The Rational Foundation of Statistical Economics

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THE RATIONAL FOUNDATION OF STATISTICAL ECONOMICS

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ABSTRACT

Theoretical advances and understanding in economics has been hampered by an inability to formally aggregate what is known about individual utility to be able to describe the macro economy. This paper shows how to formally aggregate the subjective utility of Game Theory into a form similar to that of a Cobb-Douglas Production Function using a generalization of statistical mechanics.

This paper will then explore the consequences of this formal aggregation and show how traditional foundations of macroeconomics are theoretically incorrect, misrepresent the data, and how they can be reformulated.

Keywords: microeconomics, macroeconomics, game theory, information theory, statistical mechanics, thermodynamics

NOMENCLATURE

S	entropy of the group
s	entropy of the individual
U	utility of the group
u	utility of the individual
M	money supply
m	money held by the individual
N	number of individuals in the group
T	temperature
λ	marginal utility of money
μ	individual potential

1. INTRODUCTION

From a physical science perspective, the social sciences lack an entropic term in their mathematical expressions. This lack led the author to attempt to understand why this term was not included as it represents the measure of complexity of a system being described. Critiques of a formal mathematical representation center around the claims of determinism of physics don't apply to the indeterminism of human action. (von Mises, 1998) These critiques do not seek to understand how the determinism arises or what it describes.

Fundamentally, in physics what we are doing is looking at distributions of particles measured in phase space and applying information theory to estimate the maximum entropy distribution represented by all of the available data.[1] (Gibbs, 1902) This approach can actually be generalized into other fields as the thermodynamic methodology is fundamentally a methodology of statistical inference. (Jaynes, 1957)

This paper is divided into three parts. The first part is the derivation of the macroeconomic equation of state. The second part is the application of the theory on income distributions. The third part will explore the consequences of the second part.

2. MACROECONOMIC EQUATION OF STATE

The approach of the derivation of the macro equation of state will proceed in three parts. First, we describe our knowledge of an individual's utility function as a generic and as yet undetermined probability density function. Second, apply Jaynes' method of subjective reasoning to derive the equation of state. Finally, aggregate the individuals' utility functions using the properties of Information Theory.

2.1 GAME THEORY

Game Theory represents an expression of the outcomes of a game as a property of the game. (von Neumann & Morgenstern, 2004) vNM represent the probability of the outcomes under an ergodic framework, thus their approach is an objective one.

The ergodic condition was relaxed by J. Pfanzagl in 1968. (Pfanzagl, 1968) Pfanzagl, treated outcomes from a game as a

[1] While Gibbs does not explicitly state this, Information Theory was developed 46-years after he published, he uses the same mathematical approach as Shannon. Rather Shannon uses Gibbs' approach as identified by Jaynes. (Matsoukas, 2018)

set of events and used this to derive a subjective probability of the measure of the observed outcomes.[2]

We will use this knowledge of the outcome of a game and express it in terms of a continuous probability density function, $f(x)$. This density function need not be continuous. (Pfanzagl, 1968)

2.2 MAXIMUM-ENTROPY ESTIMATES

Following (Jaynes, 1957) we will define the probability density function as:

$$f(x) = e^{-\sum_i \beta_i \varphi_i(x)} \quad 2.1$$

where, $\varphi_i(x)$ are moments of $f(x)$, $\varphi_0(x) = 1$, and where β_i are Lagrangian multipliers that maximize the information entropy of the distribution with the system subject to the constraints,

$$\mathbb{E}[\varphi_i\,(x)] = \int dx\; \varphi_i\,(x) f(x) = a_i \quad 2.2$$

The expectation of the 0th moment must be 1, $a_0 = 1$. This is Jaynes' normalization constraint. (Jaynes, 1957) It is a more general statement of Gibbs' *conservation of extension-in-phase*. (Gibbs, 1902) The normalization constraint directly results in the partition function.

$$Z(\beta) = e^{\beta_0} = \int dx\; e^{-\sum_{i>0} \beta_i \varphi_i(x)} \quad 2.3$$

The remaining Lagrangian multipliers can be determined from

$$\mathbb{E}[\varphi_i\,(x)] = -\frac{\partial}{\partial \beta_i}\ln(\mathrm{Z}) = -\frac{\partial \beta_0}{\partial \beta_i} \quad 2.4$$

The resulting entropy of the individual's demonstrated utility is

$$s = \sum_i \beta_i a_i \quad 2.5$$

2.3 GROUP ENTROPY

Before proceeding with the group aggregation, we need to assume logical independence of each individual's utility. This assumption has a physical meaning of the freedom of individual choice. There is no mind control. This assumption is a maximum entropy assumption as any forced or coercive acts will reduce the choice of action of the individual, thus the allowed states and associated individual complexity. (von Mises, 1998) as (Jaynes, 1957) notes, the assumption of the principle of maximum entropy is Laplace's "principle of insufficient reason".

Mathematically this results in the group density function, $F(X)$, being separable in $x_j \;\forall\; x_j \in X$.

$$F(X) = \prod_j f_j(x_j) \quad 2.6$$

By definition

$$S = \int dX\, F(X) \ln[F(X)] \quad 2.7$$

Due to the normalization constraint and the logical independence of the actors, equation 2.7 reduces to

$$S = \sum_j s_j \quad 2.8$$

At this point, no assumptions have been made outside of the nature of the individual utility other than each individual's expression of freedom to choose. Thus equation 2.8 formally represents a *complete* group utility function. It is not however very tractable. To make it tractable we need to assume Rawls' veil of ignorance. (Rawls, 1971) "This ensures that no one is advantaged in the choice of principles by the outcome of natural chance or the contingency of social circumstances." (Rawls, 1971) Rawls needs to be extended as he did not take the veil of ignorance far enough. The veil needs to be extended across time. What this means is that not only does one not know who they can choose in a society, but that they also cannot pick at what point in an individual's life they can choose. This interpretation of the veil effectively states that each of us given a similar set of circumstances and experience would make a similar set of choices and results in

$$S = Ns \quad 2.9$$

This result has profound implications to Rawls philosophy. Rawls maintains that under the veil of ignorance, the individual would choose two guiding principles: equality in rights and duties, "while the second holds that social and economic inequalities, for example inequalities of wealth and authority, are just only if they result in compensating benefits for everyone, and in particular for the least advantaged of society." (Rawls, 1971) He continues stating that a doctrine of justice as fairness is the correct, which he extends equivalent rights to animals and nature in our treatment. He defines this position of justice is that these inequalities are only permitted if the worst off will be better off than they might be under equal distribution.

"All social values-liberty and opportunity, income and wealth, and the bases of self-respect–are to be distributed equally unless an unequal distribution of any, or all, of these values is to everyone's advantage." (Rawls, 1971) He clarifies this position that those of greater means should have a reduction in their freedoms. Nozick countered this specific point with his "tale of the slave". (Nozick, 1974)

What Rawls missed is the origins of inequality come from individual choice, equation 2.9, and that under his theory of justice he drops his veil of ignorance arguing that those of means should incrementally give up their freedom in exchange for wealth. Nozick rightly points out that those people are no different than slaves. If the veil is maintained in Rawls' quote from the above paragraph, the distributive justice becomes one whereby allowing the greatest choice works toward everyone's advantage. Thus, the point of equality of outcome and the

[2] What is notable here is that Pfanzagl's axiomatic derivation of subjective probability closely mirrors that of Jaynes. (Jaynes, Probability Theory the Logic of Science, 2003) While it is uncertain if Jaynes was aware of Pfanzagl's work, the similarity remains interesting especially considering Jaynes' work in probability theory.

equality of rights are incompatible. The rights to which I am referring to here are those which are minimally assumed under the veil of ignorance, essentially an adaptation of Jefferson's, "…life, liberty, and the pursuit of [meaning]."

3. APPLICATION TO INCOME DISTRIBUTIONS

In the discussion of income distributions there are two main distributions to consider. The first is the lognormal distribution, which governs the "thermal" region and the Pareto distribution that governs the "epithermal" region. This is a similar differentiation of the income distribution to what has been done elsewhere, where other authors used the exponential distribution in the thermal region. (Banerjee & Yakovenko, 2010) The primary difference between the two distributions is that below the median of the lognormal the distribution behaves like a gamma distribution, while above the median value it behaves as an exponential distribution. Thus, for lower incomes the lognormal provides a more accurate representation of the observed data capturing the entire thermal region. While for looking at the entire distribution the method of (Banerjee & Yakovenko, 2010) provides a more complete picture capturing the upper 3% of the distribution. For the purposes of this paper, the focus will be on the thermal region.

A note on terminology, the author's background is in nuclear engineering. When talking about populations of neutrons in the context of reactors, there are several groupings of neutrons based on their associated energies, first the thermal neutrons, which are in thermal equilibrium with their surroundings have an average energy of about 0.025eV per neutron, the group that is immediately above the thermal region are called epithermal and range somewhere up to thousands of eV (the exact definition is arbitrary). When we are looking at income distributions, the order of magnitude of the highest tax return to the average tax return has about the same difference on a log scale, and a roughly linear energy profile on a log-log chart.

The remainder of this paper will focus only on the thermal population. Additional discussions on the transition to the epithermal region will be fruitful but are beyond the objective of this initial paper.

3.1 UNIVARIATE LOGNORMAL IN A STATISTICAL MECHANICS FRAMEWORK

We begin by setting the moment vector for the univariate case

$$\varphi(u) = \begin{bmatrix} 1 \\ \ln(u) \\ \ln(u)^2 \end{bmatrix} \tag{3.1}$$

Placing equation 3.1 in equation 2.3 results in the log of the partition function as

$$\beta_0 = \frac{1}{2}\ln\left(\frac{\pi}{\beta_2}\right) + \frac{(\beta_1 - 1)^2}{4\beta_2} \tag{3.2}$$

With a corresponding gradient of

$$-\nabla\beta_0 = \begin{bmatrix} 1 \\ \dfrac{(1-\beta_1)}{2\beta_2} \\ \dfrac{1}{2\beta_2} + \dfrac{(\beta_1 - 1)^2}{4{\beta_2}^2} \end{bmatrix} \tag{3.3}$$

We set the moment constraints as

$$\mathbb{E}[\varphi(u)] = \begin{bmatrix} 1 \\ \mu \\ \mu^2 + \sigma^2 \end{bmatrix} \tag{3.4}$$

Solving equation 2.4 results in the Lagrangian multiplier vector of

$$\beta = \begin{bmatrix} \frac{1}{2}\ln(2\pi\sigma^2) \\ 1 - \dfrac{\mu}{\sigma^2} \\ \dfrac{1}{2\sigma^2} \end{bmatrix} \tag{3.5}$$

Recalling

$$\langle u \rangle = e^{\mu + \frac{\sigma^2}{2}} \tag{3.6}$$

The entropy becomes

$$s = \frac{1}{2}\ln\left(2\pi e\sigma^2 e^{-\sigma^2}\right) + \alpha\ln(\langle u \rangle) \tag{3.7}$$

Where α is determined through the law of fluctuations

$$-\frac{\partial^2 s}{\partial\langle u \rangle^2} = \frac{\alpha}{\langle u \rangle^2} = \frac{1}{Var(u)} \tag{3.8}$$

Looking at the extrema of equation 3.7 shows that the entropy is unbounded for $\langle u \rangle$ and unbounded negative for σ^2 as it approaches 0 or ∞. Note, the boundary condition of Rawls discussed in 2.3 represents the case of $\sigma^2 \to \infty$. There is however a maximum entropy for $\sigma^2 = 1$ which corresponds to a $Gini \approx 0.531$. For the log normal distribution as σ^2 is the only parameter that affects the distribution's shape.

$$\frac{\partial s}{\partial \sigma^2} = e^{-\sigma^2}(1 - \sigma^2) = 0$$

3.2 MULTIVARIATE CASE

We continue with the methodology of the univariate case and apply it to the multivariate

$$X = [x_1 \quad \cdots \quad x_k]$$
$$\boldsymbol{\mu} = [\mu_1 \quad \cdots \quad \mu_k]$$

$$\varphi(X) = \begin{bmatrix} 1 \\ \ln(X) \\ \ln(X)\ln(X) \end{bmatrix} \tag{3.9}$$

$$\mathbb{E}[\varphi(X)] = \begin{bmatrix} 1 \\ \boldsymbol{\mu} \\ \mu_i\mu_j + {\sigma_{i,j}}^2 \end{bmatrix} \tag{3.10}$$

Because $\ln(x_i)\ln(x_j) = \ln(x_j)\ln(x_i)$, the duplicates are excluded. For the bivariate case, equations 3.9 and 3.10 become

$$\varphi(X) = \begin{bmatrix} 1 \\ \ln(x_1) \\ \ln(x_2) \\ \ln(x_1)^2 \\ \ln(x_1)\ln(x_2) \\ \ln(x_2)^2 \end{bmatrix}$$

$$\mathbb{E}[\varphi(X)] = \begin{bmatrix} 1 \\ \mu_1 \\ \mu_2 \\ {\mu_1}^2 + {\sigma_{1,1}}^2 \\ \mu_1\mu_2 + {\sigma_{1,2}}^2 \\ {\mu_2}^2 + {\sigma_{2,2}}^2 \end{bmatrix}$$

The resulting entropy is

$$s = \frac{1}{2}\ln\left((2\pi e)^k |\Sigma| e^{-Tr(\Sigma)}\right) + \sum_{i=1}^{k} \alpha_i \ln(\langle x_i \rangle) \qquad 3.11$$

4. CONSEQUENCES

Equation 3.11 has a similar form as that of the Cobb-Douglas production function, (Brown, 2016) it is also represents a generic ideal gas equation of state. (Callen, 1985) With regards to the Cobb-Douglas utility function it is clear to see that no effort has been made to look into the underlying complexity (entropy) of the system. Traditional neoclassical economics makes an implicit assumption that all processes are isentropic at best or where entropy is completely neglected at worst. The Cobb-Douglas is a common exemplar of this trend. It is no wonder that economics as a science has been hampered in its mathematical formalism and that (von Mises, 1998) critique of quantitative economics as a pseudo-science "scientism" was correct. As we showed in section 3, entropy in human society is driven entirely by individual choice. The science dedicated to the quantitative study of individual choice fundamentally neglects choice in its formalism.

Before proceeding further, we need to take a step back and consider what has been done. We have based our mathematical formalism on formal micro foundations using subjective probability theory. This means that rationality has a new and formal mathematical definition. *Rational economic activity is only that activity which can be observed*. The preference which we are studying is *demonstrated* preference. We have removed the value judgements about what is and is not rational. Utility is incredibly complex and is subject to an uncountable set of prior conditions that govern each individual's choice. It is only by arrogance that we presume to judge another individual's actions as being irrational. Paraphrasing Jordan Perterson, "If you can't see yourself as a concentration camp prison guard, then you don't know yourself very well… those guards were people just like you."

Real people did all of the terrible things in the 20th century. Those people were human just as we are human today. Unless we seek to understand why they did it, we will be doomed to repeat it. Because we are human and that action has been demonstrated in our past, we are more than capable of it today. The implication of the earlier extension of the veil of ignorance across time is a much more humble position than Rawls original veil. With the extension across time we can see within each of ourselves the capacity of both the tremendous nobility and evil that is within our capacity. The integration across time is also a maximum entropy assumption and one that effectively integrates Jung's shadow. (Jung, 1970)

While the theory presented here resolves much of the mathematical problems that have plagued economics, solving that set of problems doesn't mean we can now engineer society. Hayek noted, "The peculiar character of the problem of a rational economic order is determined precisely by the fact that the knowledge of the circumstances of which we must make use never exists in concentrated or integrated form but solely as the dispersed bits of incomplete and frequently contradictory knowledge which all the separate individuals possess." (Hayek, 1945) This is similar to what we experience in physics when we go from a detailed knowledge of particles in a microstate our ability to completely describe the system rapidly becomes intractable after only a few particles. When we go from knowledge of the individual to the group, we have to give up all of that detailed information. As we aggregate, we know less, but gain knowledge of the system as a whole. Additionally, properties, laws, emerge once the aggregation occurs, things that are invisible to the microstate are patent in the macrostate. This supports Hayek's observation of the law of a society as being an emergent phenomena, not enforced edicts of legislation which are not necessarily congruent with the emergent law. (Hayek F. A., 1973)

4.1 REFORMULATING UTILITY

Conventional economic observations while not correct, are not entirely incorrect either. Once armed with the proper theoretical footing one can construct models from the probability density functions of the data. These statistical models closely mirror those found in orthodox economics. The economists that developed their original models weren't entirely wrong in their observations and had made significant and profound insights into human action.

We will make a simple model of a society using equation 3.11. By using this equation, we are only looking at the part of society that is in thermal equilibrium. This means that we are neglecting payments to capital and are only examining payments to labor. Furthermore, we will only look at two factors, income and the total money supply resulting in,

$$s = s_0 + c\ln(\langle u \rangle) + R\ln(\langle m \rangle) \qquad 4.1$$

Which when extended to the society becomes,

$$S = Ns_0 + Nc \ln\left(\frac{U}{U_0}\right) + NR \ln\left(\frac{M}{M_0}\right) - N(c+R)\ln\left(\frac{N}{N_0}\right) \quad 4.2$$

And can be represented as

$$U = U_0 e^{\frac{s-s_0}{c}} \left(\frac{M}{M_0}\right)^{-\frac{R}{c}} \left(\frac{N}{N_0}\right)^{1+\frac{R}{c}} \quad 4.3$$

where

$$s_0 = \frac{1}{2}\ln\left((2\pi e)^k |\Sigma| e^{-Tr(\Sigma)}\right)$$

$$N_0 = 1, U_0 = 1, M_0 = 1$$

Taking some useful derivatives,

$$\frac{\partial S}{\partial U} = \frac{Nc}{U} = \frac{c}{\langle u \rangle} = \frac{1}{T}$$

$$\langle u \rangle = cT \quad 4.4$$

$$\lambda = \frac{\partial U}{\partial M} = \frac{RU}{cM} \quad 4.5$$

When combined with equation 4.4 becomes

$$\lambda M = NRT \quad 4.6$$

We can also derive the familiar polytropic relationship

$$\lambda M^n = Const \quad 4.7$$

Which for an isentropic process will have,

$$n = \gamma = 1 + \frac{R}{c}$$

Continuing

$$\mu = \frac{\partial U}{\partial N} = \frac{\gamma U}{N} = (c+R)T \quad 4.8$$

We have now defined the marginal utility of money, equation 4.5, and the marginal utility of the individual, or rather the individual's economic potential, equation 4.8.

Attempts have been made to provide an absolute reference to the marginal utility of money – economists use different deflators, such as Gross Domestic Product, GDP or Consumer Price Index, CPI, but these are fundamentally flawed measures. If economics is the study of human action, why not adopt the unit of action for the physical world, especially considering that the economic world is embedded in the physical world, and that energy is the measure of action in the physical world, it is only natural to adopt those absolute units to measure utility.

With utility now measured in absolute terms, the impact of various monetary policies can be explored through equations 4.6 and 4.7. Monetary expansion can be seen as extractive on the thermal portion of the population, which represents ~97% of the people. (Banerjee & Yakovenko, 2010) Lowering economic activity is not stimulative, it is extractive. In engineering, we extract work from gases by subjugating the system to a controlled expansion. We extract energy from the system to be used elsewhere. The question here is, where is the utility that is extracted transferred to, or is it simply dissipated to the environment (destruction of useful work, aka exergy).

One line of reasoning is to explore the question, *qui bono*? How the money supply is expanded is through controlling interest rates relative to the natural interest rate. Thus, if the interest rate is below the natural interest rate (a measure of the future time preference) then those who have access to those rates will have access to the money first before it diffuses into the society. Much like counterfeiting, the money when injected into the economy in this way benefits those who have it first. (Banerjee & Yakovenko, 2010) show this exact impact in the expansion that lead up to the .com bubble and the housing bubbles. Whether the source of monetary expansion is from mining, e.g. California Gold Rush, (Friedman & Schwatz, 1963) legal monetary expansion, QE, or illegal monetary expansion, counterfeiting, the impact on the thermal portion of society is equivalent.

Another social impact is that economic mobility will be reduced. Those that who already have access to these favorable loans have a limited downside risk as they are able to offset the natural loss of speculative bets and cause a misallocation of capital into those bets that result in the greatest spread. (von Mises, 1998)

4.2 SUBJECTIVITY AND OBJECTIVITY

Up to this point, the implications of the subjective approach have not been justified or elaborated upon. (Jaynes, 1957) identifies two modes of reasoning that are irreconcilable, subjectivity and objectivity and notes that both of these forms result in equivalent mathematical expressions. (McGilchrist, 2009) extensively details how these two lines of reasoning are embodied in the two hemispheres of the brain, with the right hemisphere specializing in subjective reasoning and the left with objective reasoning. This specialization even crosses species boundaries, with the left being the hemisphere of specific attention and the right being of being alert to the unknown.

McGilchrist notes that the progression of human experience proceeds along the following trajectory:

1. An event is first experienced.
2. The experience becomes subjectively embodied.
3. The embodiment is objectified to assess patterns and utility.
4. The objective model is returned to the subjective to provide a more integrated understanding of the world.

It is in this pattern that McGilchrist identifies the "master" as being the subjective mind and the emissary, the objective. He also identifies that pattern by which the objective hijacks the dialog by providing dialog and argument suppressing the subjective voice. He notes that the objective mind is always sure of its constructs even if those constructs are not supported by evidence, which is why the interplay between the two forms of reasoning is so critical. If objective thought cannot be reconciled with subjective experience, then the objective thought is wrong.

Postmodern thinking, e.g. Derrida's "deconstruction", adopts a position similar to that of Laplace's "Principle of Insufficient Reasoning". Rawls approach is similarly rooted in the postmodern approach (Beggs, 1999) which can be seen with his application of the veil of ignorance. What is not done with these philosophies is the return of the objective reasoning to be tested by subjective experience. When this is done, as shown in section 3, the philosophies become self-contradictory.

4.3 THE ROLE OF ENTROPY IN SOCIETY

Earlier entropy was discussed as being a measure of a system's complexity. This language prevents a considerable amount of confusion that has surrounded entropy. von Neumann famously even told Shannon that if he used the word entropy, nobody would know what he was talking about. That is not the objective here. In basic thermodynamic courses, entropy is first explained to the budding engineers as being a measure of disorder. This has led to entropy being thought of as something that must be fought. (Rifkin & Howard, 1980)

In engineering, we are taught that for a reaction to occur spontaneously [without coercion/outside force], it must progress towards a state of higher entropy. This can be seen in approximations of chemical reactions where the law of mass action shows that for a higher reaction entropy gradient, the faster the rate constant of the reaction. Conversely, in systems where entropy decreases, useful work must be expended to cause the local entropy of the system to decrease.

By assuming a maximum entropy state, what we are doing is providing a theoretical ideal that based on what we know we are providing an absolute measure with which to measure what we see. In situations where the mathematical ideal is not attained, then something structural or systemic is preventing that ideal from being realized.

Before entropy can be applied in public policy realms, we need to make a normative statement about its nature. The purpose of showing how Rawls contradicts his own principles, is that in public policy, Rawls theory of justice is the guiding theory for assessing the normative basis of policy. Stating the orthodox governing philosophy of political science is self-contradictory and must be discarded and not offer a replacement is lazy and dangerous.

If the nature of the universe is to progress toward states of greater complexity, who are we to assume that we know better than the sum of being that this is not "natural" or "good". What measure of information can we offer that would justify such a claim? It is important to note this is not a rhetorical question, claims are all testable against the sum of our experience. It is here that post-modernism fails. All possibilities are no longer equally possible when we test them against our experience. The post moderns start by assuming a uniform prior, but then say that that is sufficient and we need not be concerned about the available information and the resultant posterior from the convolution of the data and the prior. Priors are nothing but assumptions about how the world works, assuming the least is often the humblest and least presumptive approach. But the neglect that the convolution of the uninformed prior with the observed data is assuming too much and is very presumptive and arrogant.

Policies that reduce social complexity, e.g. segregation and other discriminatory practices should be shunned and formally removed. Tail risk services, such as the law enforcement/legal system and defense spending protect against internal and external forces respectively that can cause a society to suffer a loss of entropy. If a society is rampant with theft, an individual is hesitant to enter into relationships where they can be stolen from because the risk of loss of personal entropy from theft outweighs the potential gain of entropy through the interaction. This is the political science version of the law of mass action.

Rules that reduce societal entropy should be repealed. Not only do they reduce social complexity, but they also require the destruction of wealth in order to enforce them. Whether a rule is on the books or not, what only matters is the enforcement – the demonstrated preference of policy. Enforcement is the actual constraint on the system.

Letting the maximization of social entropy as being the goal of public policy – its formal "good", we have a new normative basis by which to judge and measure our policy choices. It results in a principle where the least amount of resources are expended to ensure that the people are the freest that they can be. Flourishing can be considered the increase in the set of possible choices open for an individual given their constraints.

5. CONCLUSION

What this paper does is to fundamentally to test the purely objective thinking of modern economic and social theories, against the subjective basis of their foundations. It shows how and where orthodox economic thought and philosophies fall short.

If we as a society are to move forward, we must return our objective reasoning to our embodied subjective experience. This paper was an attempt to show how this can be done formally.

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REFERENCES

Abel, C. (2020). Generalizing Statistical Mechanics. *International Conference on Thermodynamics 2.0.* Woscheter: International Association for the Integration of Science and Engineering.

Banerjee, A., & Yakovenko, V. M. (2010). Universal Patterns of Inequality. *New Journal of Physics, 12*.

Beggs, D. (1999, April). Rawls's Political Postmodernism. *Continental Philosophy Review, 32*(2), 123-141.

Brown, M. (2016). *The New Palgrave Dictionary of Economics.* Springer.

Callen, H. B. (1985). *Thermodynamics and an introduction to Thermostatistics.* John Wiley & Sons.

Friedman, M., & Schwatz, A. J. (1963). *A Monetary History of the United States 1867-1960.* Princeton: Princeton University Press.

Gibbs, J. W. (1902). *Elementary Principles in Statistical Mechanics Developed with Especial Reference to the Rational Foundation of Thermodynamics.* New York: Charles Scribner's Sons.

Hayek, F. A. (1945). The Use of Knowledge in Society. *American Economic Review, XXXV*(4), 519-530.

Hayek, F. A. (1973). *Law Legislation and Liberty.* Chicacog: The University of Chicago Press.

Jaynes, E. T. (1957). Information Theory and Statistical Mechanics. *The Physical Review*, 620-630.

Jaynes, E. T. (2003). *Probability Theory the Logic of Science.* New York: Cambridge University Press.

Jung, C. G. (1970). Psychology and Religion. In C. G. Jung, *Psychology and Religion: West and East* (p. 131). Princeton, NJ: Princeton University Press.

Matsoukas, T. (2018). *Generalized Statistical Thermodynamics Thermodynamics of Probability Distributions and Stochastic Processes.* University Park, PA, USA: Springer.

McGilchrist, I. (2009). *The Master and His Emissary.* New Haven: Yale University Press.

Nozick, R. (1974). *Anarchy, State, and Utopia.* New York: Basic books.

Pfanzagl, J. (1968). *Theory of Measurement.* New York: John Wiley & Sons.

Rawls, J. (1971). *A Theory of Justice.* Cambridge, MA, USA: Belknap Press.

Rifkin, J., & Howard, T. (1980). *Entropy: A New World View.* New York: Viking Press.

von Mises, L. (1998). *Human Action.* Auburn: The Ludwig von Mises Institute.

von Neumann, J., & Morgenstern, O. (2004). *Theory of Games and Economic Behavior.* Princeton, NJ, USA: Princeton University Press.