry standards. Businesses seek monopoly, through technological innovation, product differentiation, branding, advertising, location and product-loyalty schemes, as well as force and fraud. Once acquired, monopoly power is naturally guarded; monopoly is for the powerful, while competition is for the weak. We present a simple mathematical formulation of an entropy theory of value, consistent with institutional and evolutionary economics, that explains the roles of monopoly and oligopoly, as well as scarcity, in determining economic values and economic power. It is logarithmic in form; the argument is a probability expressing scarcity (which diminishes over time as market penetration grows) and the base of the logarithm captures the influence of monopoly power.

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Introduction

Economic power is peripheral to standard economic theory. The conventional model turns on the "ideal" of "perfect competition" – an infinite horizon of price-taking consumers and producers, meeting on grounds of equality in a free and open market. So-called imperfections, such as monopoly, oligopoly, asymmetric information, externalities, public goods and so forth, are introduced in textbooks (usually after the presentation of the competitive model) to give the theory a semblance of reality – and often ignored in formal theory. But in real life, power -- economic power, political power, social power -- is paramount, both for organizations and for individuals. A realistic economic theory needs to tackle the issue of economic power directly.

Economic power – monopoly power -- exerts its influence by affecting the value of services and goods, and their manner of distribution over time. An entropy theory of value provides a clear understanding of the main factors that affect the economic value of services and goods, and therefore of the economics of power.

Mathematically, the entropy theory of value is given by a logarithm function, in which the argument is a measure of market scarcity, and the base is given by the number of suppliers. It is as simple as that, but such a simple theory can describe the value of monopoly and oligopoly, among the most important phenomena in the economic and social world. It can also help us understand the economics of resources and innovation, the integration of markets, and of the regulations that are indispensable features of all organized economic life. It naturally incorporates change through time, as scarcity declines and competition grows. These are qualities the prevailing mainstream theory does not have.

The Entropy Theory of Value

The entropy theory of value is an *analytical* theory. This means that one can obtain numerical estimates of specific economic phenomena by plugging observed parameter values into the equation. While no economic theory is likely to give exact answers, given the limitations of economic data and the variability of human behavior, our theory does give plausible numerical predictions in real world examples – predictions that can be checked against the facts of what happened. Galbraith and Chen (2025) provide numerous examples.

An entropy theory of value is a scarcity theory, very familiar in the history of economic thought. Scarcity is the foundation of economic value in an entropy theory; all economic activity rests on the acquisition of high-quality, low-entropy resources, which are naturally scarce. Resources are used to create goods and services, to be sold at a profit. The ability to do so is related to the intrinsic desirability of the product, in the eyes of consumers, and here low entropy is the foundation of utility: consumers naturally prefer new products, fresh food, and equate youth with beauty. Entropy thus encompasses the labor theory of value – labor is a resource – and the utility theory, but it is more general and more foundational than either.

Scarcity is also related to objective factors: the scale of the available market, the size and productive power of the company, the degree of competition from other suppliers, the degree of market protection from a friendly government or regulatory agency. These factors help determine the economic value of a product as they evolve over time. In practice, the most important method to enhance valuation is to reduce the number of providers, creating monopoly or oligopoly. As a product ages and a technology matures, competitors and imitations tend to lower economic value. There is no equilibrium except for the tendency toward maximum entropy, when economic value falls to zero and nothing whatever can be produced. Economic life is not about avoiding this equilibrium, not reaching it.

In analytical terms, scarcity can be defined as a probability measure P in a certain probability space: the more probable an event or a product, the less scarce it is. The probability of an economic good or service can be thought of as the degree of market penetration or saturation -- how much can be or has already been sold, in relation to the size of the market. Generally, new products are scarce (and monopolistic) by definition, but they become less so as they spread through the market, and this explains why market economies are preoccupied with innovation, both real and imagined.

A product is defined as an economic "good" – something that is desired and can therefore be sold. To be considered a "good," the value of any product must satisfy the following properties:

(a) The value of two products must be higher than the value of each of them.
(b) If two products are independent, that is, if the two products are not substitutes or partial substitutes, then the total value of the two products will be the sum of the two values.
(c) The value of any product must be non-negative.

The only mathematical functions that satisfy all the above properties are of the form

$$V(P) = -\,log_b\,P \qquad (1)$$

where b is a positive constant (Applebaum, 1996) and P is a probability measure ranging from zero to one. As those who are familiar with Shannon's theory of information will recognize, the economic value function is similar to the measure of information in Shannon's information theory (Chen, 2005). In information theory, the base of the logarithm function is usually chosen to be two because there are two choices of code in information transmission, namely, 0 and 1 (Shannon, 1948). In economics, b, the base of the logarithm function, represents the number of suppliers of a product or a service.

Scarcity and value

Figure 1 is a graph of Formula (1), which shows that value is a decreasing function of probability, or – what is the same thing, an increasing function of scarcity[1]. That is why diamonds are worth more than water in most circumstances. In extreme abundance, when P=1 and -log P =0, the value of a given commodity is equal to zero, even if that commodity is very useful.

Value and the number of producers

[1] Scarcity on the diagram increases from right to left.

Figure 2 displays the relation between product value and the number of producers. When the number of producers is small, the unit value of a product is high. The products of monopolies and oligopolies are valued highly. If the base becomes one, i.e., absolute monopoly without substitution, value approaches infinity. Despite frequent use of the word "monopoly," this situation is very rare, and such monopolies must always be subject to regulation and control, limiting the exercise of their power.

This concludes the entire mathematical presentation of our value theory.

An Analysis of Economic Power

The allocation of resources, including human resources, is often regulated by institutions, which assign property rights and enforce them. The number of producers and service providers is also regulated, often by the existence of government monopolies, as well as by charters, credentials, and accreditation. Because of the high valuation of monopoly and oligopoly, attaining and maintaining monopoly or oligopoly is a principal goal of many economic, political and social activities.

High-quality resources, when abundant, have low economic value, yet they are the foundation of activities that generate economic value. For example, food is essential for survival. But most countries subsidize food production to guarantee the abundance and low cost of food for city-dwellers. These policies tend to tolerate, even to encourage, low incomes for farmworkers. Economic value and "social value" can diverge greatly – which is why capitalism and socialism have different institutional structures.

The case of other resources is similar. Energy and scarce materials – such as rare earths and gallium in today's advanced electronics – feed a system that generates new technologies, products, and weapons, which are themselves scarce, valuable, and the instruments of power. The profitability of these instruments of power depends on the cheapness and abundance of resources, which is why they are often deployed to control resource-producing regions. Very often, resource-producing regions remain poor so that users of resources can remain rich. This is called the "resource curse," but it is inherent in the struggle for power. When resource costs rise, profits fall, especially for advanced and complex systems.

Monopolies and Value in Business, Unions and the Arms Trade

The relation between the number of producers and economic value can illuminate many commercial and social phenomena. Businesses seek monopoly, through technological innovation and market dominance, sometime legal and sometimes not, and in many other ways, including product differentiation, branding, advertising, location and product-loyalty schemes.

In consumer products, to take just one example, each manufacturer designs printers in a way that printer ink from other firms cannot operate well. By restricting customers' choice, producers sell their ink at a higher price and obtain higher profits.

Unions seek closed shops in bargaining – a form of countervailing power – to help workers enjoy some of the fruits of their employers' monopoly power[2]. With only a single unit of bargaining, a

[2] These phenomena were analyzed in Galbraith (1952), Galbraith *fils* (1998) and by Ahmari (2023).

trade union is in a much stronger position than many individuals in bargaining with management. Unions are often formed in many stable professions, such as government employees and teachers. Professions, such as physicians and lawyers, often are certified by a single organization, which increases their monopoly value. Conversely, firms prefer to stratify their employees and deal with them in small groups, or individually – greatly reducing their bargaining power.

The power of consumers is inversely related to their numbers. When there is only one dominant customer, that customer can mostly dictate the terms of trade. Producers, on the other hand, like to increase the number of their customers, and to retain their past customers for repeat purchases at higher prices. Strategies to “lock in” a base of consumers are thus ubiquitous in the world of designed consumer goods.

Likewise, companies who make armaments seek to export them as well as to sell them to their own governments. A broader base of buyers, each locked-in to a particular set of weapons, increases the market power of the manufacturer and the economic value of their weapons. This explains the diversity of otherwise standard weapons (such as 155-millimeter artillery and shells) in NATO countries, with associated high costs, compared to the standardization and low cost of the same weapons in a socialized system such as Russia or China. This in turn explains why military superiority has largely passed from the collective “West” to Russia and China.

The Politics of Economic Power: Divide-and-Rule

Governments enjoy many forms of monopoly, including legalized violence, judicial punishments, taxation, and legal tender. Governments grant monopolies, including through land titles, patents, copyrights, charters, regulations, and industry standards. Even in nominally democratic societies, the reach of governmental monopolies tends to grow over time. Today, government powers are much greater than they were (say) in the 19th century in North America. Many important social activities, such as education and -- in most wealthy countries -- medicine, are under effective government control. Safety and environmental regulations are pervasive.

Those who hold such powers constitute a ruling class. To maintain power, the ruling class in a society generally adopts the policy of “divide and rule”. It does so by encouraging the lower classes to self-identify by race, ethnicity, religion, culture, gender, and other criteria. So long as no single group becomes too well-defined and too powerful, this division will lower the value and power of those who are ruled.

We can apply our value theory to a political analysis of this general type. Suppose 10% of the population are upper class, 30% of the population are middle class, 60% of the population are lower class. Top dogs are scarce, middle dogs are middling scarce, underdogs are plentiful.

Suppose there are two rival groups in each class – a classic “two-party system.” Then the value, or economic power, of a member of the upper class is $-\log_2 0.1 = 3.32$, the value of a member of the middle class is $-\log_2 0.3 = 1.74$, the value of a member of the lower class is $-\log_2 0.6 = 0.74$. Individually, members of the lower class are worth less, by a factor of about 5, even though the lower classes hold a strong numerical majority. That is because the lower classes, being abundant, are less coherent. Overall, taking this into account, the total weight of the lower class and that of the middle class are each only slightly more than the weight of the small minority in the upper class. And by making an alliance with the lower class -- even an inefficient one -- the upper class can dominate the political landscape.

Suppose the upper class decides to tax the middle class and to increase social subsidies for the lower class. Together, the new middle-and-lower class now represents 90% of the total population. You might think this will increase their joint power, but in fact, the value of any one member of the new equalized middle and lower class is now $-\log_2 0.9 = 0.15$. The value of a member of the upper class is unchanged. The new lower/middle class is very numerous, but even a 9/1 numerical majority is now not enough to counter the power of the dominant minority.

Further, suppose the middle and lower classes can be divided by many factors, including identity and political ideologies, hostile to each other. When there are many different groups fighting for power within the lower class, and the base of the logarithm function for that class, instead of the original 2, becomes a much larger number. Suppose the new number is 10. The value or power of a member of the new equalized middle and lower class is now $-\log_{10} 0.9 = 0.05$. This is a further reduction from the already diminished value after implementing the "equalizing" policy. The top dogs (who remain coherent) strengthen their control.

Divide and rule is effective. And fractious behavior is endemic to opposed elements within the population and (notoriously) to left-wing politics. The policy of fostering sectarian politics among the lower classes greatly reduces the political power of the majority. Meanwhile, power and wealth in society is consolidated into the hands of a small elite. This is how oligarchs rule.

Concluding remarks on entropy, evolution, and institutions

In traditional theory, economic power is said to distort the allocation of goods and services. For this to be meaningful, an undistorted allocation, or an equilibrium state, must exist to provide a reference point for distorted allocation. But what is an undistorted allocation? One thousand persons will have one thousand different answers. The reason is simple: there are no such "undistorted allocations" in the real world. One cannot easily describe that which does not exist and has never existed.

The entropy theory of value is a non-equilibrium theory. It provides a wholly different perspective on economic power. A non-equilibrium theory, as an evolutionary theory, does not predesignate an equilibrium state, or a state of undistorted allocation. Instead, the theory, with a simple logarithm function, outlines the main factors that affect economic power. This helps to understand the allocation of economic power in specific institutional structures. And it is intrinsic to the theory that the controlling variables – objective scarcity and monopoly power – tend to change over time. Innovations age; new ones take their place. Monopolies attract competitors; eventually they lose their edge. The defense of monopoly power often requires force, fraud, and violence. All of this is easily understood with an entropy theory.

Moreover, while there is a natural tendency for monopoly to decay over time as markets saturate and competitors emerge, there is an equal tendency for the cost of basic resources to rise as the most accessible deposits are discovered and depleted. This process threatens the profitability of advanced industries, which are built on specific sources of abundant resources, such as water, coal, oil, uranium, and natural gas. There is therefore an intensified struggle for control of resources, and a desperate search for new ways to obtain the abundant energy on which a complex civilization depends. In modern history, that search has often led to new and cheaper resources and improved living standards, at least for those who control resources. But this is not necessarily always the case, and the long run of human history is replete with counterexamples.

At any given state of resources and technologies, institutional policies can help the vulnerable with little economic power. This tends to happen, however, mainly when resources are abundant and widely available, so that it is not difficult for them to be shared. The early New Deal in the United States coincided with the discovery of oil in Texas and the harnessing of hydroelectric power, making possible employment programs that paved roads and built airfields, fostering new industries producing consumer goods, including trucks, automobiles and household appliances. The postwar years in North America and Europe were, similarly, years of energy abundance, aided by the spread of (and undue optimism about) nuclear power. But when oil prices started to rise, in the early 1970s, the welfare states fell into crisis, and the middle class into stagnation.

When resources become scarce, the dominant class serves its own interests before it attends to the vulnerable in its own society – let alone make concessions to other countries. In the era of global competition for resources, military and financial power have become paramount, leading to technological struggles for both military and financial advantage. But both military and financial technologies have the same problem: the monopolies they construct may become obsolete. At present, with the advent of hypersonic missiles and inexpensive drones, the balance of military power may be shifting toward those who produce resources, over those who consume them, and the balance of financial power may be shifting away from the American dollar and the institutions that feed on its monopoly power in global finance. This suggests that a crisis of economic power for the collective "West" may soon be at hand.

The first step toward tackling a problem is to recognize what the problem is, and to be able to speak of it in straightforward and realistic terms. The entropy theory of value provides such an approach to the problem of economic (and political) power.

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Appendix: Entropy, energy and economic power

From statistical mechanics

$$P(E) = \frac{1}{kT} e^{-E/_{kT}}$$

Here *P(E)* is the probability of an energy state, *E* is the energy level, k is the Boltzmann constant, and *T* is temperature. Equivalently, we can write

$$E = kT(-\ln(P(E)) + kT(-\ln(kT))$$

The second term in the above equation is a constant. We drop it to get

$$E \ \approx kT(-\ln(P)$$

We can imagine value is equivalent to energy. In this way,

$$V = kT(-\ln(P))$$

This is another way to derive the theory of value. This shows that understandings from entropy and energy are intimately related. Since power, including economic power, is closely related to energy, the entropy theory of value provides a natural description of economic power.

Figures

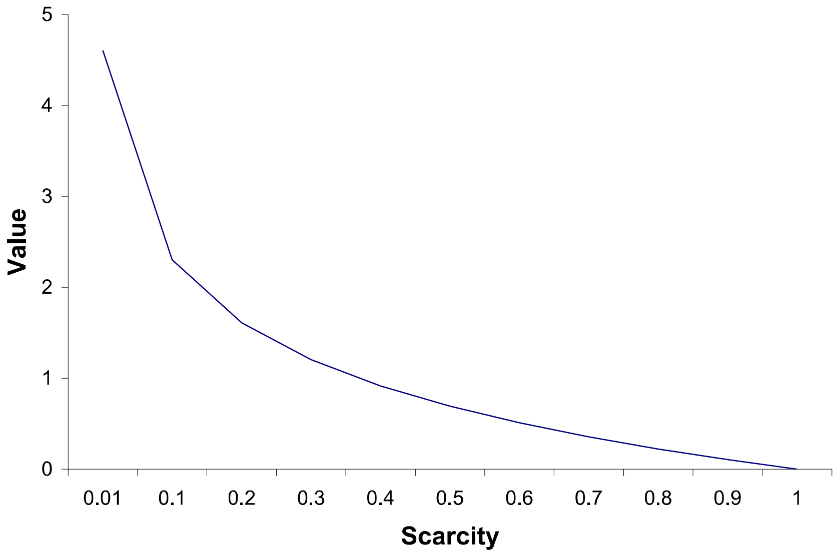

Figure 1. Value and scarcity

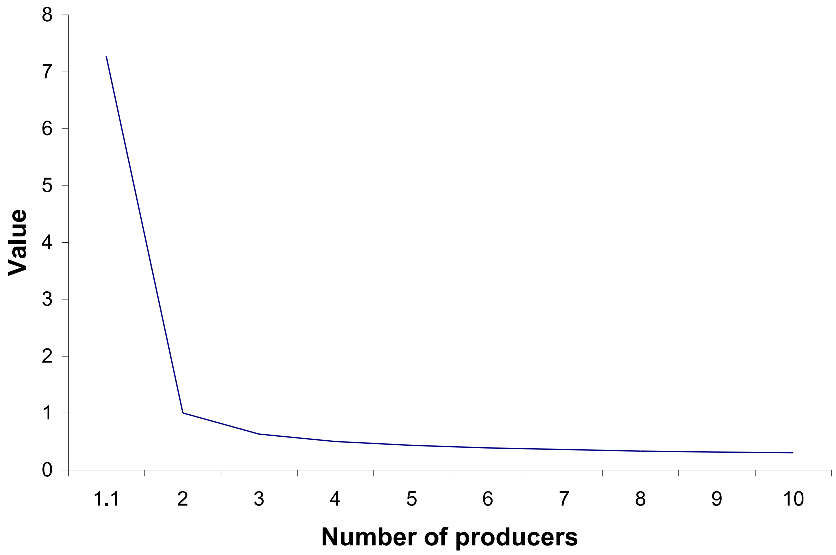

Figure 2. Value and the number of producers.

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