Modeling hybrid economic systems - money and tokens as incentives for sustainable consumption

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In the modern context of an acute need for sustainability, the focus shifts more toward the empowerment of smaller communities than ever. Acting at a local level to help communities fight global crises like climate change is becoming an overarching goal. Risk assessment and the detailed business analysis of small and medium businesses become paramount puzzle pieces in the big picture of sustainable consumption and sustainable economic growth. Economic markets are complex systems and while their development is inherently hard to predict, econophysics offers a way to model simplified systems and still retain their main features for analysis. In this paper, we propose a chemical model that describes a wide range of market configurations involving both money and tokens for the incentivisation of sustainable consumption. Our aim is to provide a method for investigating the stability of hybrid economic systems (money and incentivising elements) in order to facilitate sustainable market interactions and sustainable business decisions. The modeling method involves the mapping of market interactions (between producers and customers) onto a sequence of chemical reactions. The mapping involves also a detailed equivalence between physical quantities e.g. steric factor or activation energy and economic concepts e.g. information available to customers or customer preference. The change in time of the concentrations of the chemical reactants is described by a set of ordinary differential equations. Solving the equations provides information on the stability of the system and describes the space of possible market configurations. The model itself is meant to simplify the complexity of the economic market by mapping it onto chemical equations. The mathematical analysis (as a next step) comes to help evolve the obtained system and when mapping the results back onto the economy, we find that we retrieve a considerable amount of detail of the real complex economic situation, making the modeling strategy general enough to be manageable and detailed enough to provide valuable insights for specific situations. Hence, the proposed chemical model reveals the stability of a business model and the optimal price correlation of goods that would ensure that the incentivizing tokens are efficiently used. It also offers an overview of the wide landscape of possible ways an economic system can develop (and the choices the customers have), of ways to devise business strategies to avoid certain outcomes, and identify the desired trading patterns. The modeling of economic systems through chemical reactions is an effective tool for scientific discovery in economics as it allows for reaching precise conclusions, not obvious at the beginning of the modeling process from an economic point of view. The theoretical model described in this paper is providing the basis for further empirical research.