The Sociology of Systemic Risk in the Global Economy: A Study Combining Systems and Network Theory, Mathematical and Computer Models and an Analysis of Intermediaries in Transactions

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Statement of Research

The premise of this research is that modeling, mathematical, and analytical tools and frameworks used to understand chemical and physical processes may also provide new insight into business and social phenomena. A specific case for testing this premise is the role of the middleman function in social and business transactions. Based on a quick preliminary review of the literature, this research seems to combine elements of the following established research areas and disciplines: Systems theory and systems dynamics; from sociology, bio-economics and agent-based modeling, from finance, financial intermediation; from computer sciences, computer modeling and network theory; and from engineering process engineering and control systems.

Elaborate systems dynamic models are being developed to analyze behavior states as vague and amorphous as "happiness," [1]. It has been suggested, for example, that "happiness adapts to its initial level after a life event according to classic dynamic equilibrium theory." Equilibrium disturbances such as a pay raise, marriage, and a car accident are modeled and analyzed. Similarly, evolutionary biologists, sociologists, bio-economists, and social observers have proposed a "theory of the ethnically homogeneous middleman group as a club-like institution for contract enforcement." [2]

Problems in global finance have reached epic and crisis proportions. As a result of perceived excesses on the part of investment and bank management, waves of populism are crashing into the political arena. The wholesale notions of trading, deal-making, exchanges, derivatives, and other financial transactions are being called into question. As during past similar episodes, so-called "middlemen" are likely to be held out as responsible for the crises [3]. It is instructive, therefore, to determine how new levels of insight can be gained into the role of the middleman function in financial engineering and investments. Here, the middleman function is broadly defined as a continuum from an agent between two parties conducting a transaction (e.g., a real estate agent) to what the phrase "Wall Street" represents today in terms of investment houses and financial intermediaries.

Social and business transactions are often characterized by competition and cooperation to achieve goals and objectives. More often than not, a hybrid of the two is what occurs, sometimes called co-opetition. Likewise, the middleman functions in a positive way to make a transaction more efficient. When a middle function adds value to the transaction, then it is appropriate for the middle function to be compensated "from the deal." However, in individual transactions and in long-wave business cycles, it is clear that the middleman function gets out of control, and compensation is made with no value being added. At some point, the function transforms from one of creating real additional value for the two parties, to one of inflating value by artificial means. Bubble periods and irrational exuberance in markets are clearly characterized by agents and market participants extracting compensation that has no underlying correlation to real value. For example, in stock market parlance, such phenomenon has been called "pump and dump." In a recent *Wall Street Journal* article, the behavior has been described as "It's an old Wall Street ploy—pitch a dream and use the premium valuation to do deals." [4]

The objective of this research is to apply analogs from process engineering and control (as well as from the sciences in general) to the role of the middleman in social and business transactions. The following represents only a few of the characteristics and potential outcomes of this research:

- In addition to financial intermediaries, the role of mathematical modelers, or "quants," is also being scrutinized in today's financial crisis. [5] An emerging area of inquiry is the extent to which financial modelers understand the limitations of their models, or ignored what standard error analysis, prevalent in engineering and the sciences, could tell them about the accuracy of their models. In a few academic halls, the idea of applying rigorous error analysis to financial models and the valuation of investments is beginning to emerge. [6] The application of such engineering methodologies could potentially transform finance and investment. Just like pollsters report the "margin of error" in the results, imagine if financial advisors had to deliver an uncertainties or error analysis report attached to every prospectus or offering! The relationship of quants to intermediaries is critical because the sophisticated quantitative analysis of an investment is often part and parcel of the "pitch."

- Chemical processes must be tightly controlled; otherwise, the products of the chemical reaction will drift or rapidly redirect towards unintended compounds. Concentration of inputs, temperature, catalysis, pressure, injection rates, and many other variables are involved. Likewise, many variables, obviously far more difficult to identify and quantify, are involved in a business or social transaction. And the "economy" is made up of the millions upon millions of transactions that occur every minute, just like the "process" depends on the almost infinite number of molecular interactions among the inputs to the chemical reaction. Still, if a process can be controlled at the macro level through intelligent control system design and operation, then it seems to follow that transformation from real to artificial value could be identified and arrested through analogous process design and control principles.

Process engineering and control should be useful, for example, in identifying at what point and under what conditions a Macro agent in the economy, such as "financial firms" (or Wall Street) is driving the process (e.g., economy) towards unhealthy states. Some of the qualitative work from the bio-economics arena could possibly be quantified and modeled to reveal what might be optimum levels of intermediaries participating in the economy, or what level of intermediary participation drives macro-level transactions (e.g., the economy) towards bubble-like conditions.

- Special types of middlemen can be defined. One might be called a speculator, who has no interest in adding real value to the transaction or in making the transaction more efficient, but instead is motivated purely by money. The speculator can be considered an agent who acts within his or her legal rights but drives the transaction towards an unethical or immoral direction. Another type of middleman is one who may not have any allegiance or feeling for either party to the transaction, or worse, harbors a social or cultural grudge against one or both of the "parties." It has been pointed out many times that so called societal "outsiders" often perform middleman functions in business and social transactions. Obviously, it may be difficult to identify and quantify the social, ethnic, and cultural norms that lead to such middlemen. However, from a process engineering point of view, a convenient analog is the concept of catalysis.

  A catalyst, with an often inexplicable scientific basis, drives a chemical reaction towards a new state or more quickly to the same state. It "promotes" the reaction without being part of the reaction. It can be said that a middleman or speculator drives a transaction towards a different state (perhaps one with increased artificial value as perceived by the transacting parties) or certainly is motivated to drive towards the same state more quickly. Middlemen are compensated when the "deal" closes so accelerating towards closing and closing more and more deals are the means by which middleman acquire wealth. When the transaction ends, the middleman usually exits the transaction and the counterparties are left to manage the aftermath. The research proposed here suggests that applying the concept of catalysis to transactional behavior could offer fresh insight into how middlemen and intermediaries affect financial and economic performance.

- Transactions involve not only middlemen functions but intermediaries, who monitor firms and transactions and provide oversight [7] on behalf of investors to ostensibly reduce risk. Like the situation with middlemen, however, intermediaries are involved in the allocation of capital and are critical to economic development, but can also inhibit or even destroy it. When do such intermediaries cross the line from managing and reducing risk to accelerating it? Noting today's crises, another form of the question might be, when does the collapse of the economy result from the failure of the intermediaries (financial firms) first, which then precipitates the decline or failure of firms, investors and their portfolios, and government which depends on tax receipts

to function. Systems dynamics, of which process engineering and control is a subset, could be the appropriate framework for gaining insight.

As one of many examples, a basic input-output analysis of the change in mortgage quality going as i*nput* to the financial system and the change in value and performance of the *output* collateralized debt obligations. More importantly, a more robust system dynamics model would have also accounted for the willingness of "quants" or managers inside these intermediary firms to either accept what the models were telling them or communicate same to decision-makers.

- In a simplistic way, debt and energy are two of the most critical inputs to financial performance. This author's soon to be published white paper [8], the long run of global economic growth can be said to have been created by (1) low cost debt fueled consumption in the world's largest economy (United States) and (2) inexpensive energy costs. This growth proved untenable as energy costs began to climb worldwide beginning around 2004 and lending began to evaporate over the past year as lending quality deteriorated to the point of making debt instruments plummet in value. The paper also argues that intermediaries converted to speculators and ended up correlating the two (e.g., massive amounts of leverage to trade and hedge around energy flows). An analogy to a combustion process can be made here.

  A "boiler" is designed to accommodate a fuel, such as coal, within a range of quality specifications. When the fuel thrown into the boiler is well outside that range, all kinds of bad things happen—the steam and electricity output declines, emissions are aggravated, and even safety is compromised. The quality of debt going into the system is analogous to fuel quality. Or, if water flow to the boiler (to create steam from the heat) is interrupted, analogous to counterparties for debt instruments, then the system is subject to a meltdown as the fire continues but the heat energy has nowhere to be absorbed. Surely, some regulatory authority, government or private, could monitor the quality of the debt being shoveled into the system and the quantity of counterparties to ensure that the system doesn't melt down. This is where process engineering and control may provide new levels of insight for operating a more responsible financial system.

- The author's white paper also suggests that volatility clearly favors speculators, middlemen, and financial intermediaries, but is devastating to the parties to the transaction. For example, consider the vast amount of alternative energy development value that has evaporated as the price of petroleum on world markets plunged from $140/bbl to <$40/bbl. But the amount of transactional value that was pulled out of the energy market as the price was run up to $140/bbl (through instability caused by the Iraq war, threats to Iran, and speculation on rising demand from Asian economies) is also huge. System dynamics and control system theory can illustrate how volatility is created and exploited.

With a higher order analysis, supported by a sound theoretical framework, process engineering and design could not only help economists, financial engineers, politicians and investors forecast where and when trouble spots emerge, but also suggest solutions that are not even imagined today. Accounting standards could resemble standards used by the scientific and engineering communities, actual standards or benchmarks against which the quality of a measurement is assessed or specific calculation procedures, rather than ambiguous frameworks for individual firms to calculate the value of transactions (such as so-called "mark to market accounting"). Investors could be armed with more than a statement of *caveat emptor* regarding an investment opportunity, and receive some assessment of the uncertainty associated with it, something more robust than ratings from agencies that are part of the same financial system they rate or the anemic "past performance is no guarantee of future results." Authorities could monitor key inputs and outputs just like sensors and control, devices regulate chemical and physical processes and factories. The research described here would point the way.

Reading List

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