Economic Complexity and Equilibrium Illusion

The Principle of Large Numbers indicates that macro fluctuations have weak microfoundations; persistent business cycles and interrupted technologies can be better characterized by macro vitality and meso foundations. Economic growth is limited by market extent and ecological constraints. The trade-off between stability and complexity is the foundation of cultural diversity and mixed economies. The new science of complexity sheds light on the sources of economic instability and complexity.

This book consists of the major work of Professor Ping Chen, a pioneer in studying economic chaos and economic complexity. The chapters are selected from works completed since 1987, including original research on the evolutionary dynamics of the division of labor, empirical and theoretical studies of economic chaos, and stochastic models of collective behavior. Offering a new perspective on market instability and the changing world order, the basic pillars in equilibrium economics are challenged by solid evidence of economic complexity and time asymmetry, including Friedman's theory of exogenous money and efficient market, the Frisch model of noise-driven cycles, the Lucas model of microfoundations and rational expectations, the Black–Scholes model of option pricing, and the Coase theory of transaction costs.

Throughout, a general framework based on complex evolutionary economics is developed, which integrates different insights from Smith, Malthus, Marx, Hayek, Schumpeter, and Keynes and offers a new understanding of the evolutionary history of division of labor. This book will be of interest to postgraduates and researchers in Economics, including macroeconomics, financial economics, advanced econometrics and economic methodology.

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Economic Complexity and Equilibrium Illusion

Essays on market instability and macro vitality

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16.1 Introduction

This ongoing Grand Crisis originated in the United States, then transmogrified into an international crisis. It represents a natural experiment. The positive side of this crisis is its fundamental lesson. It is not a theoretical debate confined to ivory towers, but a historical event that has destroyed social confidence in the mainstream equilibrium theory of the so-called efficient market. This has accelerated the rise of the nonlinear evolutionary theory of the viable market. Three observations reveal where the equilibrium theory of asset pricing and business cycles went wrong: (1) the meso foundation of macro fluctuations; (2) the endogenous nature of persistent cycles in financial macro indexes; and (3) the trend of collapse and higher moment risk in the derivative market. The new perspective of nonlinear population dynamics in continuous time provides a better alternative to existing rational-actor/linear models of finance, not only for understanding the cause of the present situation, but to inform efforts related to redesign and reform. The systematic failure in the mortgage security market, unprecedented concentration in the international financial market, and unfettered speculation in the commodity and currency markets have all contributed to the current disaster. A new international financial order can be achieved if a robust and workable international antitrust law can be enacted and a Tobin tax on foreign exchange transactions can be established through global efforts. An overhaul of financial theory is needed to develop a viable market for sustainable economies.

16.2 Empirical observations and policy implications: econometric illusion in the efficient market and an alternative strategy for a viable market

Our empirical analysis of business cycles draws on tools developed by the new science of complexity and nonlinear dynamics, which were applied to US economic time series (Chen 1988a, 1996a, 1996b, 2002, 1999). The policy recommendations were reached based on alternative scenarios tested under the rubric of nonlinear evolutionary dynamics in finance and economics (Chen 2005,

2007a, 2008). The debate begins by examining the nature of business cycles, before proceeding to study the misleading role of linear models in asset pricing.

16.2.1 Endogenous nature of US persistent business cycles and a new perspective on risk management

What was the nature of the US financial crisis? US Federal Reserve Chairman, Ben Bernanke (2005), has attributed it to over-consumption in the United States and over-saving in China, while Treasury Secretary, Tim Geithner (2009), has blamed China's exchange rate policy. The hidden assumption behind Bernanke or Geithner theory is that this financial crisis was mainly caused by external rather than endogenous causes. Therefore, the first fundamental issue is the nature of business cycles. Are they generated by external shocks (Frisch 1933; Lucas 1972) or by internal instability (Schumpeter 1939; Chen 1988a, 1996a, 1996b)? This issue is essential, since all textbook investment strategies related to diversification and hedging are based on a simple assumption that an efficient market is characterized by a random walk or Brownian motion, without countenancing the possibility of nonlinear deterministic patterns such as persistent cycles and chaos (Friedman 1953; Fama 1970, 1991; Black and Scholes 1973). The application of a new technique of time–frequency analysis based on WGQ (Wigner–Gabor–Qian) transformation in time–frequency space has led to the development of a powerful tool for nonstationary time series analysis, which can replace those conventional models (Chen 1996a, 2005, 2008). Solid evidence of endogenous persistent cycles is shown in Figure 16.1, while the equilibrium illusion of white noise is simply created by the first difference (FD) filter (Figure 16.2), which is a high-frequency noise amplifier by nature (Chen 2008).

As shown in Figure 16.1, deterministic cycles can explain 65 percent of variance from HP-detrended cycles filtered by WGQ transformation in time–frequency space. The cross-correlation with original cycles is 0.94. We found these persistent cycles can be explained by color chaos. Color means that its intrinsic period is about four to five years. Color chaos is deterministic chaos in continuous time. Its correlation dimension is about 2.5 (Chen 2005). Color chaos can be considered as the nonlinear model of Schumpeter's biological clock, a better alternative model of random walk or white noise in equilibrium theory of business cycles.

From Figure 16.2, we may easily find out that FD filter is a whitening device, which suppresses low-frequency signals in business-cycle range but amplifies high-frequency noise. This is the central device in creating an equilibrium illusion of an "efficient market" which is characterized by white noise or random walk in Wall Street.

What can be learnt from these observations? First, white noise plays only a non-dominant role in the financial market. For example, the white noise component represents only about 35 percent of the variance of the HP-filtered cycles. Second, the equilibrium theory of efficient markets provides a distorted image of reality. We find that the intrinsic frequency of stock market indexes is remark-

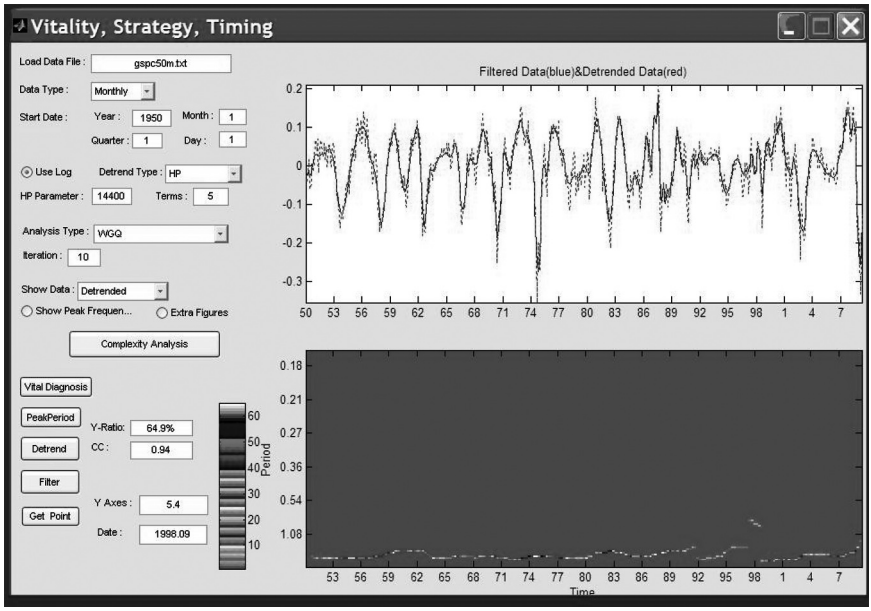

Figure 16.1 Nonstationary time series analysis based on WGQ (Wignor-Gabor-Qian) transformation (source: data used is GSPC (Standard & Poor 500 index) monthly (January 1950 to April 2009) (http://yahoo.finance).

Notes
The upper diagram shows the original (the dotted line) and filtered (the solid line) HP cyclic time series. Y-ratio (the variance of the filtered time series to the variance of the original one) is 64.9 percent. CC (their cross-correlation) is 0.94. The lower diagram shows the time trajectory of the characteristic period of the HP cyclic series. The vertical axis is the period in years, the horizontal axis is time from 1950 to 2009. The period trajectory is more or less moving around the NBER business cycle frequency.

ably stable about the business-cycle frequency, while the price level varies erratically. Therefore, *price does not contain all the information about market movements*. Market trends, cyclical periods, and correlation phases have more essential information than the price level for business decision making and macro management. Third, the equilibrium theory of asset pricing offers a misleading recipe for risk management. A diversification strategy works only if market movements have no systematic trends and persistent cycles and all players make independent rational decisions without correlated actions. If business cycles play a leading role in market movements, cash-flow and credit-line management should be the key factor in risk management (CAPM model by Sharp 1964). Investors do not just make a simple choice between stocks and bonds. Cash can become king when uncertainty is pervasive. That is why securitization is not capable of preventing crises such as the sub-prime debacle. On the contrary, complex tools of derivative trading amplify market resonance by leveraging under the guidance of equilibrium theory of arbitrage-free opportunities.

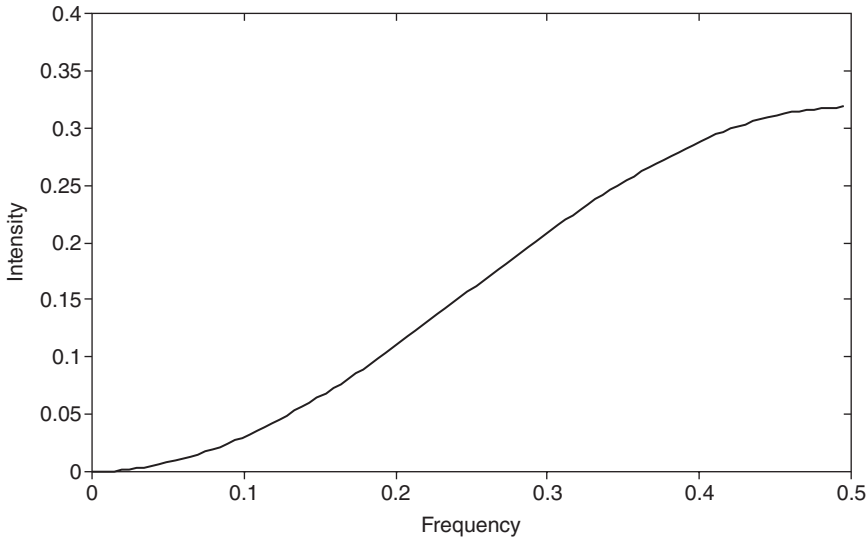

Figure 16.2 The frequency response function for the FD filter.

Notes
Here,

$$FD[S(t)] = S(t+1) - S(t) = \ln\frac{X(t+1)}{X(t)},\ S(t) = \ln X(t).$$

The horizontal axis is the normalized frequency range from zero to 0.5. The vertical axis is signal intensity.

16.2.2 The meso foundation of macro fluctuations and competition policy in the global economy

Lucas (1972) made a strong claim that business cycles could be explained by an equilibrium (rational expectations) mechanism of workers' choices between work and leisure. His microfoundations theory has, however, been rejected by empirical observations based on the Principle of Large Numbers (Chen 2002). It was Schrödinger (1944), the founder of quantum mechanics and quantum biology, who found a salient relationship between the number of micro elements and the variability of aggregate fluctuations.

$$\text{Market variability (MV)} = \frac{STD(S_N)}{Mean(S_N)} \approx \frac{1}{\sqrt{N}} \tag{16.1}$$

The implication of equation (16.1) is very clear. The more micro elements involved, the less will be the aggregate fluctuation. This is the Principle of Large Numbers. This relation holds not only for static aggregation, but for some dynamic systems such as the population dynamics of the birth–death process

(Chen 2002). Empirically speaking, since we can measure MV from aggregate indexes, we can also infer the effective cluster number (ECN), N, at the micro level. Therefore, we have a powerful tool to identify the source of aggregate fluctuations – if there is an explanation for microfoundations (the structual level of households and firms) or an explanation for meso foundations (the structural level of financial intermediates and industrial organization in the form of clusters). The empirical results are shown in Table 16.1.

The number of households, corporations, and public companies and their implied orders of MV in 1980 are given in Table 16.2.

From Tables 16.1 and 16.2, we can see that household fluctuations contribute only about 5 percent of fluctuations in real gross domestic product (GDP) and less than 1 percent in real investment, and small firms can contribute 50 percent of fluctuations in real GDP or 8 percent in real investment, while public companies can generate about 60 percent of aggregate fluctuations in real investment. Clearly, there are very weak "microfoundations" but strong evidence of a "meso foundation" in macroeconomic fluctuations. The doctrine of "too big to

Table 16.1 Market variability (MV) and effective cluster number (ECN) for various aggregate and financial indexes

Item	*MV (%)*	*ECN*
Real personal consumption	0.15	800,000
Real GDP	0.2	500,000
Real private investment	1.2	10,000
Dow Jones Industrial (1928–2009)	1.4	9000
S&P 500 Index (1947–2009)	1.6	5000
NASDAQ (1971–2009)	2.0	3000
Japan–US exchange rate (1971–2009)	6.1	300
US–euro exchange rate (1999–2009)	4.9	400
Texas crude oil price (1978–2008)	5.3	400

Sources: US aggregate indexes and exchange rates are from the Federal Reserve Bank at St. Louis; stock indexes data are from yahoo.finance; the oil price index is from the US Energy Information Administration.

Notes
For nonstationary time series, market variability is measured via the HP filter; the average is estimated from a moving time window in the range of the average length of business cycles, here is proxied at five years (Chen 2002).

Table 16.2 Numbers of households and firms in the United States (1980)

Micro agents	*Households*	*Corporations**	*Public companies*
N	80,00,000	2,900,000	20,000
MV (%)	0.01	0.1	0.7

Source: US Bureau of Census.

Note
* Here, we count only those corporations with more than $100 000 in assets.

fail" might be true at the micro level in the cases of external shocks, but it is not true at the macro level in terms of the meso–macro relationship. This fallacy of composition still misleads equilibrium economists in their representative model of macro behavior.

More surprisingly, the order of market variability in the oil and currency markets is much higher than real investment and the stock market, which indicates the ugly fact of financial concentration generated by giant financial corporations. This is the real root of this Grand Crisis!

Dan Gilligan (2009), President of the Petroleum Marketers Association (PMA), has revealed that financial giants such as Morgan Stanley, Goldman Sachs, Barclays, and JP Morgan were manipulating the oil price. They put hundreds of billions of dollars in the oil futures market, in addition to money invested by large institutional fund managers such as the California Pension Fund, the Harvard University Endowment, and other institutional investors. They started their speculation in 2000, when the US Congress deregulated the futures market, granting exemptions for complicated derivative investments called oil swaps, as well as electronic trading on private exchanges. Volatility in the price of oil increased dramatically. Later in the decade, within one year, the oil price rose from $67 a barrel to $147 a barrel, then collapsed back down to $45. On one occasion, the oil price jumped $25 in one day! Surprisingly, changes in oil demand and supply in this period were less than 5 percent, while changes in the price of oil were larger than 100 percent! From the middle of June to the end of November 2008, when a US congressional investigation started, about $70 billion of speculative capital left the future markets. At that time, demand for oil dropped 5 percent, but the price of oil dropped more than 75 percent to $100 per barrel. Gilligan estimated that about 60–70 percent of oil contracts in the future markets were controlled by speculative capital at the peak. In the past five years, hedge funds and global banks have poured capital into the oil market. Their "investment" rose from $13 billion to $300 billion. Something must be done to stabilize commodity future markets.

16.2.3 Rethinking the theoretical foundation of trend collapse, higher moment risk and the financial crisis in the derivatives market

In the 2008 financial crisis, credit default swaps (CDS) played an important role when the fall of Lehman Brothers generated a tremendous loss for AIG. We suspect that the oversimplified model of CDS options based on orthodox pricing theory played a significant role in ignoring underlying market instability.

An important discovery related to the Principle of Large Numbers is the viable dynamics for sustainable markets. For stochastic dynamics with a growth trend, there exist stochastic models with the distinct feature of market variability (Chen 2002, 2005; Li 2002). Their results are quite enlightening. Random walks are dampening, Brownian motion is explosive, but the birth–death process tends to be a constant in the form of the Principle of Large Numbers. The random walk and Brownian motion are representative agent models by nature. Only the birth–

death process is a population model, which is capable of describing social interaction and collective action in behavioral finance.

It is possible to modify the option-pricing model based on the population model of the birth–death process in stock-price movements (Zeng and Chen 2008). For the representative agent model of geometric Brownian motion, the probability of stock-price movement can be described by a binomial tree (Cox *et al.* 1979). Credit default swap valuation is also based on a similar model (Duffie 1999). For our model in the birth–death process, stock-price changes can be understood by a trinomial tree, in addition to the probability of prices moving up and down, there is a chance of a stable price. This complexity might exhibit the so-called volatility smile (changing market volatility driven by irrational herd behavior in financial market) observed in option prices. A more general model of evolution in probability distribution can be derived in terms of a master equation (Tang 2009). Based on empirical observations, transition probability can be described by a nonlinear function; its solution can be approximated by expansion in terms of higher moments. If we consider only the first and second moment (i.e., mean and variance in portfolio theory), the solution will converge to that of the Black–Scholes model, in which an arbitrage-free portfolio can be constructed. If, however, we add the third and fourth moments, the model solution might produce complex patterns, such as a trend collapse and market crisis (Figures 16.3 and 16.4). In other words, *financial crisis can be understood as higher moment risk*.

The high moments (cumulants) have infinite terms in theory. In practice, we only need to calculate finite moments from the empirical data to judge the

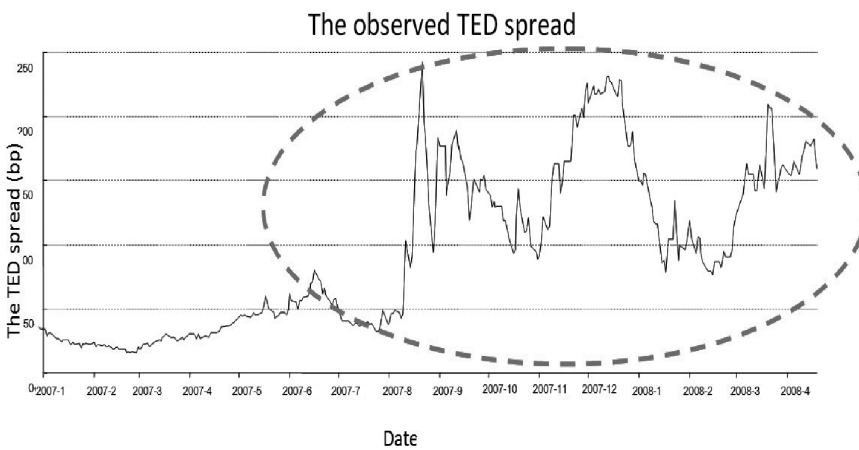

Figure 16.3 The observed TED (three month interest rate spread between eurodollar LIBOR rate and US Treasury bill rate) series (January 2007 to April 2008) (source: www.tedspread.com/).

Note
A dramatic rise of TED signaled the rising risk premium, which is an essential feature of financial crisis.

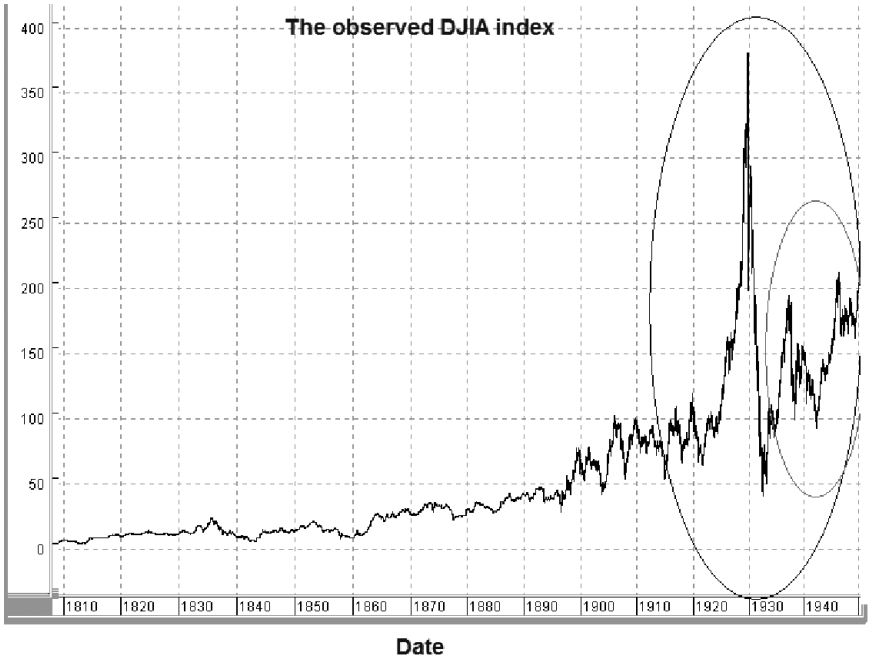

Figure 16.4 The Dow-Jones Industrial Average (DJIA) index during the Great Depression, which has a similar pattern in Figure 16.3 (source: metastcok).

overall pattern in Figure 16.3. We select the second to fifth moments here for a comparison with empirical events (Table 16.3).

Now, we have a better understanding of why the derivative market might collapse on a large scale. When the option-trading mechanism is simple enough, Black could adjust the model parameters such as market volatility so that the theoretical solution could close on the empirical price. In a complicated over-the-counter derivative market with thin market and loose regulation, however, such as the credit default swap market, trading based on an oversimplified binomial-tree model would mislead the market without empirical calibration. This Grand Crisis has provided a striking example of how a linear model for a

Table 16.3 The calculated moments of TED spread

Variance	*Skewness*	*Kurtosis*	*Fifth order cumulant*	…
0.0196	0.4537	2.8378	2.5448	…

Notes
The moments (up to the fifth moment) are calculated with a three day time window from the TED data in Figure 16.5. A clear sign of financial crisis is visualized by a dramatic rise in TED high moments.

complex market can create such a tremendous turmoil. Better alternative models on asset-pricing theory are needed to prevent a similar crisis in the future.

16.2.4 Economic complexity of transaction costs and the selective mechanism of industrial organization

The US administration has long realized the critical role of prudent financial regulation. Mainstream economists, however, still argue that the market can be self-regulating; following the Coase theory of transaction costs. Coase (1937) claimed that the foundation of the firm was the incentive to reduce transaction costs. Coase (1960) believed that social conflicts could be solved via bilateral exchange without interference from a third intermediary such as government or legal action. Coase (1990) claimed that the US financial market was an ideal model of the Coasian world of zero-transaction costs. He seemingly ignored the fact that regulating the financial market has had increasing complexity as well as increasing transaction costs. Coase (1979) challenged the need of regulation when he openly placed doubts on anti-bribery legislation for the media industry. He simply ignored the social costs that emerged when bribery and market manipulation generated system instability, which could potentially cost much more than regulation. The real aim of the Coase theory was to reject antitrust policy when he was ignored at his first meeting with the Chicago school, which forced him to change his vocabulary from competitive monopoly to transaction costs (Kitch 1983). This study revives the old debate about antitrust policy from the new perspective of market instability and economic complexity.

Coase is wrong simply because he ignored the issue of economic complexity (Chen 2007a). A firm's driving force is value creation, not transaction costs reduction. Innovation creates both instability and complexity that are sources of increasing transaction costs in division of labor. Bilateral exchange cannot solve conflicting interests in pollution and market manipulation because there is no increasing demand for negative externality. Government regulation and people's participation is essential in maintaining orderly market and resolving social conflicts. Whether regulation is proper or not, it cannot be judged by transaction costs in the short term, but by social effects in the long term. Coase theory is another type of perpetual motion machine without heat (i.e., transaction costs) dissipation, which is against the second law of thermodynamics. The simple fact of global warming is a clear case of increasing energy consumption and dissipation, which is a strong evidence of increasing transaction costs during industrialization. China could avoid a financial crisis mainly because its policy is selectively open to constructive FDI, not speculative hot money.

16.2.5 The danger of Friedman's theory of exogenous money and the tri-polar world of the Great Depression

So far, the weak effect of expansionary monetary policy reminds us of the danger of the exogenous theory of business cycles, discussed previously. The current

monetary policy adopted by mainstream economists is strongly influenced by Friedman's theory of exogenous money and his misleading explanation of the Great Depression (Friedman and Schwartz 1963). Friedman assumed monetary movement was exogenous, so central bankers' monetary policy had no historical or structural constraints. The discovery of monetary chaos challenged the monetarist theory of exogenous money but supported the Austrian theory of endogenous money (Chen 1988a, 2005). Few economists, however, realized the danger of monetarist policy in dealing with economic crises such as the failure of the Washington consensus, crises in Latin America and East Asia, and the Transition Depression in EEFSU (Chen 2006, 2008).

Friedman claimed that expansionary monetary policy alone could have prevented the Great Depression, though there is no solid empirical evidence to support his theory. It would be very dangerous for central bankers around the world to follow Friedman's simple-minded theory in dealing with the current crisis with deep social and geopolitical roots.

On the contrary, we have abundant evidence supporting the Austrian theory of endogenous money. In 1998, China had to confront severe deflation in the aftermath of the East Asian financial crisis. China managed to maintain sustained growth mainly through fiscal policy – manifest in large investments on infrastructure. So far, we already see that the effectiveness of monetary policy is highly constrained by historical policy and economic structure. When the business sector is heavily in debt, expansionary monetary policy can move only short-term interest rates and might be powerless to determine medium and long-term interest rates when investors feel uncertain about the economic outlook due to the danger of deep recession, possible inflation, and currency depreciation. Since late 2008, major countries have rapidly adopted crisis policies such as monetary expansion, fiscal stimulus, and enhancing regulation in the financial market, including setting limit to executive pay and financial leverage. From our observation, the US administration has tried only to treat the symptoms rather than to cure the American disease, which is the huge power of the financial sector to crowd out the industrial sector. So far, we see no attempt by policy makers to break up monopolistic financial firms such as AIG and Citibank. Thinking strategically, we should prepare for the worst scenario and then work out the best solution.

Kindleberger (1986) has produced a highly relevant analysis that is helpful in understanding the current crisis. Friedman believed that the Great Depression was triggered by one simple event: the death of New York Federal Reserve Governor, Mr. Strong, which left a vacuum in the Fed's monetary policy. Kindleberger pointed out that the global depression was caused by the collapse of globalization based on British leadership. The three world powers after World War I – the United Kingdom, the United States, and France – were kicking the ball among themselves and eventually provoked a collapse in the whole global system. We have a similar situation today, since the United States has lost its automatic world leadership via excessive military expansion and excessive consumption. The world order has changed since the 1980s; unless the United

States, Europe, and China coordinate their efforts, we could face an international situation discussed by Kindleberger on the international cause of the Great Depression before the 1930s.

What is the worst situation that might result from this Grand Crisis? Japan's stock market and real estate crisis of the 1990s lasted more than a decade. US President Roosevelt's "New Deal," including Keynesian policy in fiscal stimulus and welfare policy, did not end the Great Depression, which lasted for 11 years until World War II. There may be little chance of World War III among the major nuclear powers; however, the next wave of government defaults could destabilize small countries, worsen existing wars in the Middle East, and intensify regional and ethnic conflicts in South Asia and Africa. The possibility of a regional nuclear war should not be fully discounted.

The best case scenario is that current globalization can be stabilized. This is possible only if trust in security matters and financial coordination can be consolidated among the major military and economic powers, including the United States, the European Union, China, Russia, and Japan. The cold war did not turn into a "hot war" since the Yalta bipolar structure was stable during the cold war era. Since the Soviet Union dissolved, the unipolar structure based on US dominance is significantly unstable in a world of disequilibrium with increasing disparity between rich and poor countries.

16.3 China's development and a changing world order

The current Grand Crisis accelerates the demand for reforming international financial order. To reach a realistic goal, we should first analyze the deep sources of this global financial crisis, then evaluate possible scenarios, before taking a collective action.

16.3.1 The American disease and the China puzzle

Before discussing China's role, we need to understand the world today from an evolutionary perspective. Bernanke once suggested that the US imbalance was rooted not in excessive consumption but in China's excess saving. I have a different view on this. The United States is much more powerful than China and the other Asian economies combined. Its financial power still dominates the international financial order – as we already know from the foregoing discussion.

The United States' trouble in the financial markets began with former President Ronald Reagan's contradictory economic policies in the 1980s. On the one hand, Reagan launched a tremendous military expansion; on the other hand, he provided substantial tax cuts and deregulated the financial sector. Growing public debt financed the budget deficit that resulted, which drove up interest rates and the dollar, and ruined the competitiveness of the US manufacturing industry. As we know, the response to this was outsourcing – first to Japan and then to East Asia. The United States pushed Japan to appreciate the yen, but that

did not solve its trade deficit. Instead, it threw the manufacturing industry out of Japan and to the "Asian tigers" and mainland China. Since then, the United States has been putting pressure on the Chinese government to appreciate its currency without much success.

In fact, Chinese economists and governments did realize the danger of overexposure to the American financial market. The difficulty is to find a safe exit. China did some experiment in the first half of 2008 by raising the interest rate, exchange rate, and minimum wage simultaneously. Some economists believed that monetary policy alone could easily push structural changes. But waves of bankruptcy of manufacture firms in coastal areas rose strong opposition from local governments, so that central government had to adjust its policy just in time before the financial crisis reached the Chinese economy in the second half of 2008. After experiments, Chinese leaders could better tell the different effects among monetary, fiscal, and industrial policies. Certainly, China alone could not solve the imbalance both in domestic development and international market. Further dialogue among major trading partners is critical to solve the current crisis.

The United States' fundamental problem is that the financial sector has replaced the industrial sector as the driver of its economy. You cannot cure that disease by playing currency or monetary games. Since the 1970s, no matter how the exchange rate has fluctuated, the United States has had a persistent trade deficit, while Germany and Japan have had a persistent trade surplus. This imbalance has little to do with short-term exchange rate adjustment, but much with US long-term strategic policy. The United States still has advanced technology and abundant resources, but continues to waste immense resources on military spending and financial speculation. What is needed is a fundamental change in its policy framework.

As for China, of course it has to adapt to US foreign policy, but it has also benefited from its short-sighted strategy. During the East Asian financial crisis, China followed the United States' recommendation that it should not devalue its currency. Before and during that crisis, mainstream American economists had one single policy recommendation for Latin America, Hong Kong, and China: dollarization, dollarization, and dollarization! Remember that most Chinese reformers tried very hard to learn about the market economy from US textbook economics. They all lectured that US Treasury Bonds are a risk-free investment compared with risky stocks and corporate bonds. The Chinese government therefore decided to target China's exchange rate with the dollar and buy US Treasury securities. This was thought to be the best way to preserve the value of Chinese savings – or at least a much better way than to invest them on China's own enterprises. Once China chose that road, however, US Treasuries turned out to be a trap. In such a situation, China had fewer options than Japan and European countries in the currency game, because of the asymmetrical policy adopted by the United States. When the dollar goes down, Japanese or Europeans can buy US assets, but Chinese cannot – blocked as they are by the United States' national security policy. At the same time, American and other foreign banks

and firms are invited to be strategic partners with China's state-owned firms for improving China's competitiveness. Does the United States think that China is less sensitive to her security interests than to US? China's increasing confidence in its self-determined open-door policy lies in its increasing competitiveness and learning ability, not in the old-fashioned protection policy.

I would still claim that this asymmetrical trade policy has in fact done more good for China than for the United States in the changing world balance. US administrations have repeatedly used political pressure in exchange rate policy. It did not resolve the US deficit problem, but it did accelerate the economic integration of East Asia. How did that happen? If world trade were free and based on rules of symmetry, China would be buying much more US technologies than it really does. Since the United States does not allow exports of high-tech products to China, China can import only second-hand technology. The United States does, however, export high technology to Japan and other East Asian countries, and this preferential trade policy has created an arbitrage opportunity for these countries. It is not by accident that, since the 1980s, China has had a persistent trade deficit with Japan, then with South Korea and with Southeast Asian countries. In fact, these deficits are quite comparable with China's trade surplus with the United States. What does this mean? It means that the United States has given away a huge trade opportunity to China's neighbors for geopolitical rather than economic purpose.

Historically, US policy of China containment during the cold war might delay China's peaceful development of market economy, but did stimulate China's strategic investment in education, infrastructure, basic research, and strategic industries, which is also part of China's comparative advantage in global competition. Chinese philosophy has learned how to prepare for harsh adversaries mainly by strategic moves and united effort rather than by military or monetary power.

What, however, are the real results of this policy? After the East Asian financial crisis, all these countries realized that China was a more reliable partner in international trade than previously thought, since China did not devalue its currency despite the crisis. They also realized that their economies benefited greatly from China's rapid growth. So, geopolitically speaking, these countries went from being insecure neighbors to Chinese partners. South Korea, the members of the Association of South-East Asian Nations (ASEAN) countries, and Vietnam, in addition to Hong Kong and Taiwan, became increasingly integrated in the rapidly growing Chinese economy.

Today, East Asia is the third largest economic zone in the world, with relatively stable exchange rates to the dollar, which also helps to stabilize the US currency. If US policy makers realize that this can be the basis for closer economic cooperation, I would say that our future is bright. If, however, the United States considers this a challenge rather than an opportunity, it signals a troubling future.

This is the geopolitical heritage of the Reagan regime and the US imbalance. So far, the United States is still able to maintain its financial power in spite of

increasing deficits. One critical factor in this is China's exchange rate policy. So far, both Chinese and Americans are happy about the past but worry about the future. Unlike her Asian partners, China does not get any credit from US policy makers. Perhaps the United States should think about how to win other people's trust rather than just financial interests. And China should pay more attention to new opportunities beyond the American market.

We need to explain one of the "China puzzles": why China has a much higher saving rate than industrialized countries – or why do poor countries end up subsidizing the rich ones such as the United States? Some Western observers speculated that China's rapid growth was not based on technological progress and organizational innovation but on suppressing workers' wages and thus household consumption. They claim, therefore, that appreciation of the Chinese currency will not only solve the United States' problem of a persistent trade deficit, but also stimulate the consumption and welfare of the Chinese people. Is it that simple?

My observation is that China's high savings are the result of asymmetrical power in the credit market and marketing networks, since nonlinear pricing is the main tool used by the multi-national companies that dominate China's export market. More than half of China's exports are by foreign firms – and most export channels are controlled by multi-national firms such as Wal-Mart. Chinese companies and the Chinese government has no pricing power in the international market. For any Chinese product sold in the United States, Chinese companies receive 2–5 percent of the sale value. As a result, China's domestic market is more open and more competitive than those of the United States, Japan, or any other country in Asia and Europe. If we look, for instance, at China's car industry, we see that the market, unlike in the United States, is not dominated by the "big three"; there are more than 100 companies competing with each other. Their profit margins are very thin compared with their giant foreign competitors. In order to survive, they have to upgrade their technology mainly through self-financed investment. Small and medium firms have little access to the stock or bond markets. The underdeveloped financial market and marketing network leads to a very high saving rate in Chinese firms prepared for market uncertainty. China needs more bold experiments in developing financial innovation, which should aim to develop small and medium firms for creating jobs rather than for reducing transaction costs or maximizing short-term profits.

Since China launched its reforms some 30 years ago, its annual growth rate in residential income and consumption has been about 7 and 6 percent, respectively. China's high saving puzzle cannot be explained by households; it has to do with the behavior of firms. If we look at the composition of China's immense bank deposits, the deposits of individuals represent some 50 percent, with more than 30 percent coming from firms. If there is so-called excess saving, China's domestic interest rate should be even lower than those in the United States. In fact, China's interest rate in the domestic market is much higher than that paid on US Treasuries. In rural industries, the gray-market interest rate is more than 20 percent. Clearly, strong market competition leads to strong competition in

investment in technological upgrading among all industries and firms. The Chinese government has very limited means to cool investment since public investment is much smaller than private investment. Certainly, regional governments have strong incentives to preserve manufacturing industries for job creation and revenue stability.

I would guess that if the US government adopts new antitrust laws and breaks up monopolistic firms, as it did with AT&T, US industries will become more competitive. Both US firms and households will behave more like Chinese – investing on technology and education rather than on money game, big houses, and big cars. In the end, you would see more balanced trade in the world market.

Bernanke points out China's high saving rate, rather than the low saving rate in the United States, as a possible source of financial instability. We might ask a more fundamental question about the driving force of growth: should it be consumption, exploitation, new technology, or new industry? From long-term perspective, supply-side innovation rather than demand-side consumption should be the very foundation of sustainable growth.

Let's assume that one country spends most of its income on consumption, while another country spends more on innovation. Which country do you think will win the international competition? That's a very simple question – no matter what natural resources and property rights we take into account. You don't need a grand theory; commonsense will do to answer this simple question. I would suggest that China could better direct public and private savings to more investment in education, health care, and water conservation that would pave the future foundation of sustainable development.

One critical lesson from this American-made crisis is that technology leadership and market dominance alone in private sector is not sustainable without social support from public sector. The big three auto companies are near bankruptcy because of the high social costs. "Each car in Detroit carried about $1,400 in extra pension and health-care costs compared with the foreign-owned competitors in America." The averaging medical costs in the US are twice of European countries and Canada, and three times of Japan (*The Economist* 2009b). China should learn more from the mixed systems of pension and health care in Europe, Japan, and Scandinavian countries rather than the dominating private system in the US.

16.3.2 China's realistic role in a changing world order

There is much debate about China's role in a changing world order – from the "China threat" to "G2" status. As a personal observation, China's success is based on a decentralized experiment in searching for a Chinese model of global competition. There are several features of the Chinese system that are different from mainstream economics based on the Anglo-Saxon model – so-called laissez-faire economics.

First, China has been a unified country since 200 BC – formed not by market forces but by political organization based on a small-scale, self-sufficient

economy. China has only 10 percent arable land, and has experienced frequent wars and natural disasters. Historically, there has been persistent demand for effective governments rather than small governments. China developed resource-saving but labour-consuming technology while the West developed labour-saving but resource-consuming technology under different ecological conditions (Chen 1990, 1993b). The Chinese model is therefore different from the Western model because there is a trade-off between stability and complexity (Chen 2005). This implies that developing countries should explore technologies appropriate to them and develop effective government to meet historical challenges. There is no universal recipe to fit a diversity of situations.

Second, China's shift of its development basis from inland to coastal areas was based on a strategic evaluation of the changing world order. The Korean War, the Vietnam War, and the United States' policy of containment forced China to channel domestic savings into building up its defense industry and technological foundation. When US interest shifted to the Middle East, Deng Xiaoping's open-door policy seized the opportunity and developed the coastal economy, which became the engine of China's technological progress and export-led growth. China's competitiveness is not based on cheap labor, but on an effective welfare system and well-developed technology base. Four-fifths of the population live on collectively owned land without paying expensive social security taxes. China's main strength lies in his human capital. A large number of engineers and scientists were trained in Mao's era. China's effort in transforming defense industry into civilian industry is more successful than the United States and EEFSU, which was a lesson learnt from the rise of Germany and Japan after World War II and other Asian tigers. That is why China's open-door policy did not create a dependent economy; simply because China's domestic industry could rapidly learn and compete with multi-national companies. Cheap labor alone never leads to take-off in developing countries. In contrast, land and asset privatization in EEFSU led to a significant decline in agricultural and industrial output, a rapid increase in income inequality, and a breakdown of the social welfare system. The economic costs of the Transition Depression in EEFSU were even heavier than two world wars and a civil war in Russia in the 1920s (Chen 2006).

Third, China is still a developing country with large regional disparities and tremendous population pressures under limited resources. Small and medium firms engage in the export market, mainly because market channels in the domestic market are far behind those in industrialized countries. It would be naive to demand that the Chinese currency ascend to reserve currency status, which could lead to premature liberalization of the capital account. From international experience, Germany has more rigorous regulation of its financial market, so that German industry has firm support from the financial sector, while Japan wrongly accepted US advice in liberalizing its financial market and lost a decade. China's policy makers should be careful in learning and experimenting in adopting the international financial market.

We suggest that China could learn more from other countries and play a constructive role in the global arena.

First, the European Union grew out of the European Coal and Steel Community in 1951, when France and Germany became partners instead of rivals. If China, Japan, South Korea, and the ASEAN countries could build up a similar economic program – such as the joint development of offshore oil reserves – East Asia could integrate into an Asian union. Political wisdom with long-term vision is needed for Asian leaders in facing the current crisis. In Chinese, "crisis" (*wei-ji*) implies both danger (*wei*) and opportunity (*ji*). The Japanese, South Korean, and Chinese populations are aging; therefore, there is diminishing chance of military conflict but increasing desire for economic cooperation among them. Even if US-led globalization falls apart, East Asia could still maintain a stable and healthy regional economy. In doing so, other countries might join the East Asian community, including Australia, New Zealand, Russia, India, and the Pacific United States, so that a better name in the future might be the "Pacific Union," in parallel with the European Union and North America free trade zone. The next phase of globalization would then have a tripartite regional foundation that would be more competitive and cooperative than the existing US-led globalization.

Second, the euro, yen, and renminbi cannot yet displace the US dollar. The financial innovation of the "euro dollar" market was created in 1957 by the Soviet Union and British banks in order to get around the controls of US financial power. Growing US deficits led to rapid expansion of the euro dollar market. In the current Grand Crisis, European banks have experienced heavy losses, caused by the US sub-prime crisis. This in turn has hurt South Korea, Brazil, Russia, and other developing countries, as they have lost money on deposits in the euro dollar market. China could cooperate with other Asian countries to develop an "Asian dollar" market for sovereign debts, since China could constructively utilize its excess foreign reserves. Currency and sovereign bond swaps can be integrated into the Asian dollar market, increasing its depth and sophistication over time. If the US Federal Reserve printed too much money, thereby destabilizing the global economy, higher uncertainty would raise interest rates in both the euro and Asian dollar markets that would cause capital flight from the US financial market. Market forces would effectively discipline central bankers if their monetary policy was irresponsible or near-sighted. Goodwill alone is not a sufficient condition for a sound international order. International competition is a necessary condition for international stability.

Third, China's recent investment in foreign natural resources has caused a series of public relations problems since China's operation of state-owned enterprises (SOEs) is not compatible with Western laws and conventions. China should learn from the US model of land-grant universities and non-profit university endowment funds, rather than the Singaporean model of sovereign wealth funds. SOEs transformed into publicly listed, shareholder companies owned by university funds, pension funds, and so on, would greatly improve China's image abroad and its educational foundation at home. Currently, China's technological attainment depends heavily on foreign technology. China's higher education system is essentially a teaching rather than a research system. By dividing

state assets among a dozen or so competitive "land-grant" university endowment funds, China could build up a strong system of innovation by integrating research, education, and production. Western media could easily understand the nature and objective of a Peking University Fund or Fudan University Fund along the lines, for example, of the Texas University Fund and Columbia University Fund as qualified investment institutions.

Fourth, large holdings of American government debt are not a sound investment both for China and the US, since subsidizing American excess consumption and military expansion is not sustainable. However, China could diversify her currency risk and increase goodwill among American people by encouraging cross investment between regional governments. For example, the state of California has tremendous human resources but huge financial stress in this crisis. They simply had no money to repair poor bridges or hire university scientists. I would like to suggest that Shanghai city government could help California by buying California state bonds in exchange for long-term cooperation between the California State University System and the Shanghai higher education system. China's regional governments are very innovative in not only advancing local industry but also developing human networks for win–win competition.

16.3.3 Basic considerations in reforming the international financial market

Based on the above discussion, there are some basic considerations for reforming the international financial market.

First, current economic and financial bureaucracies are heavily influenced by equilibrium economists and financial interests. It would be helpful to establish a non-governmental expert forum under the United Nations; their policy recommendations could be more constructive for discussions among world leaders.

Second, regulation and supervision should center on an international competition or antitrust policy. The market shares of giant financial companies in the commodity market, currency market, and some key financial sectors should be subject to an upper limit, such as 5 percent. Trading volume should be monitored frequently and transactions above a certain threshold should be reported and regulated.

Third, a Tobin tax on currency and commodity exchanges is essential to protect small countries without large amounts of foreign reserves. Tobin tax receipts should be housed in a specific development fund for helping developing countries. Debt equity swap under strategic agreement may increase mutual trust and ease market anxiety about financial uncertainty.

Fourth, each country has the sovereign right to match its exchange rate regime to its development stratagem. Its exchange rate can be linked to SDR (Special Drawing Rights), a reserve assets created by IMF calculations with gradual adjustment every five years or so. An economic council under the United Nations, which is responsible for coordinating major countries in stabilizing

their exchange rates, could regulate the IMF. An orderly adjustment of exchange rates could be conducted every five years or so except in emergency situations.

Fifth, an overhaul of financial theory and financial regulation would speed up the academic debate about rethinking economic history and theory (Chen 2008). This conference on China's new place in a world in crisis is a small step toward this direction.

16.4 Conclusion

This Grand Crisis is deeply rooted in the new classical counter Keynesian revolution in mainstream economics and Reagan revolution in deregulating market and dismantling the role of governments in managing business cycles. Their main results were concentration of financial power and explosion of market instabilities. To recover the damage and to prevent the next crisis, we must take collective actions among major economies in breaking monopoly powers and enhancing market regulations, so that market forces could advance innovations for majority people, rather than generate destructions for few greedy. We also need to change the linear equilibrium thinking and learn complex evolutionary perspective in a changing world order. Future generations of political leaders and economic students would learn a better lesson from this Grand Crisis.

Let us work together for a better future.

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12 The Frisch model of business cycles: a spurious doctrine, but a mysterious success

1 Originally (1999) *IC2 Working Paper* 99–05–01, University of Texas at Austin, USA; and CCER Working Paper 1999-007, China Center for Economic Research, Peking University, Beijing, China.

13 Microfoundations of macroeconomic fluctuations and the laws of probability theory: the Principle of Large Numbers vs. rational expectations arbitrage

1 Originally published in (2002) *Journal of Economic Behavior and Organization*, 49(3): 327–44. Received 8 March 1999; received in revised form 4 September 2001; accepted 6 September 2001.
2 This ratio is called variation coefficient in statistics and finance literature when the mean is positive. Mathematically speaking, this is a dimensionless number, which can be called "the relative deviation" comparing to the standard (absolute) deviation. In macroeconomic analysis, this ratio can be considered as a salient indicator of "market variation" in business cycles and financial volatility.
3 The pattern of

$$\frac{1}{\sqrt{N}}$$

is well known in physics and biology literature (Schrödinger 1944) under various technical terms, such as the relative magnitude of fluctuation (Reif 1964), the root-mean-square relative fluctuation about the mean (May 1974a), and the fractional deviation (Reichl 1998). The terms "relative deviation," "Principle of Large Numbers," and "positive variable" are used by the author for general readers in understanding the points at issue.
4 We made one mathematical simplification for the LMI model. Here, our allocation variable ϕ is

$$\left(\frac{\vartheta}{2}\right)$$

in the original LMI formulation. Other symbols in this section are the same as the LMI model for the reader's convenience.

14 Complexity of transaction costs and evolution of corporate governance

1 Originally published in (2007) *Kyoto Economic Review*, 76(2): 139–53.

15 Market instability and economic complexity: theoretical lessons from transition experiments

1 In Yang Yao and Linda Yueh (eds.) (2006) *Globalisation and Economic Growth in China*, Chapter 3. pp. 35–58, Singapore: World Scientific.

16 From an efficient to a viable international financial market

1 In R. Garnaut, L. Song, and W.T. Woo (eds.) (2009) *China's New Place in a World in Crisis: Economic, Geopolitical and the Environmental Dimensions*, Chapter 3. pp. 33–58, Australian National University E-Press and The Brookings Institution Press, Canberra.