

Interactions among Financial Institutions -----From a Biological Ecosystem to a Financial Ecosystem

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Abstract

Based on theories and models of interactions among species in ecology and the inner similarities between a biological ecosystem and a financial ecosystem, in this article, we plan to construct the corresponding theories and models of interactions among financial institutions in a financial ecosystem and confirm them with historical data from the US. Finally, we will discuss the hot topic, the US financial crisis in 2008, from the perspective of r-selection and K-selection theory in ecology.

Key words: interaction; financial ecosystem; financial institution; financial crisis

1. Introduction

Based on Karl Marx's notion on "human nature" and Charles Darwin's theory of evolution, evolutionary economics was developed as interdisciplinary subject combining economics and evolutionary biology. Thorstein Veblen provided a framework for the general evolutionists approach in his works *Theory of the Leisure Class* and *Theory of Business Enterprise*; meanwhile Kenneth Boulding was one of the advocates of the evolutionary methods in social science. Joseph Schumpeter proposed the evolutionary perspective in his book *The Theory of Economic Development*. Richard Nelson and Sidney Winter focused on the issue of changes in technology and routines, while Ulrich Witt proposed that a proper tool set for socio-economic evolution analysis was provided by the range of self-organization and complexity theories. Inspired by these ideas, economists began to research financial systems from the perspective of biological ecosystems. Zhou Xiaochuan (2004) brought up the term "financial ecology" into the financial field in his report "Perfect legal system, improve financial ecology". Li Yang (2005) proposed a financial ecosystem is a dynamic equilibrium system in which financial entities and their environment form an interacting and interdependent relationship.

The book *Theory of Financial Ecology* included a comprehensive analysis of the theory of financial ecology in China (Xu Nuojin, 2007). In this book, the author casts light upon financial ecology from three aspects including financial ecological entities, financial ecological environment and financial ecological adjustment. Current empirical studies on financial ecology concentrate on comparison analysis of the regional differences of financial ecological environment, represented by *Evaluation of the Financial Ecological Environment in Chinese Cities* (Li Yang, 2005). Li chooses nine indicators to evaluate and rank fifty cities in terms of financial ecological environment in China.

However until now, we almost see nothing about theories and models in financial system, as inspired by theories and models in ecology. Han Tingchun and Wei Yu confirmed the existence of inner similarities between a biological ecosystem and a financial ecosystem, with the financial data of the US, Germany, Japan, and China, and various statistical tools such as cluster analysis and time series analysis (Han Tingchun, & Wei Yu, 2010).

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Simultaneously, many scholars in ecology realize the similarities between a biological ecosystem and a financial ecosystem. Robert M. May, Simon A. Levin and George Sugihara mentioned that “There is common ground in analyzing financial systems and ecosystems.....” (Robert M. May, Simon A. Levin & George Sugihara, 2008). It is worth noting that the work done by Han and Yu is to reveal this “common ground”.

In this article, with this “common ground”, we first give the whole picture of a financial system by comparing it with a biological ecosystem, and then focus our attention on the interaction of financial institutions with plenty of corresponding theories and models in ecology. Finally we will analyze the recent United States financial crisis based on the r-selection and K-selection theory in ecology.

2. The whole picture of a financial ecosystem

Before depicting the whole picture of a financial system, we first show the whole picture of a general biological ecosystem and gain some hints from it (see figure 1).

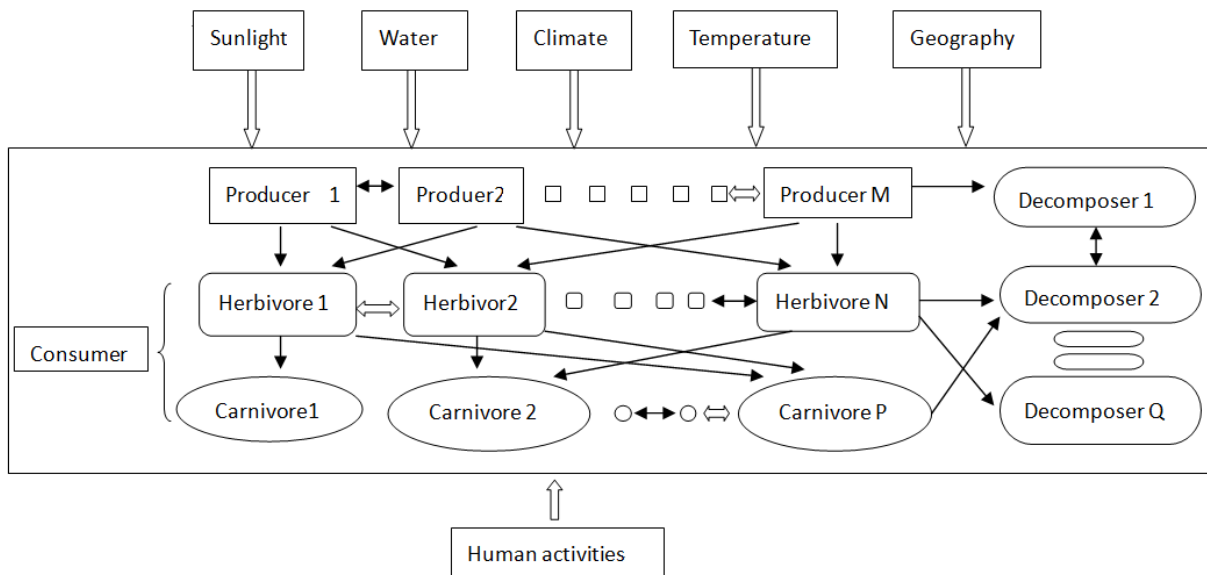


Figure 1. Whole picture of biological ecosystem

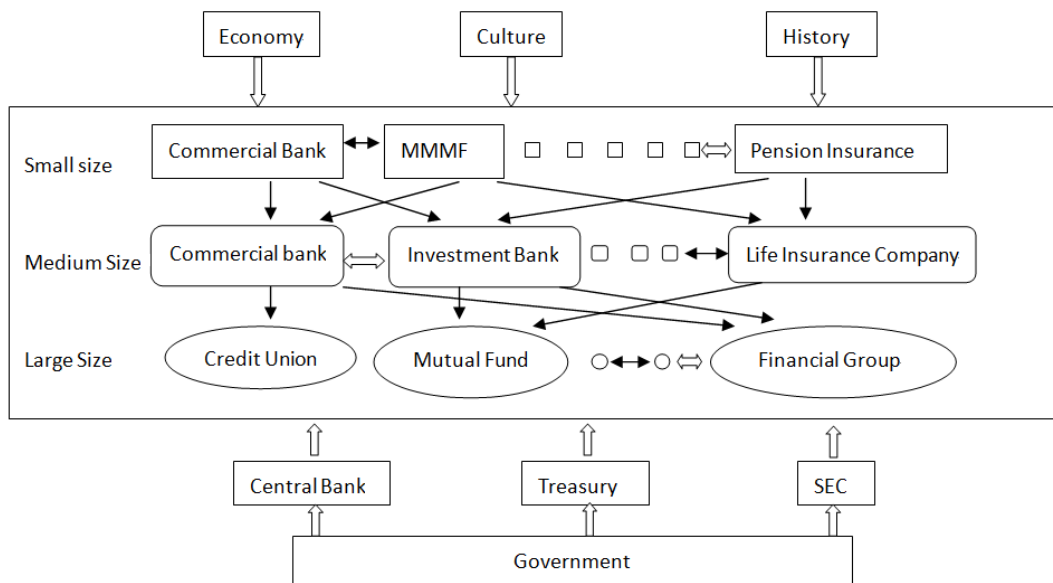
Just as the picture shows to us, a biological ecosystem contains two major parts-----organisms(the contents in the huge rectangle) and the environment (the elements surrounding the huge rectangle).

Organisms in a biological ecosystem can be classified into three categories: producer, consumer and decomposer. The producer, mainly consisting of plants, uses energy from the sun or from the oxidation of inorganic substrates to produce organic molecules. Plants are the food for herbivores, the primary consumers, and then herbivores are eaten by carnivores, the secondary consumers. In this process, a decomposer plays the role of a cleaner-----decomposing the nonliving organic materials. The most important decomposers are bacteria and fungi.

You may notice the arrows in the huge rectangle. There are three types of arrows. "A → B" means that A is B's food, in other words, A is prey and B is predator (these words might not that appropriate when decomposers are involved); "A ↔ B" means A and B compete for food, space and other resources; while "A ⇄ B" means A and B collaborate, and their relationship can be mutualism or symbiosis. These three types are the main relationships between organisms, and we can find these relationships between two different species, as well as in a single species.

↔The environment plays a so vital role in a biological ecosystem that we can nearly acclaim that the environment determines the fate of organisms after their births. The environment contains two parts-----the natural elements and the human elements. Natural elements are the sunlight, water, climate, temperature and the geography, etc. While human elements are mainly human activities. Nature selection works through the natural elements, while human selection works by human activities.

Based on the analysis of a biological ecosystem above and making the analogy between a biological ecosystem and a financial ecosystem, we gain the whole picture of a financial ecosystem below (see figure 2).



NOTE: MMMF is short for Money Market Mutual Fund; SEC is the Securities and Exchange Commission.

Figure 2. Whole picture of financial system

Just like the case in a biological ecosystem, a financial ecosystem contains two major parts-----financial institutions (the huge rectangle) and the environment (the elements surrounding the huge rectangle).

Financial institutions can be classified into two types-----depository financial institutions and non-depository financial institutions. Commercial banks, savings institutions and credit unions are depository financial institutions, while insurance companies, mutual fund, MMMF¹, investment banks, finance companies and securities brokers and dealers are non-depository financial institutions.

Like the relationships among organisms in a biological ecosystem, there are three types of relationships in financial institutions. As it shows in the picture, “A → B” means A is B’s “food”, that is B can own A by purchase; “A ↔ B” means A and B compete for the same resources, two commercial banks, for example, compete for small size time deposits by enhancing their interest rates respectively; “A ← B” means A and B work on the same project with different roles or consolidate together to gain economies of scales and scope, such as the merger of J.P. Morgan and Chase. These three types of relationships can be found among different kinds of financial institutions, as well as in the same kind. But “predator-prey” is often seen between two financial institutions with different sizes, so we give three sizes (small, medium and large) in the picture.

The environment of a financial ecosystem also consists of two parts-----governable elements and ungovernable elements. Government owns the main governable elements and it regulates the financial system through three divisions-----the central bank, the Treasury and the SEC. The central bank’s main job is to adjust money supply to propel economic growth and decrease inflation and unemployment by adjusting reserve requirements, discounting rate and by open market operations; Government purchase and government bond issues are realized through the Treasury’s work to affect the financial ecosystem; The SEC acts as the regulator to guarantee market efficiency. An interesting topic is the relationship between the independence of the central bank from its own government and the inflation rate (Lawrence S. Ritter, William L. Silber & Gregory F, 2008). Ungovernable elements are the economy, culture and history, etc (Han Tingchun & Wei Yu, 2010).

3. Interactions among financial institutions

3.1 Models for a single financial institution

-----with the birth of MMMF as a example

Ecologists have built many population models for a single species in ecology, such as continuous growth model, delay model, and discrete logistic model. Here we introduce Verhulst’s model in discrete situation:

¹ MMMF is short for Money Market Mutual Fund.

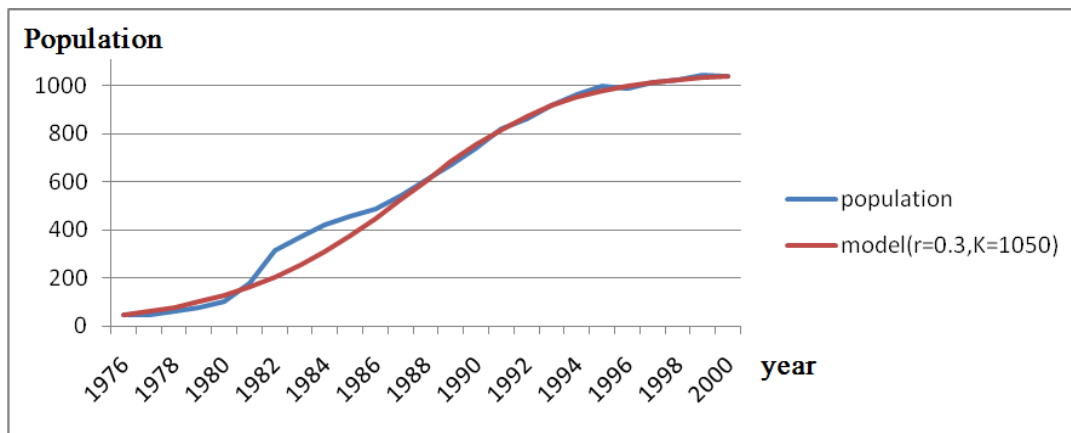
$$N_{t+1} - N_t = rN_t \left(1 - \frac{N_t}{K}\right) \quad (1)$$

In which N_t is the population of the species in question at the time t , r is the birth rate, and K is the carrying capacity of the environment.

It is easy to see that there are two steady states in model (1), they are $N_t = 0$ and $N_t = K$. If a new kind of species is created, we have N_0 , the beginning population, which is relatively much smaller than K , that is $1 - \frac{N_t}{K} \approx 1$, $N_{t+1} = (1 + r)N_t$. That is why we say r is the birth rate. When N_t is large enough relatively comparing with K , or $1 - \frac{N_t}{K} \approx 0$, we have $N_{t+1} \approx N_t \approx K$ and the growth rate is nearly zero.

This model is also suitable for a single financial institution, especially for a new one. When human intelligence creates a new financial institution, say, MMMF in 1970s, there were enough resources for its development and competition among institutions was very weak, just as the situation in ecology. But when the population is growing and approximates to the carrying capacity of the environment K , the shortage of resources and the violent competition among institutions lead to smaller or even zero growth rate.

In order to confirm that this is an appropriate model, we compare the data about MMMF (population and total asset size) with the expected results from the model we just introduced (see figure 3).



Data source: Federal Reserve and FDIC

Figure 3. MMMFs’ population evolution

The blue line in the picture above is the population of MMMF in the United States over years, while the red line is the model with $r = 0.3, K = 1050$.²

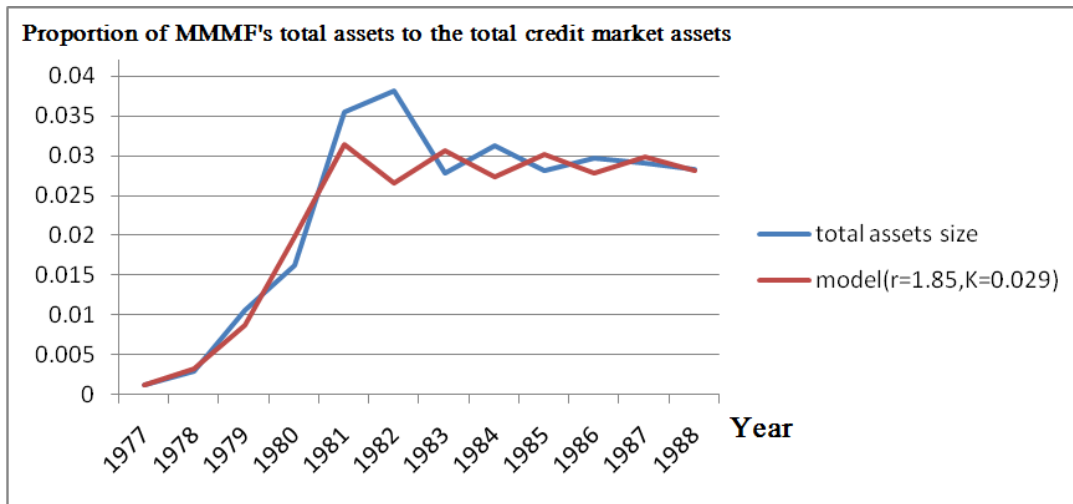
It is worth noting that there is a big difference between institutions in financial ecosystems and species in biological ecosystems: When species are in their adulthood, there is no big difference in their weights and heights; however, that is not the case in a financial ecosystem, say, the differences in asset size of different commercial banks can be very large, even though they all may be thirty years old now. We call this situation in a financial ecosystem “size effect”. Thus, the total asset size may be more appropriate than population to play the role of N_t in this model.

Before we figure out the total asset size of MMMF, we should notice the inflation effect, which leads to the loss of comparability.

² The estimation of r and K is obtained by minimize the residual sum of squares, namely

$$\min \sum_{t=1}^n (N_t - n_t)^2, \text{ where } N_t \text{ is the data in year } t \text{ and } n_t \text{ is the value of year } t \text{ from the model.}$$

One dollar in the asset this year is different from one dollar next year. In order to eliminate this effect, we use the proportion of MMMF’s total assets to the total credit market assets to substitute the total asset size. Besides, we can clearly see the relative power movement by using the proportion. Then we gain the picture below (see figure 4).



Data source: Federal Reserve and FDIC

Figure 4. MMMFs’ total assets evolution

Just like the case of population, the blue line is the total asset size of MMMF (technically, the proportion of MMMF’s total assets to the total credit market assets), while the red line is the model when $r = 1.85, K = 0.029$.

With these two pictures, we can confidently say the model we introduced is appropriate both for a biological ecosystem and a financial ecosystem.

3.2 Competition models for financial institutions
 -----with the story of MMMF and depository institutions

In ecology, the simple 2-species Lotka-Voterra competition model is a typical competition model, the discrete case is as follows:

$$N_{t+1}^1 - N_t^1 = r_1 N_t^1 \left[1 - \frac{N_t^1}{K_1} - b_{12} \frac{N_t^2}{K_1} \right] \quad (2)$$

$$N_{t+1}^2 - N_t^2 = r_2 N_t^2 \left[1 - \frac{N_t^2}{K_2} - b_{21} \frac{N_t^1}{K_2} \right] \quad (3)$$

In which N_t^1 is the population of species 1 at the time t, r_1 is the birth rate of species 1, K_1 is the carrying capacity of species 1 and b_{12} represents the impact of species 2 on species 1, and similar things happen in (3). When $b_{12} = 0$, there is no impact on species 1, we get the model for a single species, as the case in 3.1.

Now we make such substitutions:

$$u_t^1 = \frac{N_t^1}{K_1} \quad u_t^2 = \frac{N_t^2}{K_2}$$

$$a_{12} = b_{12} \frac{K_2}{K_1} \quad a_{21} = b_{21} \frac{K_1}{K_2}$$

Then (2) and (3) become:

$$u_{t+1}^1 - u_t^1 = r_1 u_t^1 (1 - u_t^1 - a_{12} u_t^2) \quad (4)$$

$$u_{t+1}^2 - u_t^2 = r_2 u_t^2 (1 - u_t^2 - a_{21} u_t^1) \quad (5)$$

So we can easily see the steady states are

$$u^1 = 0, u^2 = 0; \quad (i)$$

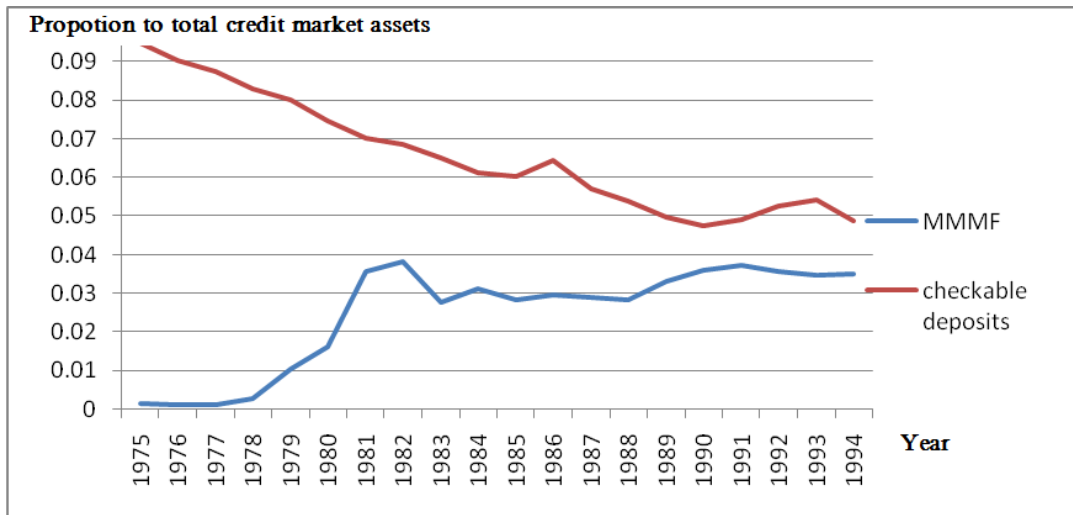
$$u^1 = 1, u^2 = 0; \quad (ii)$$

$$u^1 = 0, u^2 = 1; \tag{iii}$$

$$u^1 = \frac{1-a_{12}}{1-a_{12}a_{21}}, u^2 = \frac{1-a_{21}}{1-a_{12}a_{21}}; \tag{iv}$$

State (i) means two species die out eventually, state (ii) and (iii) are the cases that one species dies out while the other species survives, and state (iv) is an equilibrium that two species coexist. Which state the system will be is determined by a_{12} and a_{21} .

This model is also appropriate for two competitive financial institutions in a financial ecosystem. Before giving the example, let us first review some background. In 1970s, high interest rate and the Regulation Q gave the Federal Reserve the responsibility of imposing ceilings on deposit rates for preventing “destructive competition” among depository institutions and led to the birth of MMMF in the end. People could gain higher return to invest in MMMF than deposit in depository institutions (Lawrence S. Ritter, William L. Silber, Gregory F. Udell, 2008). Since then, the violent competition between depository institutions (such as commercial banks and savings institutions) and MMMF began. The picture below is the size of MMMF versus the size of checkable deposits in commercial banks and savings institutions (see figure 5). Certainly, we use the proportion of the corresponding assets to the total credit market assets to eliminate the size effect and inflation effect we ever described in 3.1.

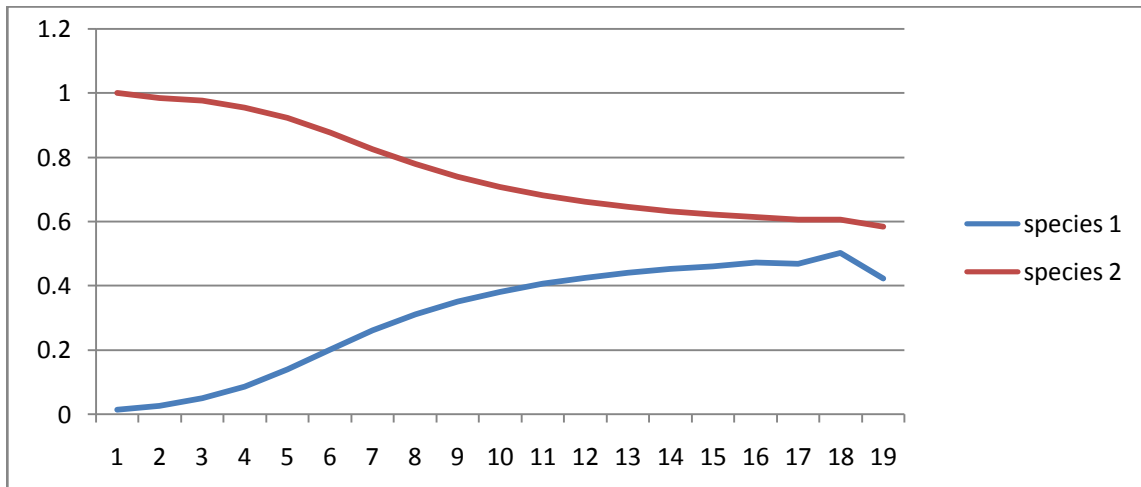


Data source: Federal Reserve and FDIC

Figure 5. Size of MMMF Versus size of checkable deposits

The blue line is the size of MMMF and the red line is the size of checkable deposits in commercial banks and savings institutions. It is easy to see that the birth of MMMF depleted a lot of depository institutions’ sources from 1975 to 1983 and the market share of MMMF and depository institutions tended to be steady and attained equilibrium. This is the case of steady state (iv) in our model! The picture below (see figure 6) is the model with

$$N_0^1 = 0.0149, \quad N_0^2 = 1; \quad r_1 = 6.60, \quad r_2 = 1.26; \quad a_{12} = 0.86, \quad a_{21} = 0.84.$$



Data source: Federal Reserve and FDIC

Figure 6. Competition between two species

The comparison of the two pictures confirms that the competition model we introduced is appropriate both for a biological ecosystem and a financial ecosystem. But the big difference between a financial ecosystem and a biological ecosystem may ruin everything-----it is the uncertainty in a financial ecosystem which caused by the central banks, governments and unpredictable international environments determines parameters in the model, such as $K_1, K_2, r_1, r_2, b_{12}, b_{21}$. In a biological ecosystem, if the human activity is not that violent, we can treat these parameters as constants for a period long enough; while in a financial ecosystem, it may be improper to treat them as constants because of violent changes of the environment. Add a random item to the model and allow the variation of parameters, we get

$$N_{t+1}^1 - N_t^1 = r_1(t)N_t^1 \left[1 - \frac{N_t^1}{K_1(t)} - b_{12}(t) \frac{N_t^2}{K_1(t)} \right] + \mathcal{N}(0, \sigma_1 N_t^1) \quad (6)$$

$$N_{t+1}^2 - N_t^2 = r_2(t)N_t^2 \left[1 - \frac{N_t^2}{K_2(t)} - b_{21}(t) \frac{N_t^1}{K_2(t)} \right] + \mathcal{N}(0, \sigma_2 N_t^2) \quad (7) \quad \text{in which } \mathcal{N}(0, \sigma) \text{ is a}$$

random variable which has normal distribution with mean 0 and standard deviation σ .

To a large extent, which form is appropriate for a parameter depends on the situation we want to model. For example, the phasing out of the Regulation Q would lead to the decrease of $r_1(t)$, so the proper form of $r_1(t)$ may be $r_1(t) = a - bt$ or $r_1(t) = a + e^{-bt}$; while $r_1(t) = \begin{cases} a & t \leq t_0 \\ b & t > t_0 \end{cases}$ is proper for the immediate elimination of Regulation Q at the time t_0 .

**3.3 Predator-Prey models in a financial ecosystem
-----with the story of banking industry in the U.S. since the 1980s**

Volterra first proposed a simple model for the predation of one species by another in ecology

$$\frac{dN}{dt} = N(a - bP) \quad (8)$$

$$\frac{dP}{dt} = P(cN - d) \quad (9)$$

in which $N(t)$ is the prey population while $P(t)$ is the population of predator, a is the birth rate of prey without predators and d is the mortality of predator without prey, and b is the impact factor of predator on prey while c is the impact factor of prey on predator.

However in a financial ecosystem, the story is a little different. The first problem is the inflation effect we mentioned in 3.1, and the second big problem is that the “predator” in a financial ecosystem can still survive even though without “prey”. Examples always help us understand everything quickly: big commercial banks, acting as predator, may purchase small commercial banks, which play the role of prey.

Without small banks, however, big commercial banks can still do good jobs. But the fate of a horse is death without grass. These problems urge us to make some improvements to the predator-prey model when we introduce it into the financial ecosystem.

Now we also consider two “species” in a financial ecosystem, one is “predator” and the other is “prey”, that is the institution acting as the “predator” can purchase the institution acting as the “prey”. As known, purchase happens either between two institutions with the same kind, such as big MMMF and small MMMF, or between two institutions with two kinds, such as a big commercial bank and a small investment bank. Here we plan to model the former. We assume K_n and K_p are the carrying capacity of the “prey” and the “predator”, a and c are their birth rates, and b and d are the impact factors predator on prey and prey on predator, respectively. We also believe these parameters are constant in a short time. Thus we gain the model:

$$N_{t+1} - N_t = aN_t \left(1 - \frac{N_t}{K_n} - bP_t \right) \quad (10)$$

$$P_{t+1} - P_t = cP_t \left(1 - \frac{P_t}{K_p} + dN_t \right) \quad (11)$$

But in (10) and (11), we do not consider the inflation effect. Now we assume the ratio r , the number of “prey” changing into “predator” because of the inflation effect in every unit time to the number of prey N_t , is a constant, then we gain a new model:

$$N_{t+1} - N_t = aN_t \left(1 - \frac{N_t}{K_n} - bP_t \right) - rN_t \quad (12)$$

$$P_{t+1} - P_t = cP_t \left(1 - \frac{P_t}{K_p} + dN_t \right) + rN_t \quad (13)$$

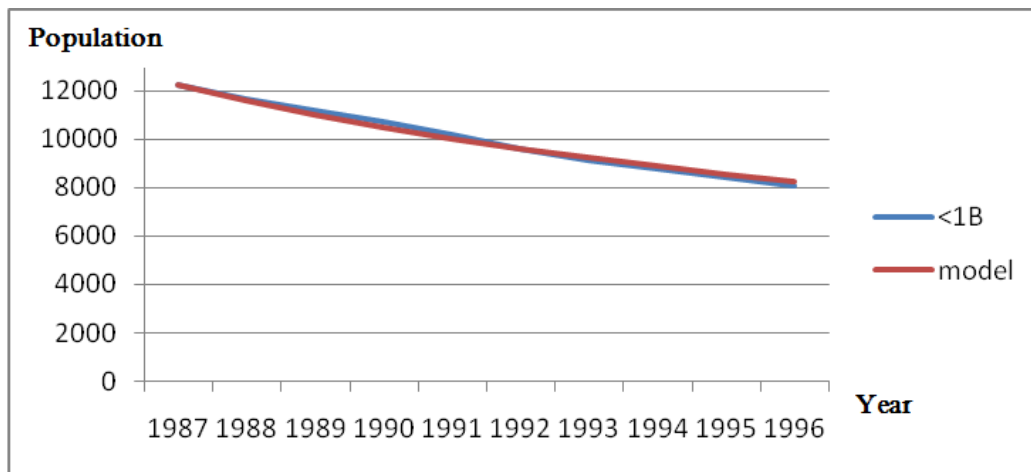
A good example for predator-prey model is the transition period of the United States banking industry since 1980s. The McFadden Act of 1927 prohibited banks from branching state lines and prevented competition in banking industry, resulting in 14,400 banks in the United States by the beginning of 1980s and 40% of them with assets less than \$25 million. However since 1980s, a gradual process of repealing the McFadden Act took place and in 1994 the Riegle-Neal interstate Banking and Branching Efficiency Act overturned the McFadden Act (Lawrence S. Ritter, William L. Silber, Gregory F. Udell, 2008).

Now we classify all the commercial banks in the United States from 1987 to 1996 into two groups: banks with assets smaller than 1 billion (acting as the “prey”) and banks with assets bigger that 1 billion (acting as the “predator”). With the data from FDIC, we estimate the parameters below:

$$N_{t+1} - N_t = 0.003N_t \left(1 - \frac{N_t}{1600} - 0.017P_t \right) - 0.00099N_t \quad (14)$$

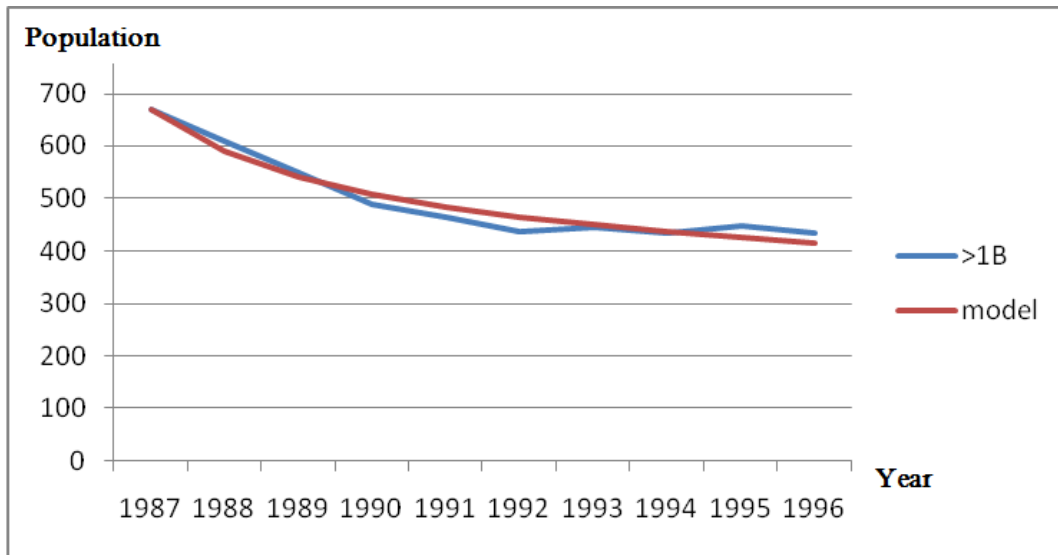
$$P_{t+1} - P_t = 0.094P_t \left(1 - \frac{P_t}{170} + 0.00012N_t \right) + 0.00099N_t \quad (15)$$

The following two pictures are the number of “prey” and “predator” (the blue line) versus the result from (14) and (15) (the red line), respectively (see figure 7 and figure 8). It is obvious that the model we built is proper for institutions in a financial ecosystem with a predator-prey relationship.



Data source: Federal Reserve and FDIC

Figure 7. Number of “prey”s



Data source: Federal Reserve and FDIC

Figure 8. Number of “predator”s

3.4 Mutualism models in a financial ecosystem

-----An example: Mergers in the banking industry

As you can imagine, ecologists construct the mutualism or symbiosis model (in the continuous situation) as follows:

$$\frac{dN_t^1}{dt} = r_1 N_t^1 \left(1 - \frac{N_t^1}{K_1} + b_{12} \frac{N_t^2}{K_1} \right) \quad (16)$$

$$\frac{dN_t^2}{dt} = r_2 N_t^2 \left(1 - \frac{N_t^2}{K_2} + b_{21} \frac{N_t^1}{K_2} \right) \quad (17)$$

where N_t^1 is the population of species 1 at the time t, r_1 is the birth rate of species 1, K_1 is the carrying capacity of species 1 and b_{12} represents the impact species 2 makes on species 1, and similar things happen to species 2.

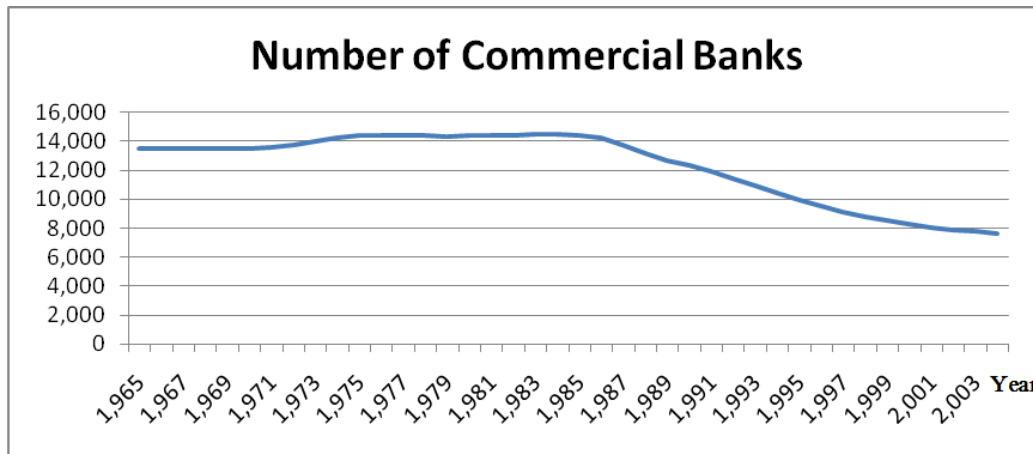
In a biological ecosystem, when the existence of species 1 provides species 2 a better life and the same thing happens to species 1, we say the two species have the mutualistic relationship. Plant and seed disperser is one example. In a financial ecosystem, institutions with the mutualistic relationship can be seen everywhere. Institution merger is a typical example. But the situation in a financial ecosystem is a little different from that in a biological ecosystem. Similar to what we discussed before, N_t^1 and N_t^2 are the populations of species 1 and species 2 in a biological ecosystem, while it should be more appropriate that N_t^1 and N_t^2 are the sizes of total assets of type 1 financial institutions and type 2 financial institutions in a financial ecosystem. As we will see right now, institution mergers lead to the increase of total assets but the decrease of population.

As with the situation in the predator-prey relationship, mutualism can be found between financial institutions with different types and between institutions with the same type. The merger of two commercial banks with equivalent asset size will increase their market share and decrease the costs for overlapping expenditure; while the merger of a commercial bank and an insurance company will enlarge their business scope and increase integrity. The key to judge the relationship of two financial institutions (predator-prey or mutualism) is to compare the sizes of the institutions. If one institution is obviously bigger than the other one and the former has the full rights to determine the fate of the latter, they are in a predator-prey relationship; If there is no much big difference between their asset size of the two institutions and they cooperate with each other to gain more profits, they are in a mutualistic relationship.

Bank merger in 1990s in the United States is a good example for mutualism. As the Riegle-Neal interstate Banking and Branching Efficiency Act overturned the McFadden Act, bank mergers became an irreversible trend and the number of banks decreased dramatically, while the asset size³ of banks was steady.

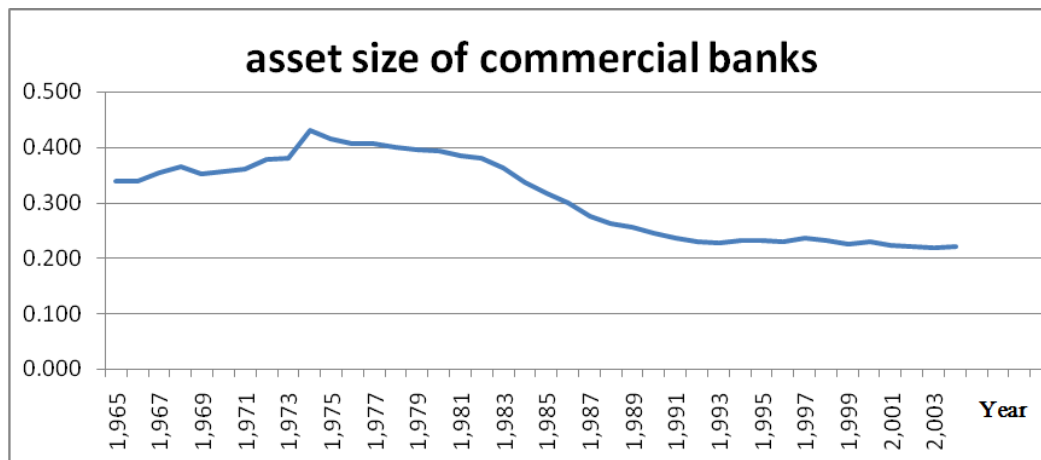
³ Here we use the proportion of total assets to total credit market assets to eliminate the inflation effect.

From the two pictures (see figure 9 and figure 10), we can see that the asset size of commercial banks decreased dramatically in 1980s due to the Regulation Q and the birth of MMMF as we described in 3.1 and 3.2, while the number of commercial banks decreased dramatically since 1987 due to the repeal of the McFadden Act.



Data source: FDIC

Figure 9. Number of Commercial Banks



Data source: FDIC

Figure 10. Proportion of total assets to total credit market assets

3.5 A summary of interactions among financial institutions

The three types of interactions among financial institutions we introduced consist of the main contents of financial institutions interaction⁴. Now we consider two institutions A and B, with N_t^1 and N_t^2 being their population, or asset size, r_1 and r_2 the birth rate and K_1 and K_2 the carrying capacity, respectively. b_{12} represents the impact on A from B and b_{21} represents the impact on B from A. Then we can write one model⁵ (in continuous situation) for three types of interactions:

$$\frac{dN_t^1}{dt} = r_1 N_t^1 \left(1 - \frac{N_t^1}{K_1} + b_{12} \frac{N_t^2}{K_1} \right) \quad (18)$$

$$\frac{dN_t^2}{dt} = r_2 N_t^2 \left(1 - \frac{N_t^2}{K_2} + b_{21} \frac{N_t^1}{K_2} \right) \quad (19)$$

When $b_{12} < 0$ and $b_{21} < 0$, A and B are competitors;

When $b_{12} > 0$ and $b_{21} < 0$, A acts as the “predator” and B is the “prey”;

When $b_{12} < 0$ and $b_{21} > 0$, B acts as the “predator” and A is the “prey”;

When $b_{12} > 0$ and $b_{21} > 0$, A and B have the mutualistic relationship.

⁴ Here we exclude the case that one institution makes no impact on the other one.

⁵ As examples in 3.2 and 3.3, we need some modifications on the model when meeting some special cases.

Thereafter, what is the consequence of these three types of interactions? Competition means the strong beats the weak; predator-prey relationship means the big one becomes bigger and the small one disappears; while mutualism means two small ones consolidate and form a new big one! One word in all, the number of small entities decreases and the number of big entities increases. In the word of ecology, it is the switch from r-selection to K-selection.

4. The r-selection and K-selection in a financial ecosystem

In ecology, r- selection and K-selection theory describes two different life history strategies. K-selected species, say, tigers, elephants, are adapted to be competitive with slow development, large adult size, few but large offsprings and a long generation time, while r-selected species, such as ants, herbs, are adapted to maximize the growth rate of population, with rapid development, small adult size, many but small offsprings and a short generation time(Langohr,1998).

If we apply this theory to a financial ecosystem, we get two choices for financial institutions: to be specialized and flexible with smaller size, or to be integrative, and steady with larger size. The financial institutions mergers during 1990s in the United States were the institutions’ choice to switch from r-selection to K-selection. Before 1990s, many financial institutions, especially commercial banks, were specialized in their business, with small asset size and limited business scope because of the McFadden Act; during 1990s, the number of financial groups with integrative business, large asset size and business scope increased dramatically(Lawrence S. Ritter, William L. Silber & Gregory F. Udell, 2008). The merger of Citicorp and the Travelers Group is a typical example. The picture below describes the four mergers in 1990s and ultimately the birth of Citigroup, with assets of almost \$700 billion and divisions including commercial bank, investment bank, market mutual fund and insurance company (see figure 11).

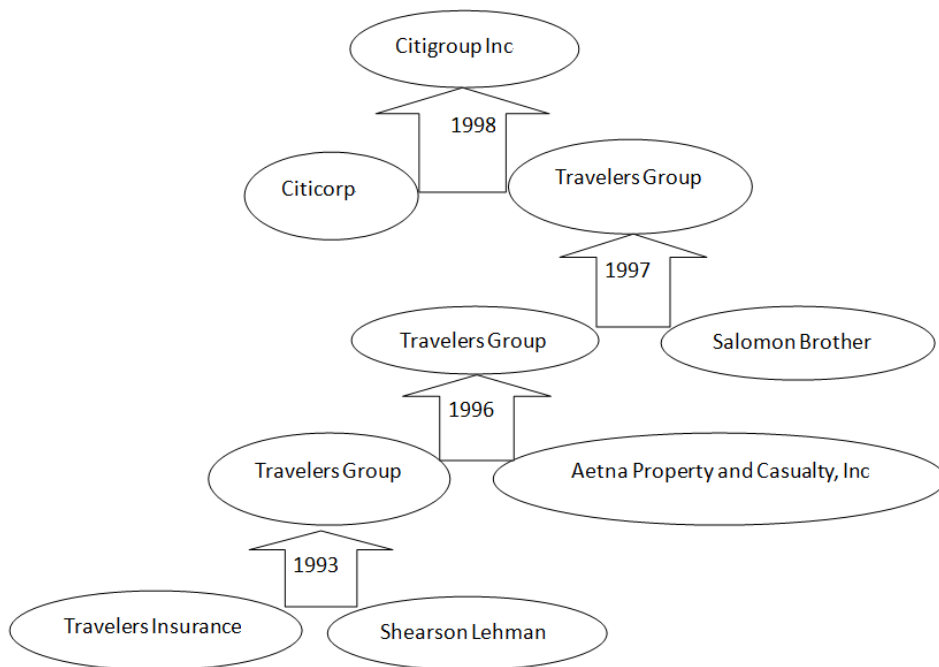


Figure 11. Merger of Citicorp

Switch from r-selection to K-selection might bring positive effects on a single institution because of economies of scale and economies of scope. Mergers between institutions enlarge product scope, customer base, geographic coverage and market share, which makes the new institution stronger and more resistant to violent disturbs outside. What’s more, large market share means pricing power, oligopoly, or even monopoly, and becomes the driving forces for bankers’ irrational behavior when facing mergers between institutions. The positive effects may disappear, however, just as Langohr mentioned (Langohr, 1998):

“Complexity increases exponentially with product scope, customer base and geographic coverage. New coordination, monitoring, and communication costs overlay rapidly the fixed costs associated with smaller size. In the end, average costs often increase”.

Therefore, there is an upper bound for the size of a financial institution, just as the upper bound for the weight of animals in ecology⁶.

However the switch from r-selection to K-selection might make the whole financial ecosystem unstable because of the increasing relevance and decreasing independence among financial institutions. With K-selection, large financial institutions almost have the same business scope and common customer base. When a new product, say the securitization of mortgage, is created with good expectation for future, many institutions will take this new product into their product scope. However, when something wrong happens on this new product, say debtors losing their ability to pay the mortgage, nearly the whole financial system will be influenced, and it is the true story happened in the United States in 2008.

It is similar with the following case in ecology: all horses in the world are on the same huge grassland and feed on the same grass G. One day some poisonous substance is found in grass G and ultimately all horses are poisoning and many of them die.

In fact, the financial system in the Great Depression of the 1930s in the United States is somewhat similar with the one in 2008. Before the Great Depression, the securities industry entered a boom period since 1920s and the distance between commercial banks and investment banks was closer and closer. The boom of stock market and other securities brought generous profits to investment banks; meanwhile the capital support for investment banks from commercial banks guaranteed the boom. The National City Bank of New York (predecessor of Citigroup), and the J.P. Morgan are typical examples.

For an enterprise, the diversity of its assets guarantees relatively a lower risk, therefore the combination of commercial and investment banking seems to be a wise choice from the respective of the portfolio theory. However it might be a catastrophe for the financial system, because the close relationship between commercial and investment banking leads to a higher risk for the whole financial system. The bad news of investment banking would exert impact on commercial banking and vice versa. The portfolio theory tells investors should not to put all his/her eggs in one basket”, but the close relationship of commercial and investment banking means all the baskets are tied together, and the flip of one basket equals the flip of all baskets! The great crash in the stock market in 1929 was a catastrophe to the securities industry, and the close relationship between commercial and investment banking led to the depreciation of the assets of commercial banks and the lack of cash and liquidity, ultimately the run on a bank and the bankruptcy of many banks. The financial system collapsed.

In 2008, the US made the same mistake it ever made in the Great Depression, after they repealed the *Glass-Steagall Act* in 1999 and allowed the close relationship between commercial and investment banking. At the beginning, debtors losing ability to pay the mortgage resulted in the huge decrease of relevant securities and the depreciation of assets of investment and commercial banks. It further led to the bankruptcy of investment banks, and even commercial banks. Ultimately, the financial system collapsed and the government began to clean up the mess.

In fact, after the collapse of financial system in 1930s, the congress passed the *Glass-Steagall Act*, which demanded the separation of commercial and investment banking. Thereafter the security division of the National Bank of New York was separated and the J.P. Morgan was divided into two banks, J.P. Morgan---a commercial bank and Morgan Stanley---an investment bank. However in 1999, this act was repealed, bringing the whole financial system back to a higher risk position and foretelling the second collapse of the financial system in the future. Therefore we see the birth of financial giants, Citigroup, J.P. Morgan Chase, etc.

Here come two important topics:

First, is the repeal of the *Glass-Steagall Act* a wise choice? As we know, the birth of MMMF and the boom of the securities industry in 1970s and 1980s led to the decrease of commercial banks' market share. In order to survive, commercial banking had to seek a way out. The most feasible and profitable way is to consolidate with investment banking, because commercial banking dominated the credit market and was be able to provide an adequate money supply, while investment banking could produce generous profits with these enough money. Therefore the mutual benefit between commercial and investment banking beat the *Glass-Steagall Act* entirely in 1999.

⁶ Animals with too much weight always lack competition ability to catch prey because of slow speed.

The following picture is the proportion of corporation bonds and equity securities to the total assets of commercial banks (see figure 12). We can see that this proportion increased dramatically around 1999.

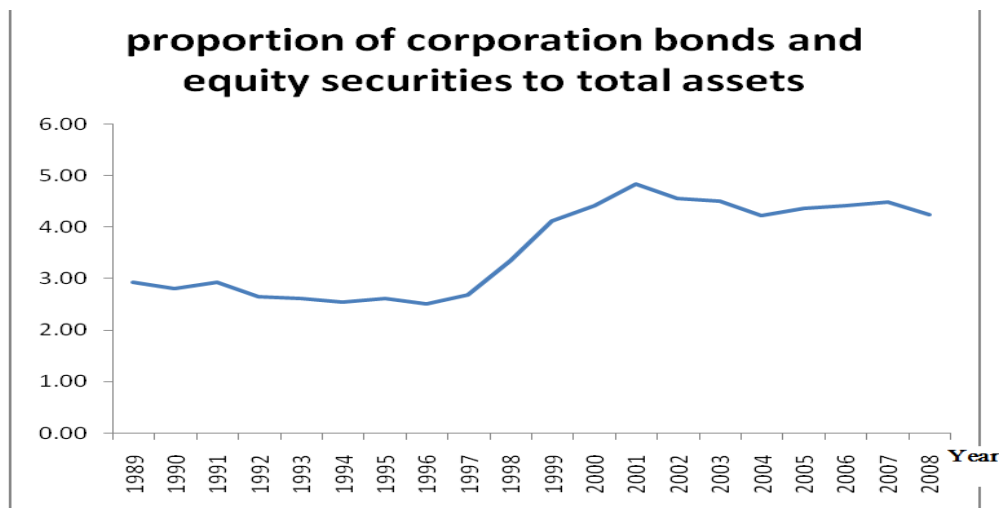


Figure 12. Proportion of corporation bonds and equity securities to total assets of commercial banks

However the alliance of commercial and investment banking made the assets of commercial banks in a higher risk level, the whole financial system became unstable and ultimately the financial crisis began in 2008. Without the money supply from commercial banks, the intensity and range of the financial crisis could not be so strong and widespread. To some extent, the repeal of the *Glass-Steagall Act* should be responsible for the 2008 financial crisis.

Second, what will happen in the process of financial globalization? To a single nation, the government can pass relevant laws, like the *Glass-Steagall Act*, to guarantee the separation of commercial and investment banking; however to the whole world, there is no such an organization that can regulate the international financial system and guarantee this separation. In fact, to every nation, the consolidation of commercial and investment banking, namely the K-selection, is the best way to dominate the international financial system. However, like the case we discussed above, every nation's K-selection means the instability of the international financial system and foretells the international financial crisis, which is usually ignored by each nation. Only experiencing catastrophic international financial crisis several times, can people realize the importance and urgency of building an international organization to regulate the international financial system. Just as only after World War I and World War II, could we realize the importance of establishing the United Nations.

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