Understanding Global Financial Crisis Through System Dynamics

Dr.Sambasivam Srinivasan, Professor,
VGSOM, Indian Institute of Technology Kharagpur
Kharagpur, West Bengal – 721302, India

Sriram Srinivasan
College of IS&T, University of Nebraska at Omaha
Omaha, Nebraska – 68106, USA

ABSTRACT

Starting from the summer of 2007 first at USA, followed by European and Asian markets we witnessed a global financial crisis. As we are slowly recovering from the crisis, as of now, several economies are in painful process of slow recovery .We are nowhere near to the pre crisis state. Some experts [1] have blamed repeal of Glass-Steagall act which allowed the commercial banks to more risky areas and in general deregulation policies. Some attributed to the derivatives and Structured Investment vehicles that were designed and sold by Financial Engineers which was not understood by ordinary investors. Robert C.Merton attributes that non linear derivatives not fully understood by ordinary focks as well as regulators and compares the situation to that of going for increased speed of engine without tracks to support such a high speed train – lack of infrastructure [5].

Keywords: System Dynamics, Global financial crisis, Financial Engineering, Investors, structured Investments.

1. INTRODUCTION

We have developed a comprehensive model to explain the crisis. The crisis is due to the combination of several small reasons which have created the crisis as well propagated through the system boundries in a non linear way. In addition to several economic issues, the general greed and fear of the investors have multiplied the small oscillations to big waves. System Dynamics which speak of interconnected systems is an excellent tool to model such situations. Also the behavioural features can only be modeled through System Dynamics.

The paper will outline the model structure which we are making and present the results of first stage which has withstood first stage validation tests. The model considers three regions USA, Europe and Asia and each region consists of speculators, Investors and Regulators. The flow of liquidity across the globe and effect of one region on another is well captured using appropriate table functions. Also the impact through behavioral features is the special feature of System dynamics based models. The model outline and first stage results will be presented. Subsequently we are in the process of scaling up the model to global level.

All the previous approaches take a very mathematical view of the stock and option markets. However, the changes in stock prices are reflected in the changes in option prices only after passing through the very subjective judgment process of the different market players like the speculators and the investors, who all react differently to the same market situation. A purely mathematical model cannot capture this aspect of the market. Moreover, not only do the market fluctuations affect the decisions of the investors, but these decisions also lead to further fluctuations in the market. Such a feedback cannot be captured in any of the previous models. Hence a system dynamics-like approach is necessary in order to take this factor into account.

System dynamics is the theory of structure and behavior of systems [2]. As global economy has evolved by integration of capital markets, we need global regulatory system to effectively control. Understanding the Financial crisis and evolving coordinated stabilization polices is the final objective of our efforts. System Dynamics modeling with its system orientation, easy to use, intuitively appealing, and yet mathematically sophisticated methodology is the best tool to comprehensively understand and analyze the crisis.

2. BROAD OUTLINE OF PROPOSED MODEL

The approach described in this report simulates the subjective judgment process of the different market players in order to estimate the asset price at the end of the day. It does not describe the asset price as a mathematical function .It simulates the decisions made by the market players according to the *movements* in stock price, and open interest [4]. The various market

players and their decision-making criteria are as described below [3].

INVESTORS

Investors are concerned with long-term returns on their investment. Hence, they use the International version of Capital Assets Pricing (CAPM) model or Arbitrage Pricing Model (APT) as a bench mark to determine intrinsic value of an asset. This helps them to determine whether a given investment is under-priced or over-priced. The basic investing strategy with regards to an investment is to buy under-priced options and sell over-priced options. Thus the investors compare the actual asset price in the market with the theoretical CAPM/APT price. If actual price is greater than CAPM/APT Price, i.e. the asset is over-priced, they sell; otherwise, they buy. The causal loop diagram for investors is as shown in Figure 1.

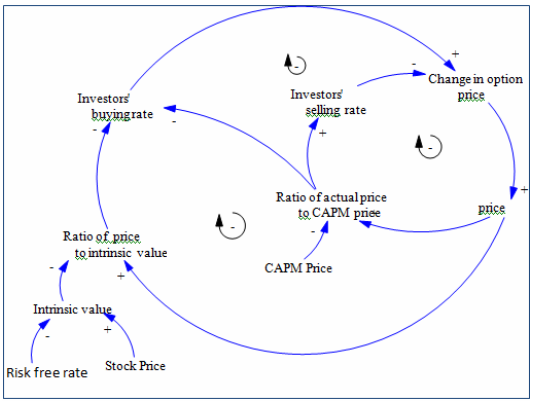

Figure 1: Causal loop diagram for Investors' buying & selling decisions

SPECULATORS

The speculators are concerned with quick gains from the market. Thus their trading strategies are driven by the current price of the asset rather than whether the asset is over-priced or under-priced. One of the market indicators used here is the smoothed average [4]. If the current market price of the security is greater than the smoothed average of past values, they step up selling and reduce buying anticipating a decrease in price. On the other hand, when the current market price of the security is less than the smoothed average of past values, they step up buying and reduce selling, anticipating an increase in price. The causal loop diagram for the speculators' decision-making process is as shown in Figure 2.

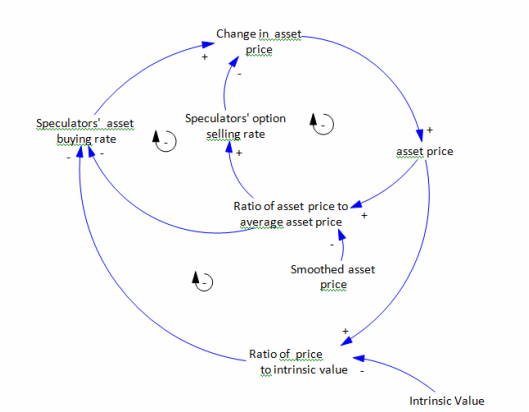

Figure 2: Causal loop diagram for speculators' buying & selling decisions

HEDGE FUNDS

Hedge funds play in many international markets and have highly sophisticated decision-making algorithms. However, the basic criterion for investing in any market is whether the markets are bullish or bearish. One of the parameters used for determining whether the asset market is strengthening (bullish) or weakening (bearish) is to compare the changes in the price of the asset n with the changes in the open interest.

Open interest is defined as the total number of asset contracts that have not yet been exercised, expired or fulfilled by delivery. It is often used to confirm trends and trend reversals for options contracts as they measure the flow of money in the options market. Pring [4] gives the guidelines to be used while using open interest as a market indicator. These are summarized in Table 1.

Table 1: Buying and selling decisions of hedge funds

Asset price	Open Interest	Market State	Hedge Fund Decision
Rising	Rising	Bullish	Buy
Rising	Falling	Bearish	Sell
Falling	Rising	Bearish	Sell
Falling	Falling	Bullish	Buy

Increasing open interest means that new money is flowing into the market place. As a result, the present trend (up, down or sideways) will continue. Decreasing open interest means that market is liquidating and implies that the prevailing price trend is coming to an end. Combined with the changes in asset price, the changes in open interest give the following rules for hedge fund activity in the given asset market. The causal loop diagram for hedge fund activity is as shown in figure 3.

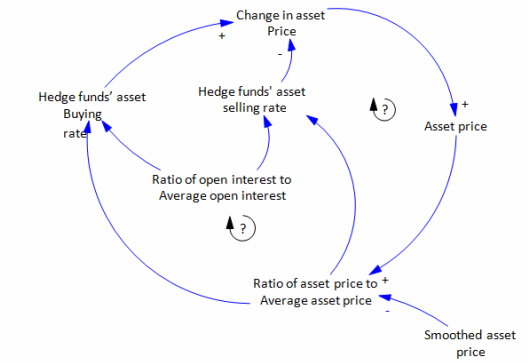

Figure 3: Causal loop diagram for hedge funds' buying and selling decisions

CONCLUSION

We sum up the buying/selling rate of Investors, Speculators and Hedge Fund opeartors as total buying rate/selling rate for each region. When total buying rate is equal to the total selling rate the asset price is in equilibrium. With this as a basic building block, we simulate conditions and study the global impact on asset prices. We sare still in the process of development of a world wide model and once completed, we will be able to similate the impact on asset prices at global level. Initial simulated results fairly depict the actual run for Indian based securities.

This model can easily be applied to explain individual stock/option price or at aggregate stock index at national or global level. The basic model stands validated at one country-Indian level.We are yet to try in International environment. The impact of say housing bubble on the other asset markets through interlinked global markets can be simulated and anaylsed . Some structrul imbalance resulting in initial downward push creating a negative feed back amplified by fear as manifested in Table function values would exactly create the current crisis conditions we are model through via model.

Several policy options at different sectors can also be studied using this model if coordinated polices are put in action or uncordinated polices are practiced. Hopefully we will be able to develop the full scale model with full scale policy sensitivity studies and present during the next conference . The power of System dynamics based model to explain and design policesto contain the current Financial crisis incorporating the behavioual aspects is the basic motivation of our paper.

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