A THERMODYNAMIC APPROACH OF ECONOMICS

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ABSTRACT

Thermodynamics and Economics analogies are not new [1]. However, only recently has a new approach been introduced to explore this analogy [1,2]. The economic analog of the First Law is expressed through the units of merchandise and money balance equations, similar to the First Law of Thermodynamics expressed through the energy balance equation [1]. Taking as the analog of spontaneous heat transfer in the decreasing temperature direction, driven by a temperature difference, the *spontaneous* merchandise transfer in the increasing unit price difference, driven by a unit price difference, allows setting the Economics analog of entropy and of the Second Law. Entropy is defined through the differential expression as $dS \equiv (\delta Q/T)_{\text{int rev}}$, and the economic entropy is defined similarly through the differential expression as $dS_E \equiv (\delta M/T_E)_{\text{int rev}} = (\delta M \cdot p)_{\text{int rev}}$.

Entropy is generated in heat transfer Q through a finite temperature difference $(T_1 - T_2) > 0$, and it is $S_g = Q(1/T_2 - 1/T_1) > 0$. Similarly, economic entropy (financial value) is generated in merchandise transfer M through a finite unit price difference $(p_2 - p_1) > 0$, and it is $S_{E,g} = M(1/T_{E,2} - 1/T_{E,1}) = M(p_2 - p_1) > 0$, easily identified as the profit generation (financial value generation) in the trading operation of merchandise *M*, purchased at unit price p_1 and sold at the unit price $p_2 > p_1$. Defining the economic temperature as the inverse of the merchandise unit price, $T_E = 1/p$, merchandise transfer occurs *spontaneously* in the decreasing economic temperature direction. With that in mind, developments can be made starting from the first principles which are the economic analogs of the Kelvin-Planck and Clausious statements of the Second Law, to set a Four Laws structure for Economics similar to that well-established in Thermodynamics [2].

The economic analog of the Carnot cycle, and cycles arbitrary in terms of reversibility can be introduced in Economics, as illustrated in Fig. 1 (right), which allows obtaining merchandise wealth W_M (merchandise at an infinite economic temperature, or a null unit price), the reversible economic operation having null economic entropy generation (null financial value generation). This similarly to what is made in Thermodynamics, the Carnot cycle, and cycles arbitrary in terms of reversibility as illustrated in Fig. 1 (left), allowing obtaining mechanical work W (which can be seen as heat at an infinite), the reversible operation having null economic generation.

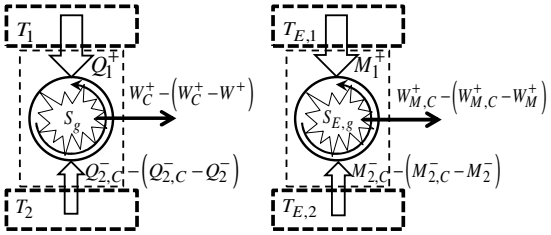

Fig. 1. Cycles arbitrary in terms of reversibility: (left) In Thermodynamics; and (right) In Economics.

Relevant and challenging results can be obtained and reflections made, allowing different and innovative approaches to both, Economics and Thermodynamics. In Thermodynamics, the first analyses are based on First Law (balance) principles, and the Second Law results are a consequence of that. In Economics, the first analyses are based on Second Law (financial value) principles, and actions, of First Law nature, are a consequence of that. Only specialists are prepared to conduct Thermodynamics Second Law analyses, but everyone has experience and expertise and is thus a *specialist*, in conducting Economics Second Law analyses (financial analyses, and mental calculation of the economic entropy flows and economic entropy generation). A natural (Physics) law states that heat flows spontaneously in the decreasing temperature direction, and government laws state that merchandises (must!) flow *spontaneously* in the decreasing economic temperature direction (in the increasing unit price direction) in trading operations.

REFERENCES

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