Table of Contents

Go Back

Functionality of Banks and Hedge Funds and Contagion Between Financial Institutions

Andrew Lo
Harris & Harris Group Professor
Sloan School of Management
50 Memorial Drive, Bld E52, Room 432
Cambridge, MA 02142-1347
Phone: 617-253-0920
Fax: 781-863-9695
alo@mit.edu

Mila Getmansky
PhD Student
Sloan School of Management
30 Wadsworth Street, Bld E53, Room 358
Cambridge, MA 02139
Phone: 617-253-8094
Fax: 617-468-8132
mgetman@mit.edu

ABSTRACT

The paper studies crises and contagion effects in the framework of two financial institutions: a bank and a hedge fund. System dynamics models of a hedge fund and a bank are formulated. The concept of contagion is discussed in the framework of these two financial institutions. The goal of the paper is to understand conditions under which each of the financial institutions can fail and determine when a failure in one financial institution can trigger a contagion effect that leads to the failure in another financial institution. Both models and the concept of contagion are validated and discussed within established financial frameworks. The paper provides conclusions and policies how to avoid or mitigate the effects of financial crises and contagion.

INTRODUCTION

Section 1 gives an overview of the general structure of hedge funds and banks as well as background for these financial institutions. Section 2 provides a framework for a generic model. A generic model is made to account for both bank and hedge fund structure. Appendix A provides equations for the running model. Section 3 along with Appendix B provides the reasons behind financial crises in each of the financial institutions. The issues of contagion between a bank and a hedge fund are discussed in Section 4. Section 5 explains how validation and calibration of the model should be done. Recommendations and conclusion follow.

The goal of the paper is to understand conditions under which each of the financial institutions can fail and determine when a failure in one financial institution can trigger a contagion effect that leads to the failure in another financial institution.

Section 1

Hedge Funds

Since 1990s there has been a growing awareness about hedge funds. Hedge funds are often called alternative investments because hedge fund managers are not restricted to any particular type of investments. Hedge funds have the ability to buy (long) or sell (short) securities that they do not hold. They are not restricted to plain "buy and hold" strategy. Hedge funds' activities are usually not transparent to investors and to the government. Hedge funds have the capability of leveraging - borrowing against their existing assets. In 1990 there were about 70 hedge funds. There are about 50,000 hedge funds in 2000. The hedge funds also grew in size of assets under management. Currently, there are about $8 to $15 trillion dollars invested in these alternative investments. Despite spectacular growth and performance in double digits of various hedge funds, there have been many horrifying collapses and bankruptcies of hedge funds such as Granite Capital, Global Systems fund, and LTCM.

The current form of most U.S. hedge funds is a limited partnership, or a limited liability company established to invest in public securities. However, there is no

common definition of a hedge fund. Hedge funds are defined by their freedom from regulatory controls stipulated by the Investment Company Act of 1940. The controls limit fund leverage, short selling, holding shares of other investment companies, and holding more than 10% of the shares of any single company. However, the laws are relatively lax, especially compared to the laws that mutual funds have to abide by. Like mutual funds, hedge funds are actively managed investment portfolios holding positions in publicly traded securities. However, unlike mutual funds, hedge funds have a bigger flexibility in the kind of securities they can invest. Hedge funds can invest in domestic and international debt and derivative securities. They can take undiversified positions, sell short, and level up the portfolio.

Hedge funds seek to generate above-average returns to their investors. Most hedge funds use the following strategies:

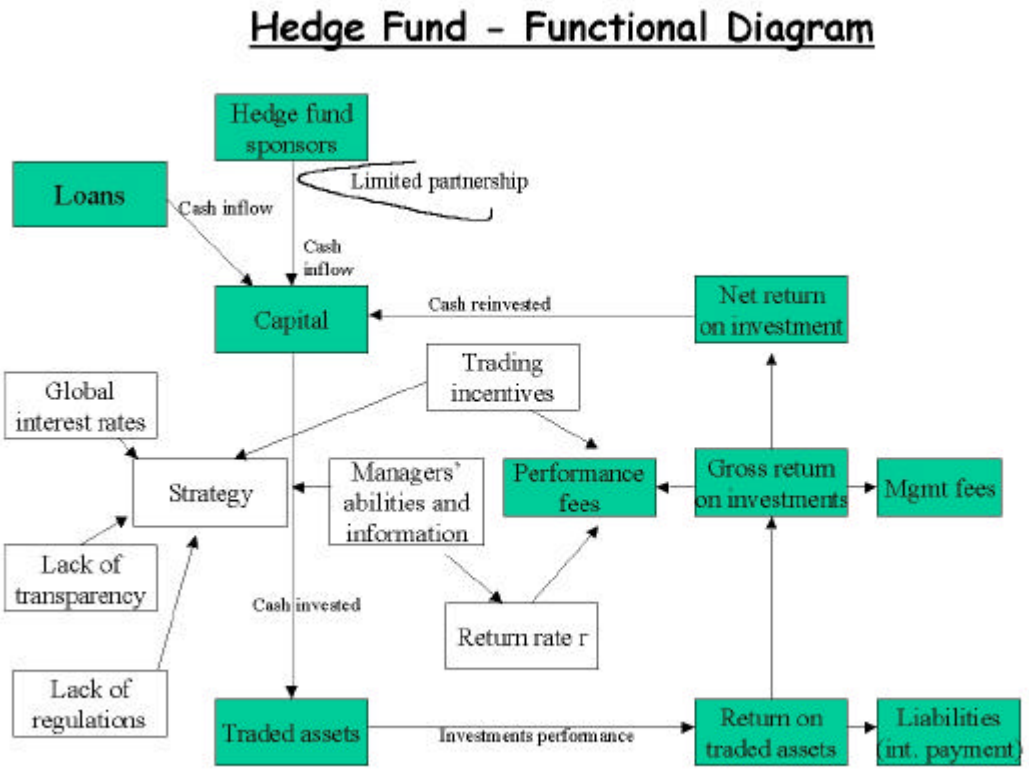
- Short selling. The strategy involves the sales of borrowed securities hoping the price of these securities will go down. A hedge fund manager should have sufficient skills and expertise to identify overvalued securities and being able to cost-efficiently borrow the overpriced stocks.
- Hedging. The strategy involves decreasing risk inherent in hedge fund's portfolio. The risks might be the following: political, economic, company, interest rate and market risks. Hedging can use the combination of derivatives and short sales. Hedge fund managers should be able to use efficient hedging techniques. For example, it is very costly and not efficient to hedge by shorting a share of a stock for every share held long in the portfolio. It might be more economical to short contracts or shares of different assets which are highly correlated with the underlying asset.
- Arbitrage. The strategy involves finding any price inefficiencies or discrepancies between securities or markets. The strategy is risk-free; however, in current efficient markets it is very hard to find any price inefficiencies. Even if such inefficiencies are found, they do not last. Therefore, fund managers tend to use leverage in order to enhance returns due to such minuscule short-term opportunities.
- Leveraging. The strategy involves either borrowing money, to increase the size of the portfolio; or assigning cash or securities as down payment, collateral, or margin for a percentage of the position one seeks to establish.

- Synthetic positions or derivatives. The strategy involves using derivative contracts to establish certain positions or strategies in the hedge fund.

There are many hedge fund types. The list of hedge fund types is the following:

- Macro funds
- Special-situation funds
- Pure equity funds
- Convertible arbitrage funds
- Funds of funds
- Market-neutral funds
- Commodity trading advisor funds
- Private equity funds
- Risk arbitrage funds
- Long or short funds
- Emerging market funds
- Event risk funds
- Restructured or defaulted security funds

The structure of a typical hedge fund is provided below. Hedge funds increase capital by borrowing from wealthy investors, taking loans from the bank and reinvesting net return on investments. The diagram below describes both material as well as information flows. For example, capital can only be increased or decreased by material flows. However, performance fees can be adjusted to past performance fees, track performance, the effort exerted by managers, managers' skill and other parameters. Investment performance depends both on assets invested as well as on the skill of hedge fund managers.



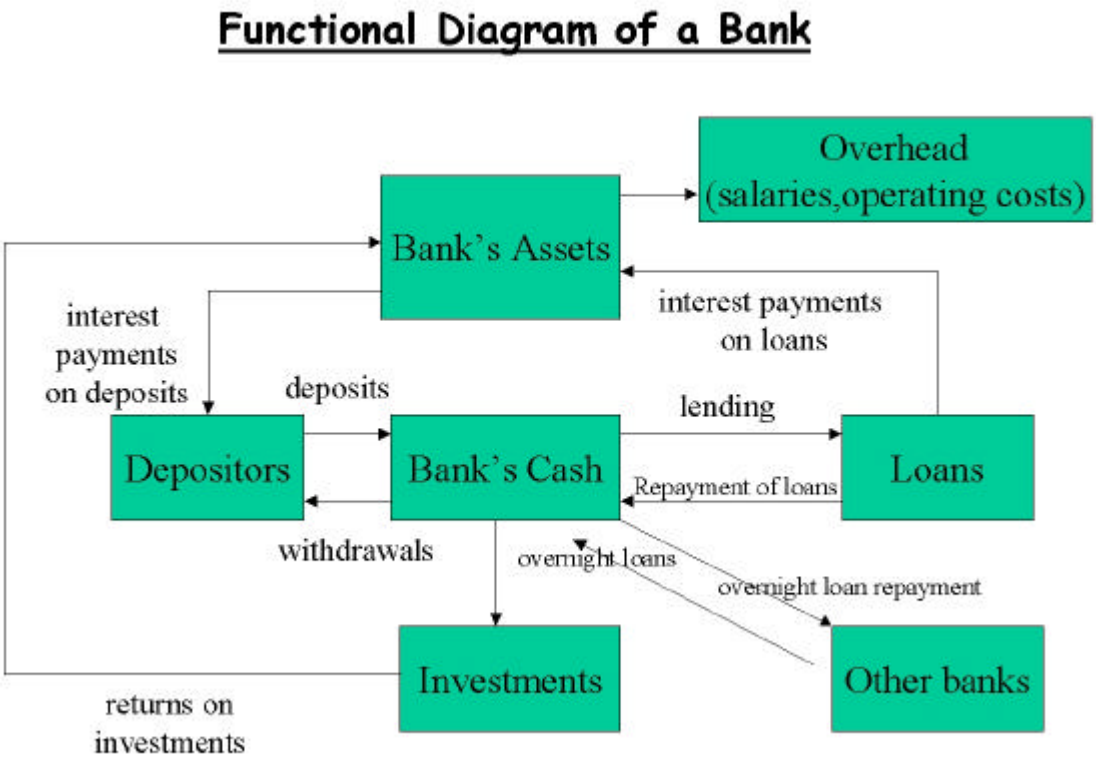
Banks

Banks have been in the USA since the 19th century. They are structured to promote depositor safety and economic stability. Federal Reserve is supposed to make emergency loans to commercial banks. Banks by law have to keep 10 % reserve requirement. They cannot invest all of their money like hedge funds. Banks primarily make money by taking deposits and lending money as loans. Interest rates charged on loans are much greater than the ones promised to depositors. However, banks can also invest some part of their assets into more risky assets. Banks are financial institutions whose main purposes are the storing and lending of money. Banks, like most large companies, are owned by stock holders. These stock holders elect the individuals who run the operations of the bank, the board of directors. The stock holders also reap the benefits of the profits that the bank makes. Banks make it desirable for customers to store their money thereby offering both security and also profit for the customer in the form of interest on deposits. The security inherent in a large financial institution is

enhanced by federal protection of the depositers' funds, in the form of the Federal Deposit Insurance Corporation (FDIC). A bank invests the money it holds, reaping profit on the earnings from these investments. Another service offered by banks is the lending of money to individuals and institutions. Customers take advantage of these loans for things ranging from mortgages to car purchases to business expansions. These loans are repaid to the bank with interest, and it is on this interest that the bank makes a significant portion of its profit.

The net profit made by a bank is a balance between the profit due to the returns on investments and the interest paid to the bank on loans and the expenses due to the operating costs (salaries, buildings, etc.) and the interest paid to customers on their deposits. A bank will often delve into other areas of financial business. Many banks offer credit cards, mutual funds, insurance and currency exchange. Banks occupy a very important niche in the economy. When a bank lends money it allows a business or an individual to borrow against their future income in order to accomplish things they otherwise couldn't. Further, it allows businesses and individuals to store, and make profit on, their wealth with minimal risk.

A simple diagram based on banks' functionality is drawn below.



Section 2

Research Question

The proposal is to study the ways a generic hedge fund can fail. Under which conditions a generic hedge fund might fail? It is imperative to find the leverage points in the hedge fund's structure and decision points which lead to the collapse of the generic hedge fund. (Note, as was mentioned in the introduction, we are building a model of a generic financial institution, and then calibrate it to a specific one. For this paper, a model was calibrated to a hedge fund. That's why we will often make references to a model of a hedge fund.)

Method

In finance, the following saying that is true - the past does not guarantee the future. If a hedge fund failed due to one cause, it does not mean that other hedge funds

will fail only due to this cause. It is true that a huge leverage of LTCM in 1998 was the main factor which led to the almost bankruptcy of the fund. Other hedge funds that had similar structure as LTCM had to go down. However, other factors should be included in the equation in order to predict the possibility of a hedge fund to go down. In order to address the problem of hedge fund failures, it is imperative to study a generic hedge fund structure thoroughly. It is important to identify all stocks and flows which are the backbone of an operational hedge fund. After this is done, major effects which lead to the change in flows should be identified and measured. To illustrate, a fund's value is called the net asset value (NAV). NAV is going to be a dependent variable. NAV is the sum of cash, total investments less liabilities.

NAV = Cash + Total Investments - Liabilities

NAV is a function of hedge fund's leverage, reputation, return, risk of positions, skill and other factors. Of course, there are many more variables that affect NAV. However, it seems that leverage, return, risk of positions and skill are the most important to study. They vary a lot with NAV and they are the answer why hedge funds can fail. The skill of managers is a huge factor that determines NAV. A skillful manager can deliver above average returns; therefore, increasing NAV of the fund. New investors, who are aware of the skillful manager, are eager to invest with this manager. Leverage is one of the defining elements of a hedge fund's operations. It is an important component which affects returns and the additional benefits or value added they bring to investors. By allowing managers to increase the size of the hedge fund portfolio due to leverage, hedge fund managers are able to magnify their returns. Since many hedge fund managers are paid on the basis of performance, the greater the leverage, the greater the fund's potential returns and performance fees. Leverage is an important factor for the study of hedge funds collapse. Overleveraging to boost fees is a common temptation faced by many hedge funds. Excessive leverage is the major cause of hedge fund losses in volatile or falling markets. For example, LTCM collapsed in the summer of 1998 due to the use of high leverage ratio which magnified relatively minor but unexpected negative price moves during that time. Risk of positions is an important factor in looking at NAV.

Investors tend to stay away from risky funds which have high volatility stocks with negative returns. However, they are more eager to invest with funds which have risky positions in instruments which bring positive returns. Return of a fund is of course, an important variable. Investors will fly away from funds which consistently bring negative returns or less than expected returns (compared to their peers or to the indices).

We are interested in finding the exact dependence of NAV on the independent variables. Therefore, the problem is to find "f", where

NAV = f(leverage, return, risk of positions, skill) + E

The equation below is wrong and oversimplified. NAV is not linearly dependent on the following factors. Hedge fund operations has many implicit feedback loops which do not lead to a simple linear dependence. The model in the following section is going to fully address needed feedback loops.

NAV = b1 * leverage + b2* return + b3 * risk of positions + b4*skill +E

Where b1..b4 are regressors of NAV on leverage, return, risk of positions, and skill respectively. E = is the error.

Estimation of Variables and Problems in Finding Data

It is very hard to find data on all independent and even dependent variables. The hedge fund industry lacks transparency. Hedge funds are heavily dependent on intermediaries devoted to matching buyers and sellers who have every reason to limit the flow of information to the public. These intermediaries charge substantial commissions for their efforts, and are eager to limit the distribution of information to investors in order to maintain their roles. Fund managers are also interested in maintaining the lack of transparency because they are engaged in arbitrage strategy and are not interested in revealing positions or order flows. However, with the growth of hedge funds, recent collapses of huge hedge funds and the push from international regulators, a growing

number of publications and sources now offer hedge fund data. Laws are also changing. For examples, the U.S. Securities and Exchange Commission ruled in 1997 that hedge funds could distribute data using an Internet subscriber service, provided only "qualified investors" have access to this information.

A hedge fund's prospectus contains information on the fund's investment strategy, philosophy, as well as its track record. Track record of the fund is another important source. A hedge fund track record is simply the historical presentation of the fund's historical returns as measured by the changes in its value over time. The track record tells how NAV has changed over time.

NAV

It is important to realize that NAV (dependent variable) which is quoted in the track record might have errors associated with it. The sources of such errors are the following:

- The Relevance Problem. Some funds present *pro forma returns* - theoretical returns what the fund could have made in the past had such a methodology, manager, or asset composition been used. *Pro forma* statements are particularly commonly used by funds of funds, new hedge funds and system-following commodity trading advisers. In general, since these returns have not been validated by actual market events, pro forma track records should not be considered in evaluating NAVs.
- The Consistency Problem. Usually, the longer we have returns for a manager, the better and more precise is our evaluation of the manager and his fund. However, the longer we have returns for a manager, the higher is the probability that the manager uses other managers to run the fund or he combined several funds into one fund. The data should be adjusted for the radical change in strategy, markets, leverage and any change in management structure in order to evaluate the correct NAVs.
- Fees. All fees should be subtracted from overall earnings in order to get consistent estimates of NAVs.
- Valuations. NAV requires that the assets and liabilities of a fund be valued at a prevailing market price. However, there are different techniques for calculating NAVs which are reported in funds' track records. The prevailing techniques are the

following: marked to spot, marked to model, and marked to market. Marked to market should be always used.

Risk of Positions

Generally, the higher a fund's standard deviation, the greater its risk for an investor. Standard deviation of the fund is going to be used as a metric for measuring the risk of the fund's positions. However, it should be noted that the standard deviation of the fund's returns is not perfectly correlated with the general risk of the fund for an investor. The correlation coefficient is 1 only when returns are normally distributed. If returns are normally distributed, thus symmetrical, ranking funds by means of average returns and standard deviation will give meaningful results. However, if returns of the fund are skewed, then results should be adjusted. The presence of skews means that it is imperative to distinguish between positive and negative standard deviations and volatility. Real-world investors are more sensitive to losses than to gains. They prefer positive volatility (positive returns greater than the fund's average returns). Investors seek to avoid negative volatility (negative returns greater than the fund's average returns). Therefore, all other things being equal, a fund with high positive volatility will always be more attractive to an average investor. (Prospect Theory). It is important to adjust for the skews because in reality the assumption of normality in the distribution of hedge fund returns is generally incorrect.

Returns

It is incorrect to assume a normal distribution of returns for a typical hedge fund. In a simulation model where sometimes returns are deterministically or stochastically used as an input to the model in order to test the effect of returns on NAV, it is imperative to make the correct assumptions about returns. For example, most hedge funds have the loss "tail" in the distribution of returns. It is more frequent than should have been predicted by a normal distribution. Also, all the distributions have a positive skew; that is, the frequency of positive returns is to some degree greater than should have been the case under the normal distribution. Positive skews might be explained by the skills of

hedge fund managers. Hedge fund managers charge enormous fees and higher the best people in the industry in order to deliver better than average positive returns. Therefore, the more skillful the managers, the less likely their returns will be to conform to a normal distribution. These skillful managers tend to hold on to assets with positive volatility and sell assets with negative volatility. Hedge funds' returns can be found in investment track records of hedge funds.

Skill

Manager's skill depends on prowess and risk management strategy. Prowess is the ability to identify and capitalize on situations that have high reward and lower risk than perceived by the market. Risk management is the manager's ability to cut losses and let winners run. In a way, a good hedge fund manager has a linear utility function compared to average investors who have convex utility functions when faced with losses, and concave utility functions when faced with the possibility of future gains. A skill is usually hard to measure since this variable is often dependent on many other factors. It is also dynamic in nature. A hedge fund manager's skill can be decreased or increased over the life span of the fund. The following metric is proposed for the estimation of the hedge fund manager's skill. It is called D ratio.

D ratio = Abs D/U, where
D= number of positive returns
U= number of negative returns
Abs = absolute value
The D ratio will have a value between 0 and infinity. A D ratio of 0 is a distribution of returns that have no downside. A D ratio of 1 is a perfectly equal distribution of returns around 0. A D ratio of infinity signals that managers have a low skill and cannot deliver any positive returns to their investors.

Leverage

Leverage is the value of assets or positions a fund has over and above its capital. The larger the market value of a fund's positions over its investor supplied capital, the greater the fund's leverage. The following statistic can be used to calculate leverage:

Leverage = (Total Investments)/ (Total Investments -Liabilities)
Another proxy is a Debt Ratio:

Debt ratio = Liabilities/Assets

It is important to have the correct leverage ratio in order to make the right assessments of the impact of leverage on the NAV. Many fund managers do not disclose leverage. Only one-third of the fund's leverage can be readily determined on the basis of its bank borrowings. The remainder of the fund's leverage is "hidden" by being contained in the structured note it is holding in its investment portfolio. Sometimes, only after the collapse of the fund, the leverage of 50:1 come as a surprise to many of its investors who did not realize that the manager of the fund used such a high leverage ratio.

Model

There are three important accounting variables that should be represented in the model: "Assets," "Liabilities," and "Equity." According to the accounting identity:

$$\text{Assets} = \text{Liability} + \text{Equity}$$

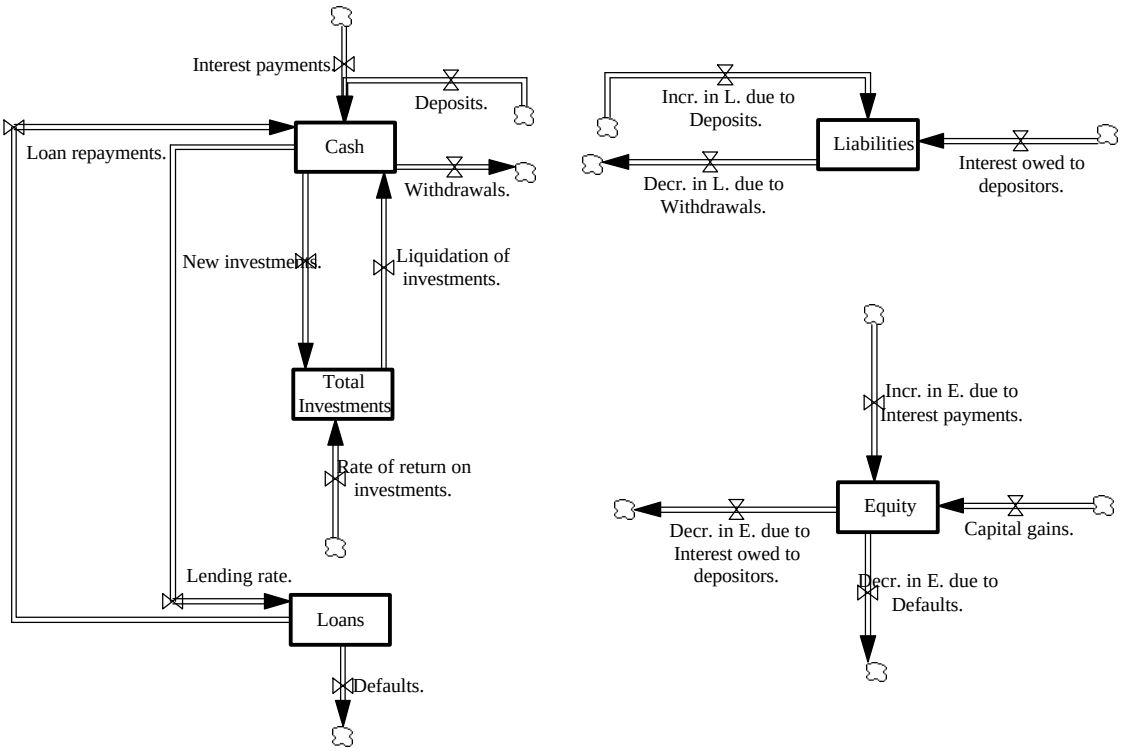
Each financial institution has three types of assets: "Cash," "Total Investments," and "Loans." Each of these types of assets is presented as a stock in the final model. These stocks are the operational stocks of a generic fund. They were inferred from operational description of hedge funds.

In the model, a financial institution can invest in three types of investments: low-risk, medium-risk, and high-risk. For example, when a hedge fund invests in a treasury bond, it invests in a low-risk security; however, when a bank invests in a hedge fund, it

invests in a high-risk security. All these relationships are mapped out in the model. Loans can be short-term or long-term. Note that since we are trying to model a generic financial institution, the term loans does not apply to all financial institutions, hedge funds, for example. Hedge funds, by definition, are not able to make loans.

"Cash" can be increased by "Interest Payments," "Deposits," "Loan Repayments," and "Liquidation of Investments." It can be decreased by "New Investments," "Withdrawals," and "Lending Rate." "Total Investments" is increased by "New Investments" and "Rate of Return on Investments." However, it is decreased by "Liquidation of Investments." "Loans" are increased by "Lending Rate" and are decreased by "Loan Repayments" and "Defaults." The variable "Liabilities" has two additive components: "Increase in Liabilities due to Deposits" and "Interest Owed to Depositors." "Liabilities" is decreased by the rate " Decrease in Liabilities due to Withdrawals." Finally, "Equity" is increased by "Capital Gains" and "Increase in Equity due to Interest Payments." "Equity" is decreased by "Decrease in Equity due to Interest Owed to Depositors" and "Decrease in Equity due to Defaults." Negative equity stock means that a financial institution failed.

The diagram below shows a stock and flow structure of a generic financial institution.



Formulation for the Rate of Return

- Lognormal distribution of returns
- r_{it} are continuously compounded single-period returns, IID normal
- Single-period gross simple returns R_{it} are distributed as IID lognormal variates
- Three types of returns are used: low risk, medium risk and high risk

Rate of Return: Calculation

$$r_{it} \sim N(m_i, s_i^2)$$

$$r_{it} = \log(1 + R_{it})$$

$$R_{it} = e^{r_{it}} - 1$$

$$E[R_{it}] = e^{m_i + \frac{s_i^2}{2}} - 1$$

$$Var[R_{it}] = e^{2m_i + s_i^2}[e^{s_i^2} - 1]$$

Rate of Return on Investments

- I_{it} is the rate of return on investments [$/year]
- T_{it} is the total investments [$]
- L_{it} is the total net losses [$]
- $I_{it} = R_{it} T_{it}$
- $L_{it} = \int -I_{it} dt$

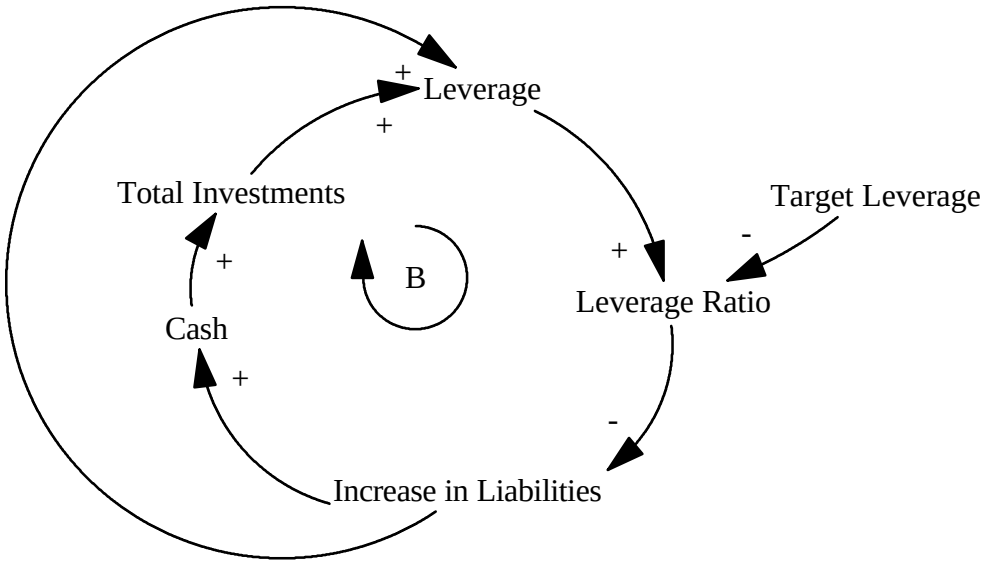
Section 3

Hypotheses for Collapse of a Hedge Fund

HYPOTHESIS 1: Effect of Leverage on Liquidation, Deposits, and Withdrawals

The following hypothesis is going to be tested: Hedge funds decide on target leverage based on their peer group, their own strategy or the current market conditions. If their current leverage is below the target leverage, they increase their liabilities, therefore, increasing the cash and total investments of the hedge fund. However, the combination of the increase in cash, total investments and liabilities leads to the increase in leverage. Therefore, leverage is increased until the target leverage is reached. This loop is very important in the study of crises in hedge funds. If hedge funds have a very high target leverage such as 50:1, they might end up magnifying small decreases in the market, thus, increasing their exposure to losses. However, if target leverage stays within the boundary of a sustainable one, then the hedge fund might prevent its collapse. The diagram below describes the decision of the increase of leverage based on its target leverage. "B" stands for a balancing loop. It means, that the increase in leverage is balanced by the target leverage. The leverage will not be increased beyond its target value. "+" means that an increase in one variable leads to an increase in another. For

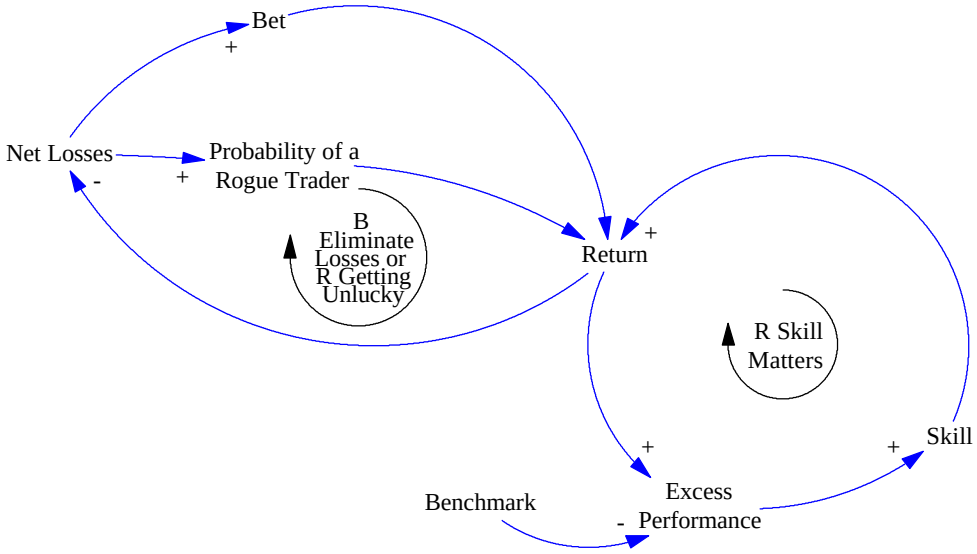
example, an increase in leverage leads to the increase in the leverage ratio. "-" means that an increase in one variable leads to a decrease in another. For example, increase in leverage ratio leads to the decrease in the increase in liabilities.



However, if the balancing loop is absent due to the lack of transparency, management skill or the lack or reporting, then leverage can grow out of a “normal” boundary and lead to a collapse of a fund.

HYPOTHESIS 2: Effect of a Rogue Trader on Net Loss

The following hypothesis is being tested: The presence of a rogue trader can sometimes lead to a financial collapse and contagion. Sumitomo bank (Appendix B) provides a rich analysis for the reasons of the presence and behavior of a rogue trader in the bank. Behavior of a rogue trader can be analyzed in the following causal loop diagram.



As the amount of net losses grows, there is a greater probability of a rogue trader placing a larger bet. However, the effect of the probability of a rogue trader and the amount of the bet on return can be either positive or negative, depending on the skill of the rogue trader. Skill is reinforced by an increased return earned by a rogue trader.

Formulation for the rogue trader

•If L_{it} is negative, then rogue trader exists with probability P_{it}^{rt}

•If a rogue trader exists, then

$$I_{it}^{bad} = aL_{it}/t$$

$$I_{it}^{good} = -aL_{it}/t$$

•Where I_{it}^{bad} is a poor investment

I_{it}^{good} is a good investment

a is aggressiveness of a rogue trader

t is time to make a bet

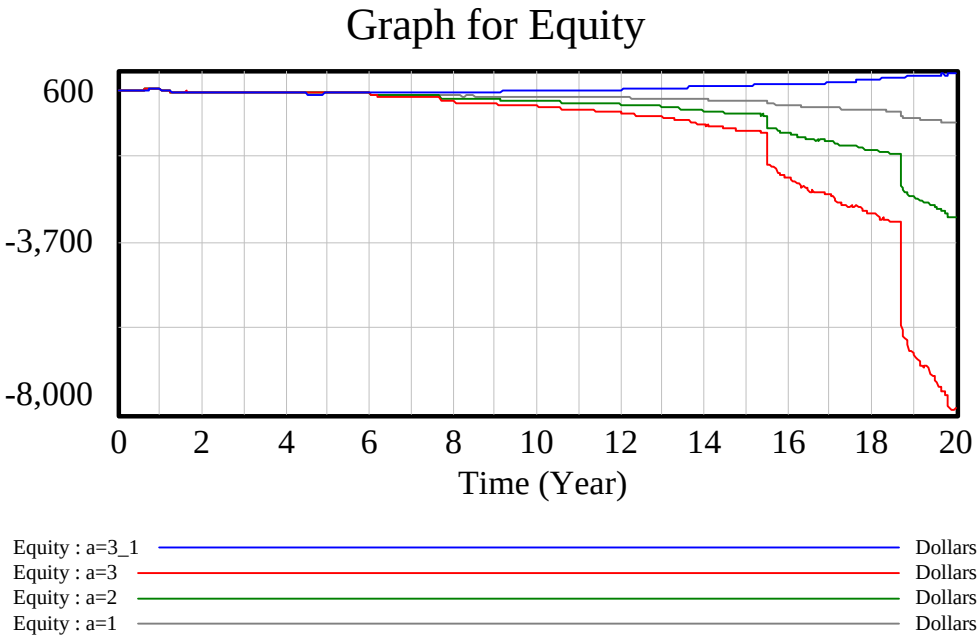
Rate of Return: Rogue Trader is Present

•If a rogue trader is present, rate of return on investments is the combination of the "normal" rate of return and a return on a rogue trader's bet

•With P^{up} a rogue trader makes a good bet, and $I_{it} = r_{it} T_{it} + I_{it}^{good}$

•With $1 - P^{up}$ a rogue trader makes a poor bet, and $I_{it} = r_{it} T_{it} - I_{it}^{bad}$

The following graph shows simulation of equity of a hedge fund at different values of aggressiveness of a rogue trader. As can be seen, greater the aggressiveness, greater the risk the rogue trader takes, and greater is the probability of a total collapse of a financial institution.



Causes of Banks Going Under

•No capital gains (capital losses)

–Bank does not make prudent decisions in risky investments

–Market collapses

–Hedge fund makes poor investments

•Defaults on principal

–Hedge fund or another borrower defaults on loans

•Defaults on interest payments

Examples:

1. Financing illiquid assets with short-term deposits
2. Expectation about the behavior of other depositors that drives the behavior of any individual depositor (this causes bank runs)
3. A bank failure can trigger a run on other, solvent banks when bank customers of the solvent bank assume that the value of banks assets are highly correlated with each other.
4. Asymmetric information between banks and their depositors.
5. When a bank is in trouble, bank managers and equity holders have an incentive to gamble for resurrection.

Causes of Hedge Funds Going Under

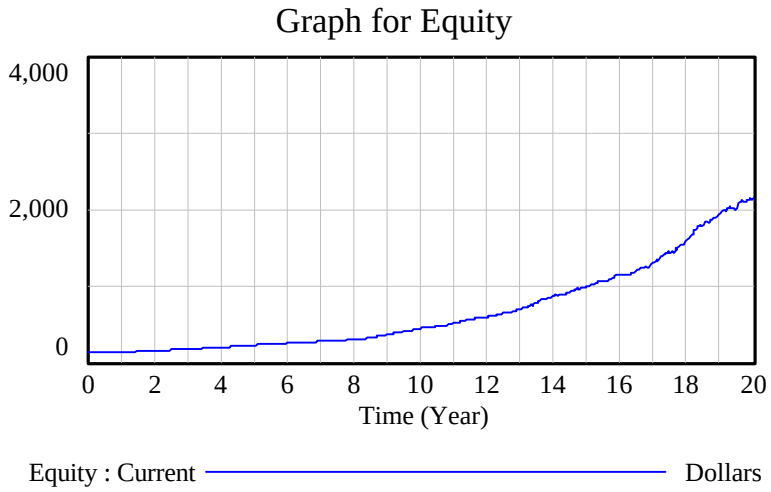
•Makes poor investment decisions

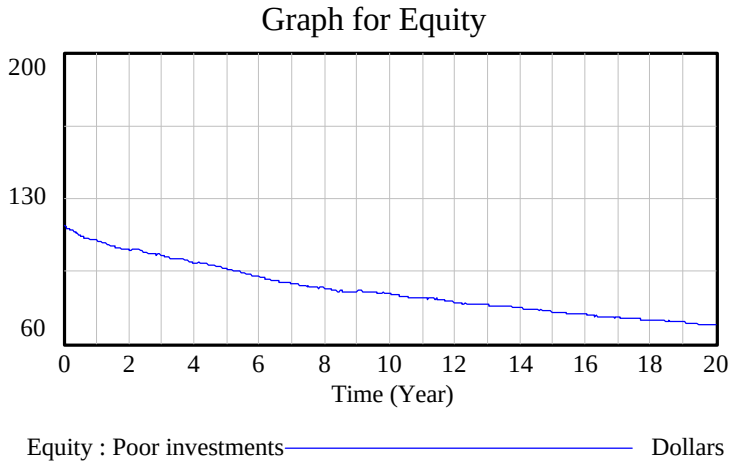
•General market conditions are bad

•Banks or other lending institutions decide not to lend (make new deposits), especially in crises times when liquidity is very much needed

The model was simulated under two conditions:

- Current run – investing in securities that on average earn positive returns
- Poor investments run - investing in securities that on average earn negative returns

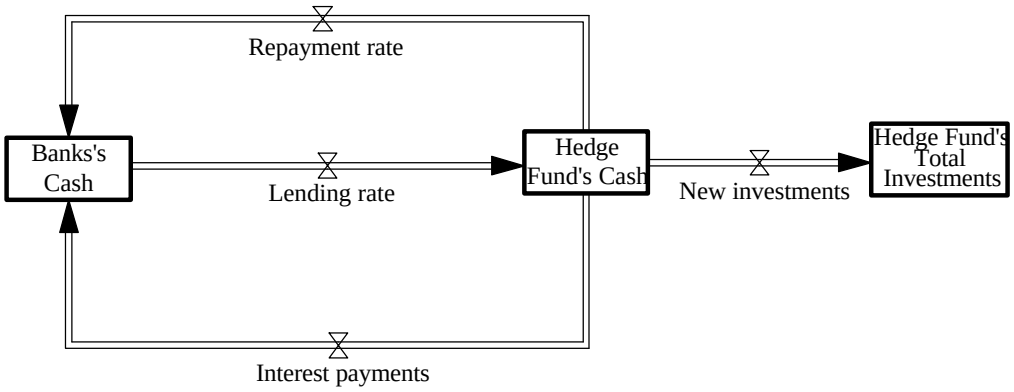




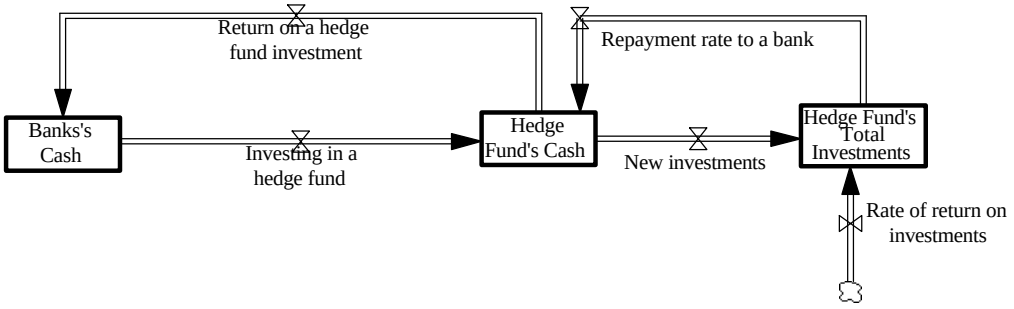
Section 4

Contagion can arise when two financial institutions are coupled. If a hedge fund goes down, then it is possible for the disaster to spread itself into a bank, and vice versa. Of course, contagion only happens under certain structural conditions that are analyzed in the paper. Every day several hedge funds fail; however, not all banks that lend them money or invest in them fail. The size of a hedge fund or the percentage of a bank's total assets lent to a hedge fund have to reach some critical number (determined by a model) in order for both coupled financial institutions to fail. The section analyzes such couplings through which contagion can spread from one financial institution to another.

There are two ways for a hedge fund and a bank interact: bank lending to a hedge fund and investing in a hedge fund. When a bank lends money to a hedge fund, the bank earns interest on this money. The hedge fund borrows money from the bank to increase its leverage. It has to pay interest on the money borrowed to a bank. The channel that describes lending to a hedge fund is depicted below:

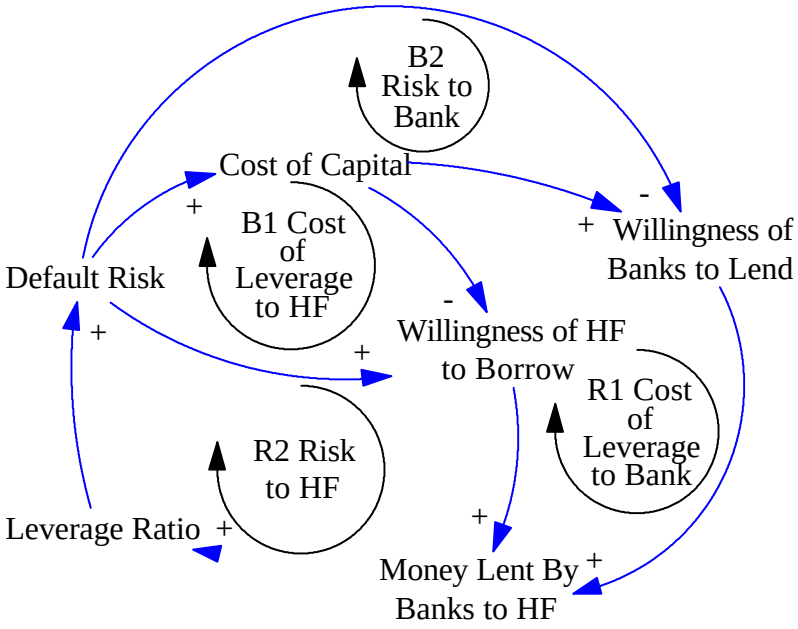


A bank can also invests in a hedge fund. The channel that describes investing in a hedge fund is shown below. A bank invests in a hedge fund; therefore, it earns interest on investment. A hedge fund receives money from the bank and usually invests right away.



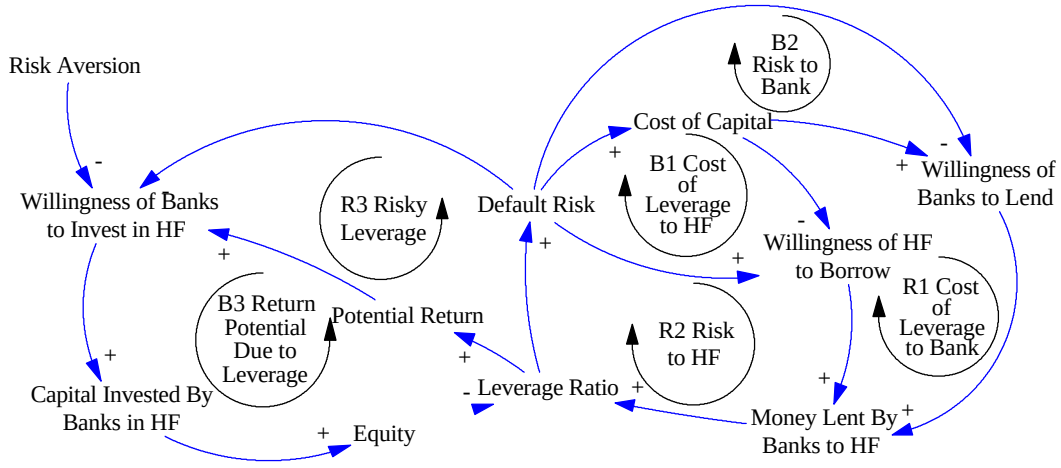
The following feedbacks between a hedge fund and a bank are modeled.

Cost and Risk of Leverage



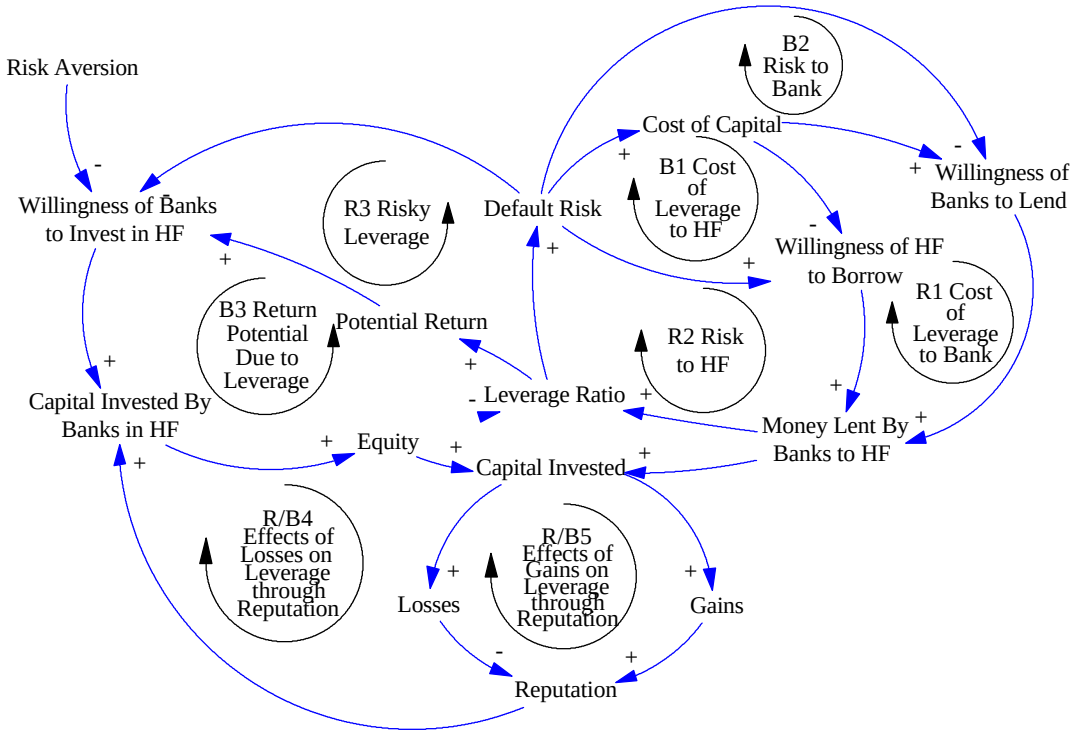
As leverage ratio increases, the default risk of a hedge fund increases, leading to an increase in the cost of capital asked by banks. Due to the increase in costs, hedge funds are less likely to borrow more, thus decreasing the leverage ratio as depicted by B1 loop. However, as the cost of capital increases, banks are willing to lend money at a higher rate; therefore, the leverage ratio increases as shown by a reinforcing R1 loop. Of course, the cost explanation is only a half story. The second half is shown by risk. As default risk of a hedge fund increases, hedge fund managers are willing to borrow more knowing that if they bring higher returns, then the hedge fund is going to become more profitable. On a downside, they have nothing to lose – a hedge fund is already ranked as a fund with a high probability of default. Reinforcing R2 loops depicts this behavior. Symmetrically, as default risk increases, banks are less willing to lend even if they can obtain higher returns due to an increased cost of capital. As default risk increases, banks expect to lose more money by lending to the risky institution. Therefore, they are willing to lend less. This loop is shown by B2.

Return Potential



As was discussed before, banks can also invest in hedge funds. Therefore, as leverage ratio increases and default risk increases, banks are less willing to invest in a fund that has a higher probability of getting bust. Therefore, hedge fund equity decreases, leading to an increase in leverage ratio; hence, a reinforcing behavior depicted by R3 Risky Leverage loop. Also, as leverage ratio increases, potential return increases, leading to an increased willingness of banks to invest in the hedge fund. Hence, the leverage ratio decreases. The behavior is shown by B3 Return Potential Due to Leverage balancing loop.

Reputation



It is also important to note that reputation is a great factor that should be modeled in the hedge fund- bank relationships. By law, hedge funds cannot advertise to a public. Therefore, reputation that leads to the word of mouth effect is essential to have a hedge fund running. Reputation can be lost by having losses, and can be gained by positive returns within the hedge fund. As reputation increases, capital invested by banks in a hedge fund increases. Therefore, equity increases, leading to the decrease in leverage ratio. However, depending on the effect of leverage ratio on the willingness of banks to lend (loops B2 and R1), the actual money lent by banks to a hedge fund may decrease or increase depending on which loop is prevalent at a time. Therefore, it is possible reputation might be reinforced or balanced depending on different mechanisms.

Section 5

Model Testing

Hypotheses are tested against available data and case studies that have been collected (Appendix B). Case studies are studies of individual hedge fund and bank

collapses. They encompass reasons behind each collapse, the change in NAV in each case, and the outcome of the crisis. The model is currently being calibrated and checked for validity.

CONCLUSION

In order to fully understand the ways a typical hedge fund or a bank can fail, it is not enough to study past case scenarios and find the reasons behind each collapse. Past case scenarios provide important variables such as manager's skill, return of the hedge fund, risk of its positions, and leverage. These variables are important decision vehicles that impact NAV of the fund. One variable or the combination of these variables might lead to the collapse of the fund. It is imperative to build a model based on the functions of the hedge fund. Once the model is built, all important decision points should be incorporated in the model. The interaction of the feedbacks in the system might lead to potential collapses in individual financial institutions. A good understanding of a model and contagion mechanism leads to comprehending the reasons behind collapse and contagion in different cases.

APPENDIX A
HEDGE FUND MODEL

```
Assets=
        Cash+SUM(Loans[Types of loans!])+SUM(Total Investments[Types of
Investments!])
        ~       Dollars
"Assets - Liabilities - Equity"=
        Assets-Liabilities-Equity
        ~       Dollars
Average time to repay loans[short term]=
        1 ~~|
Average time to repay loans[long term]=
        10*0+1
        ~       Year
Capital gains[Types of Investments]=
        Rate of return on investments[Types of Investments]
        ~       Dollars/Year
"Capital gains."=
        SUM(Capital gains[Types of Investments!])
        ~       Dollars/Year
Liquidation of investments[Types of Investments]=
        Total Investments[Types of Investments]*Normal liquidation fraction
        ~       Dollars/Year
"Decr. in E. due to Defaults"[Types of loans]=
        Defaults[Types of loans]
        ~       Dollars/Year
"Decr. in E. due to Defaults."=
        SUM("Decr. in E. due to Defaults"[Types of loans!])
        ~       Dollars/Year
"Decr. in E. due to Interest owed to depositors"=
        Interest owed to depositors
        ~       Dollars/Year
"Decr. in E. due to Interest owed to depositors."=
        "Decr. in E. due to Interest owed to depositors"
        ~       Dollars/Year
New investments[Types of Investments]=
        MIN(Cash/TIME STEP,Cash*Weights[Types of Investments]*Normal new
investments fraction\
                )
        ~       Dollars/Year
"New investments."[Types of Investments]=
        New investments[Types of Investments]
        ~       Dollars/Year
Defaults[Types of loans]=
        Loans[Types of loans]*Normal default fraction
        ~       Dollars/Year
```

"Defaults."[Types of loans]=
	Defaults[Types of loans]
	~	Dollars/Year
Normal liquidation fraction=
	0.3
	~	1/Year
Normal new investments fraction=
	0.4
	~	1/Year
Rate of return on investments[low risk]=
	Total Investments[low risk]*Returns on individual investments[low risk] ~~|
Rate of return on investments[medium risk]=
	Total Investments[medium risk]*Returns on individual investments[medium risk]
Rate of return on investments[high risk]=
	Total Investments[high risk]*Returns on individual investments[high risk]
	~	Dollars/Year
"Incr. in E. due to Interest payments"[Types of loans]=
	Interest payments[Types of loans]
	~	Dollars/Year
"Incr. in E. due to Interest payments."=
	SUM("Incr. in E. due to Interest payments"[Types of loans!])
	~	Dollars/Year
"Liquidation of investments."[Types of Investments]=
	Liquidation of investments[Types of Investments]
	~	Dollars/Year
Types of Investments:
	low risk, medium risk, high risk
	~
Interest owed to depositors=
	Deposits*Interest rate promised to depositors
	~	Dollars/Year
"Interest owed to depositors."=
	Interest owed to depositors
	~	Dollars/Year
Interest payments[Types of loans]=
	Loans[Types of loans]*Interest rate[Types of loans]
	~	Dollars/Year
"Interest payments."[Types of loans]=
	Interest payments[Types of loans]
	~	Dollars/Year
Interest rate[short term]=
	0.2*0+0.1 ~~|
Interest rate[long term]=
	0.1
	~	1/Year
Interest rate promised to depositors=

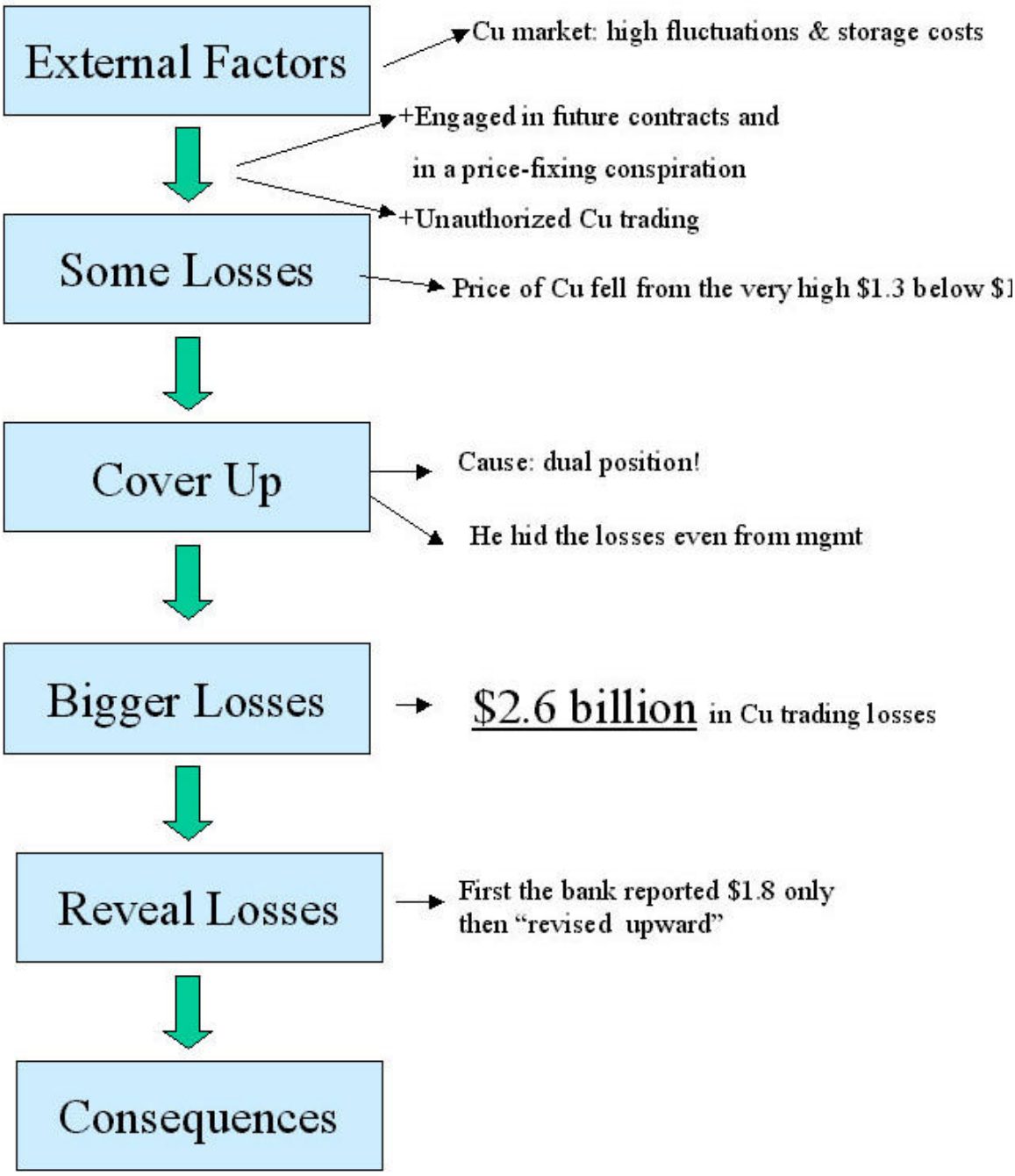
0.05
~ 1/Year
Lending rate[Types of loans]=
MIN(Cash/TIME STEP, Cash*Normal lending fraction[Types of loans])
~ Dollars/Year
"Lending rate."[Types of loans]=
Lending rate[Types of loans]
~ Dollars/Year
Weights[Types of Investments]=
Total Investments[Types of Investments]/SUM(Total Investments[Types of Investments!]\
"Rate of return on investments."[Types of Investments]=
Rate of return on investments[Types of Investments]
~ Dollars/Year
Returns on individual investments[low risk]=
0.05*0 ~~|
Returns on individual investments[medium risk]=
0.12*0 ~~|
Returns on individual investments[high risk]=
0.2*0
~ 1/Year
Loan repayments[Types of loans]=
Loans[Types of loans]/Average time to repay loans[Types of loans]
~ Dollars/Year
"Loan repayments."[Types of loans]=
Loan repayments[Types of loans]
~ Dollars/Year
Types of loans:
short term, long term
Normal lending fraction[short term]=
0.25/2 ~~|
Normal lending fraction[long term]=
0.25/2
~ 1/Year
Withdrawals=
Deposits+Interest owed to depositors
~ Dollars/Year
Normal default fraction=
13.75/13-1
~ 1/Year
Cash= INTEG (
"Deposits."-SUM("Lending rate."[Types of loans!])-SUM("New investments."[Types of Investments\
!])-"Withdrawals."+SUM("Loan repayments."[Types of loans!])+SUM("Interest payments."\

```
                [Types of loans!])+SUM("Liquidation of investments."[Types of
Investments!]),
                50)
        ~       Dollars
"Decr. in L. due to Withdrawals"=
        Withdrawals
        ~       Dollars/Year
"Decr. in L. due to Withdrawals."=
        "Decr. in L. due to Withdrawals"
        ~       Dollars/Year
Deposits=
        10
        ~       Dollars/Year
"Deposits."=
        Deposits
Equity= INTEG (
        "Capital gains."+"Incr. in E. due to Interest payments."-"Decr. in E. due to
Defaults."\
                -"Decr. in E. due to Interest owed to depositors.",
                50+200/3)
        ~       Dollars
"Incr. in L. due to Deposits"=
        Deposits
        ~       Dollars/Year
"Incr. in L. due to Deposits."=
        "Incr. in L. due to Deposits"
        ~       Dollars/Year
Liabilities= INTEG (
        "Incr. in L. due to Deposits."+"Interest owed to depositors."-"Decr. in L. due to
Withdrawals."\
                ,
                13*2/2.2)
        ~       Dollars
Loans[short term]= INTEG (
        "Lending rate."[short term]-"Defaults."[short term]-"Loan repayments."[short
term],
                13/2.2) ~~|
Loans[long term]= INTEG (
        "Lending rate."[long term]-"Defaults."[long term]-"Loan repayments."[long
term],
                13/2.2)
        ~       Dollars
Total Investments[low risk]= INTEG (
        "New investments."[low risk]-"Liquidation of investments."[low risk]+"Rate of
return on investments."\
                [low risk],
```

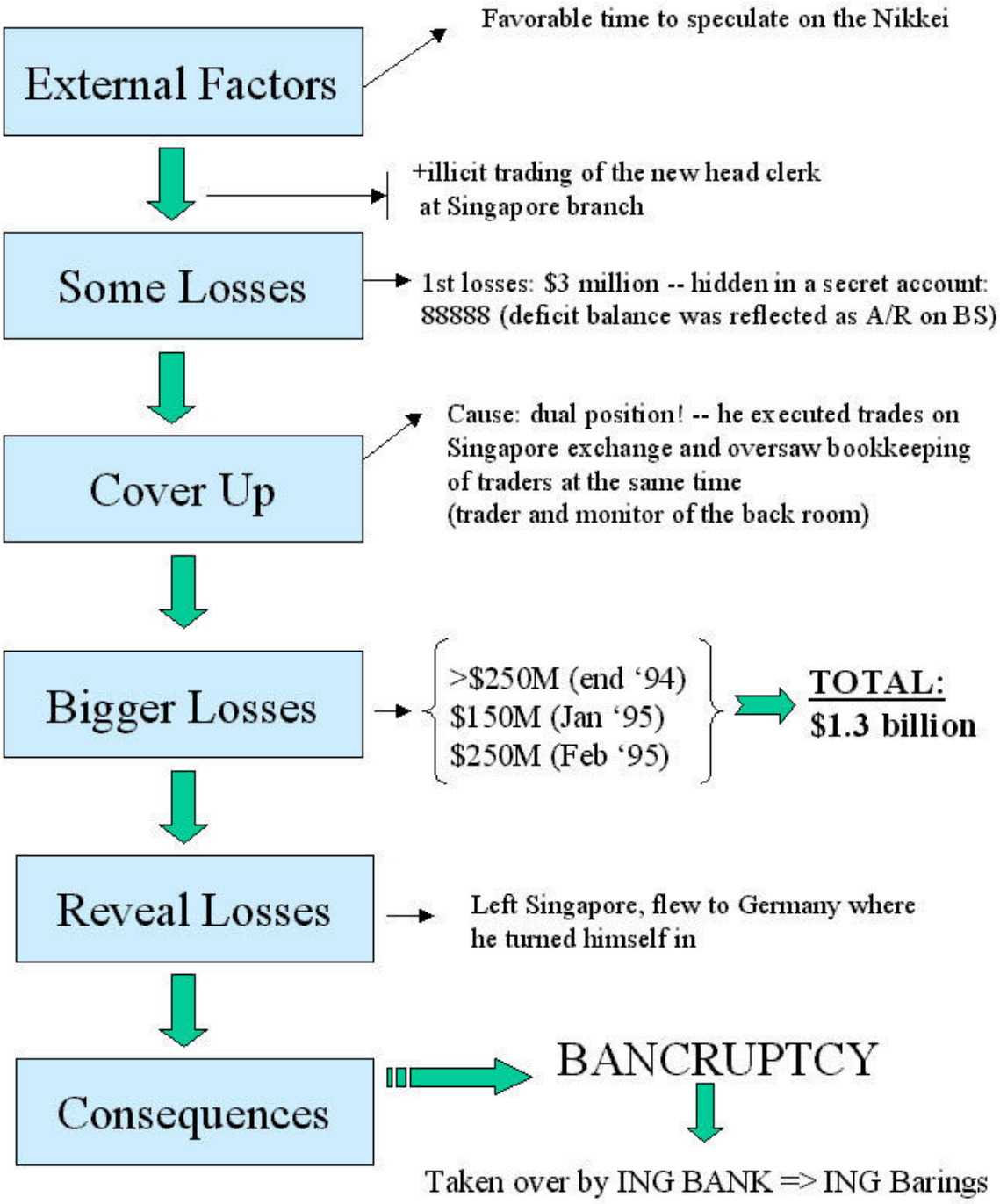
```
                200/9) ~~|
Total Investments[medium risk]= INTEG (
        "New investments."[medium risk]+"Rate of return on investments."[medium
risk]-"Liquidation of investments."\
                [medium risk],
                200/9) ~~|
Total Investments[high risk]= INTEG (
        "New investments."[high risk]+"Rate of return on investments."[high risk]-
"Liquidation of investments."\
                [high risk],
                200/9)
        ~       Dollars
"Withdrawals."=
        Withdrawals
        ~       Dollars/Year
        ~               |
********************************************************
        .Control
********************************************************~
                Simulation Control Parameters
FINAL TIME  = 100
        ~       Month
        ~       The final time for the simulation.
INITIAL TIME  = 0
        ~       Month
        ~       The initial time for the simulation.
SAVEPER  =
      TIME STEP
        ~       Month
        ~       The frequency with which output is stored.
        |TIME STEP  = 1
        ~       Month
        ~       The time step for the simulation.
```

APPENDIX B: TIME LINE DIAGRAM FAILURES: SUMITOMO BANK, BARINGS BANK, LTCM HEDGE FUND AND TIGER HEDGE FUND

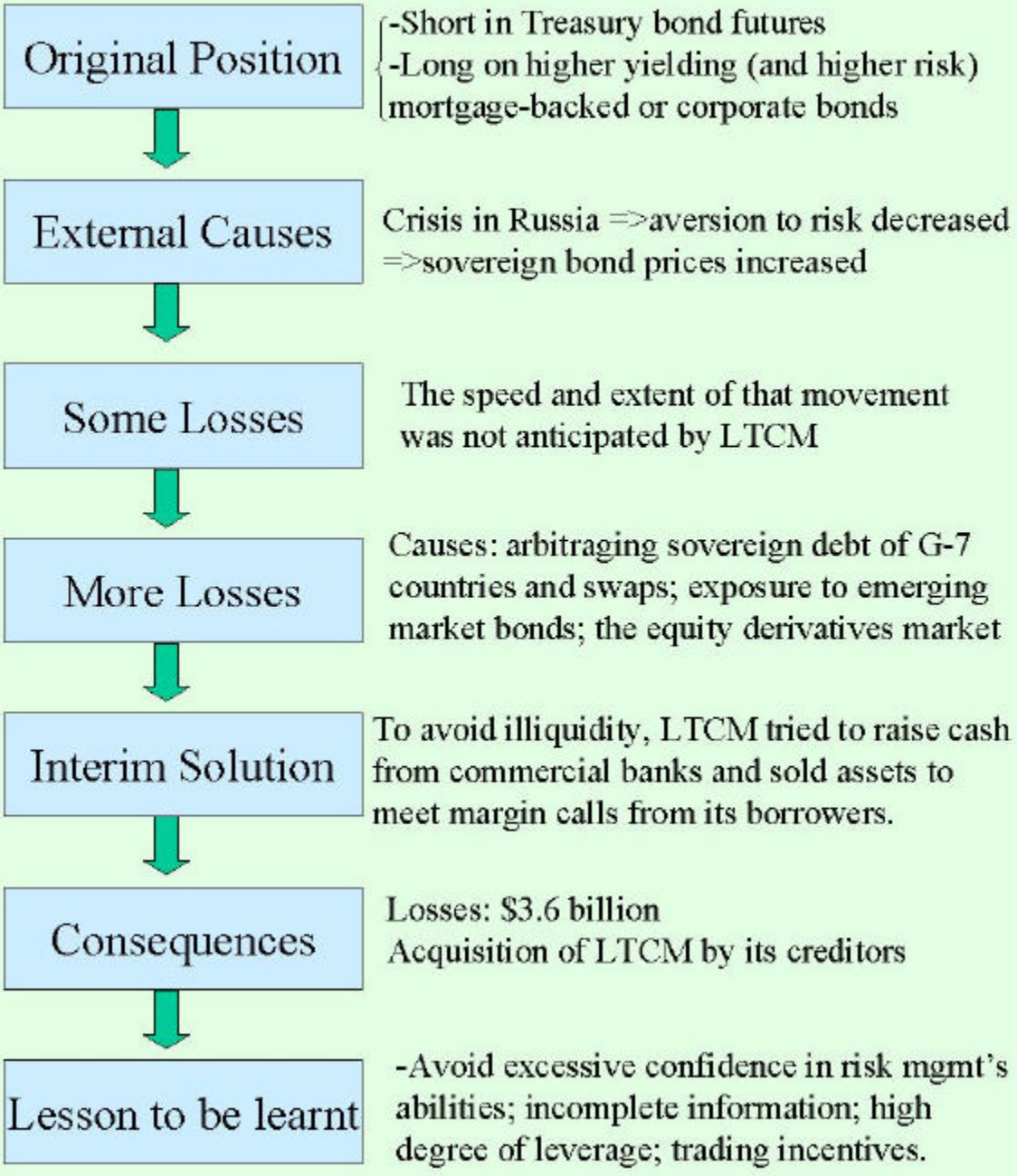
SUMITOMO Corp.

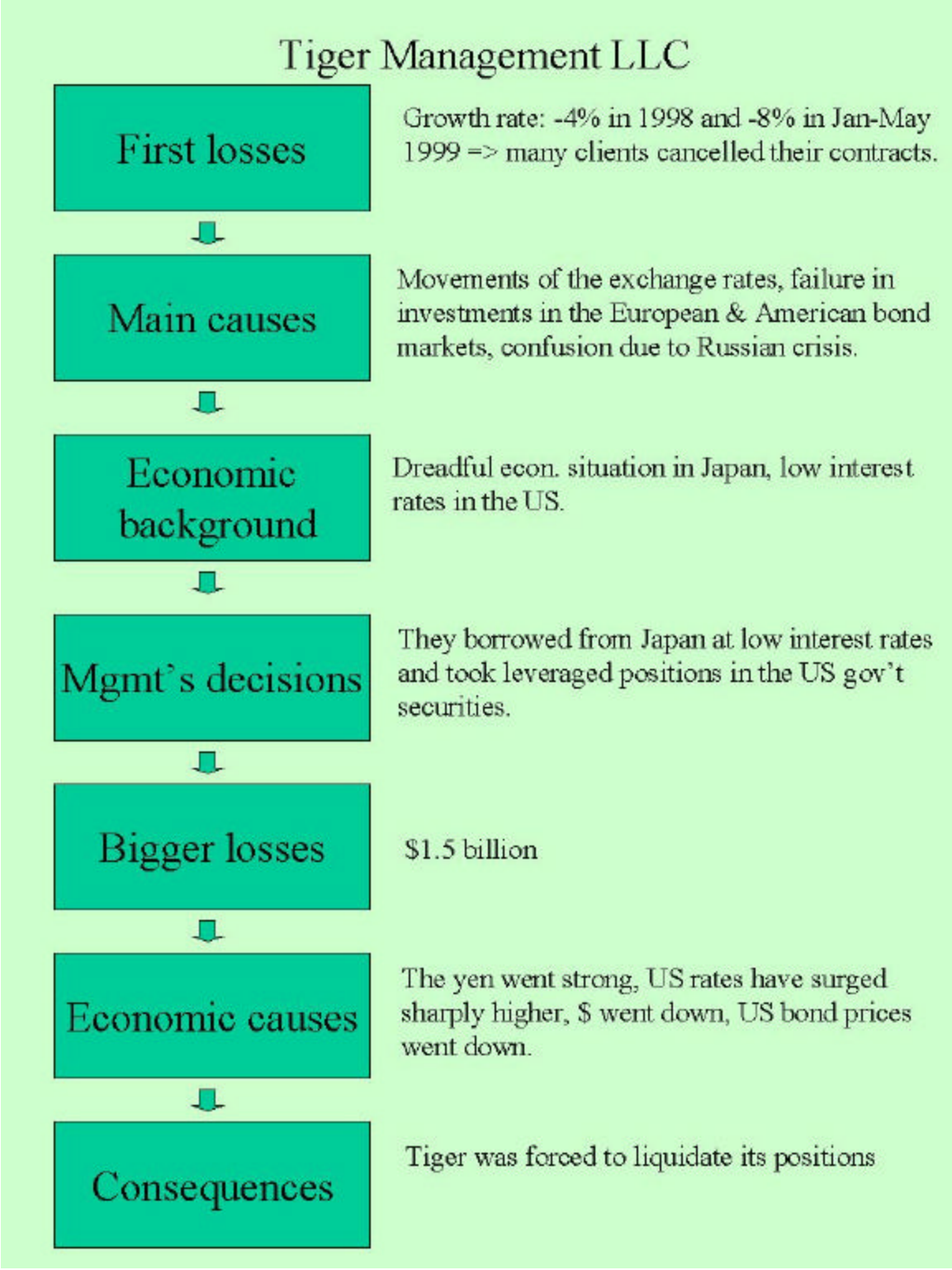


BARINGS


External Factors
Favorable time to speculate on the Nikkei
+illicit trading of the new head clerk at Singapore branch
Some Losses
1st losses: $3 million -- hidden in a secret account: 88888 (deficit balance was reflected as A/R on BS)
Cover Up
Cause: dual position! -- he executed trades on Singapore exchange and oversaw bookkeeping of traders at the same time (trader and monitor of the back room)
Bigger Losses
>$250M (end '94)
$150M (Jan '95)
$250M (Feb '95)
TOTAL:
$1.3 billion
Reveal Losses
Left Singapore, flew to Germany where he turned himself in
Consequences
BANCRUPTCY
Taken over by ING BANK => ING Barings

LTCM


Original Position
-Short in Treasury bond futures
-Long on higher yielding (and higher risk) mortgage-backed or corporate bonds
External Causes
Crisis in Russia =>aversion to risk decreased =>sovereign bond prices increased
Some Losses
The speed and extent of that movement was not anticipated by LTCM
More Losses
Causes: arbitraging sovereign debt of G-7 countries and swaps; exposure to emerging market bonds; the equity derivatives market
Interim Solution
To avoid illiquidity, LTCM tried to raise cash from commercial banks and sold assets to meet margin calls from its borrowers.
Consequences
Losses: $3.6 billion
Acquisition of LTCM by its creditors
Lesson to be learnt
-Avoid excessive confidence in risk mgmt's abilities; incomplete information; high degree of leverage; trading incentives.



Back to the Top