Theory of Dynamic Preference: Impact of Trade Imbalance on Financial Crisis

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Abstract

Huge imbalances in the global economy drove the boom as American borrowers took on massive, unsustainable amounts of debt, funded largely by emerging economies such as China. The unstable flows of money around the world contributed to the crises for poor economies such as Mexico, or woefully mismanaged ones like Iceland. This is a problem again today for America, as well as for the rest of the world. The challenge ahead for us is then to rewrite the rules of international finance in a way that keeps investment flowing around the world in search of the best returns while protecting against volatility that can cause financial crises. To synthesize the aforementioned causes of financial crises, i.e., discredited capitalism, ineffective dollar standard financial system and rampant as well as unbridled international capital flow, we would attribute the root problem to the unchecked trade imbalance that results from the incompatibility of “national” vs. “world’s” economic interest. By proposing a dynamic preference mechanism and drawing upon the implication of system dynamics, this study will provide an additional indicator to measure the degree of economic stability resulting from bilateral trading activities with empirical evidence supports. When international trade imbalance is so severe as to undermine the financial stability in the international trade system, a global coordinated effort and mechanism should be put in force. The implication of this study will shed some light on the proposal by US Treasury Secretary, Timothy Geithner, who urged each of the G20 countries to limit its trade imbalance within 4 percent of GDP.

Keywords: Trade imbalance, financial crisis, dynamic preference
JEL: F47

I. Introduction

In the wake of the carnage of bankruptcies, soaring unemployment, and millions of families losing their homes during the financial crisis of 2007-2009, the set of ideas that had been delivering unprecedented prosperity on a global scale suddenly teetered on the verge of collapse. We are at a crossroads, and decisions about how to reshape a discredited capitalism will profoundly affect whether the coming years will be ones of depression, stagnation, or renewed prosperity.

Some crises are purely financial, but some of the most damaging crashes throughout history were caused by fundamental imbalances in the world monetary system. Since World War II, the world has operated on what has been effectively a dollar standard. In the 1990s the emerging economies of Asia, Latin America, and the former Soviet Union were buffeted by financial crises as they tried to maintain the credibility of their economies with dollar investors. While their own policy errors were part of the problem, the volatility of the dollar and failure of the rich countries to help them out had led to the doubt of those countries about the genuine role played by the international capital.

For the past decade, as a result, emerging economies have stopped borrowing from America and have become creditors instead. Huge imbalances in the global economy drove the boom as American borrowers took on massive, unsustainable amounts of debt, funded largely by emerging economies such as China. This has made the bust initially triggered by some financial symptom much worse. The dollar standard may have made sense when America’s economy was truly dominant. Now, as other economies rise in importance, the dollar’s preeminence has become more of a liability than an asset for the United States, and the world. Finding a better system for managing how money flows around the world is essential to creating a stabler financial system.

For centuries, financial bubbles and crashes have been caused or amplified by foreign money rushing in or out of a market. The unstable flows of money around the world, in and then out of countries, contributed to the crises for poor economies such as Mexico, or woefully mismanaged ones like Iceland, or America’s first Great Depression in the 1870s, the near-catastrophic crash of 1907, and the Great Depression of the 1930s. This is a problem again today for America, as well as for the rest of the world. These crises have provoked a nationalistic reaction to reduce the ability of capital to flow in and out though this be a hugely cost strategy, as money from abroad can be an important source of finance for economic growth. The challenge ahead for us is then to rewrite the rules of international finance in a way that keeps investment flowing around the world in search of the best returns while protecting against volatility that can cause financial crises.

A related issue is the role of dollar as global reserve currency, which made the world's monetary policy largely a slave to the domestic needs of the American economy. One man who foresaw the problem of using dollar as the global reserve currency was Keynes. Keynes argued that the new monetary order should not be based on a reserve currency controlled by a single country. Instead, he proposed a global reserve currency called "bancor." His proposals were defeated by the United States' lead negotiator, Harrry Dexter White, who argued that the dollar, the currency of world's leading creditor nation, should be at the center of the global financial system. The current crisis has proved him right again, about the vulnerability o fusing the dollar as the global reserve currency.

To synthesize the aforementioned causes of financial crises, i.e., discredited capitalism, ineffective dollar standard financial system and rampant as well as unbridled international capital flow, wewould ascribe the root problem to the incompatibility of "national" vs. "world's" economic interest. According to the conventional trade theory (e.g., Heckscher-Ohlin model) a nation is characterized by its own endowment of capital and labor. Once these two factor inputs are freely mobile across a country's boundary as the global market mechanism has gone through its full gamut, the two factors' owners would pursue their best interests sometimes at the expense of "nations" that define their citizenship. An individual who possesses its capital wealth and labor skill needs to compromise its duty of citizenship (in the best interest of its nation) with its own self-interest (in favor of the best global market returns). The duel and sometimes conflicting roles of "national-man" vs. "global-man" that each individual is supposed to play will be shown in this study to engender the recurrence of our economic crises.

Another form of organization that is supposed to facilitate the pursuit of an individual's interest initially but sometimes interferes or even contradicts one's best interest is "corporation". This so-called agency problem can be particularly harmful in the financial system. Shareholders of financial institutions have a conflict of interest with the bank's senior executives, especially when those executives are rewarded for good performance but do not have a large fraction of their wealth tied up in the shares of the bank. Many financial institutions have large quantities of debt, which creates a conflict of interest between the bank's creditors and its shareholders. At the highest level, there is a conflict of interest between society as a whole and the private owners of financial institutions. The result is privatized gains and socialized losses. If things go well, the firms' owners and managers claim the profits, but if things go poorly, society subsidizes the losses.

Why are these organizations of nations, corporations and other explicit or implicit social contracts (e.g., gold or dollar standard) that are contemplated and conducted for the best interest of an individual initially turning up a roadblock that impedes his interest? Why are we not rational enough to mull over thoroughly the consequences of forming these organizations in the very beginning? Would the short term interest always transcend the long term one in our decision making? How long is short-term? All of these questions pinpoint the necessity of unraveling the mystery of our decision process in more details.

Neuroeconomists have argued that release of dopamine, the brain's pleasure chemical, may indicate economic utility or value. There is also growing interest in new evidence from neuroscience that tentatively suggests that two conditions of the brain compete in decision making: a cold, objective state and a hot, emotional state in which the ability to make sensible trade-offs disappears. The potential interactions between these two brain states are ideal subjects for economic modeling. Already, neuroeconomics is giving many economists a dopamine rush, as they see the possibility of transforming economics, by providing a much better understanding of everything from people's reactions to advertising to decisions to go on strike.

Instead of thinking backward as advocated by game-theoretical solution concept in a dynamic model, we would rather describe our decision mechanism driven forwardly by an evolutionary force according to Chinese "Chi" or "Tao" or western "dopamine." Nature builds in inherent forces of constantly opposing oneself (or counterbalancing element) and self-effacing predilection akin to entropy dissipation. It is the undercurrent of a human's mental power that flows freely within our physical body and has a natural tendency to flow from an orderly state to disorder if there were no external force or disturbance interfering with its movement. It plays a pivotal role in forming our preference. "Chi" is closely related to but different from energy. Lacking energy "Chi" will gradually dissipate into void. It is the internal force that drives our intention or motive to behave. In other words, Chi plays a pivotal role in bridging our brain and action like our hidden consciousness. Section II reviews the related literatures. Section III to V describes our idea on the theory of dynamic preference. The applications of this theory are discussed in section VI, VII and VIII. The last section concludes.

II. Literatures Review

Richard Portes(2009) maintains that 'global macroeconomic imbalances are the underlying cause of the crisis'. At the conference at the council on foreign relations on 10 March 2009 Ben Bernanke of the Federal Reserve has said 'in our view… it is impossible to understand the crisis without reference to the global imbalances in trade and capital flows that began in the latter half of the 1990s'. In his statement before the G20 summit in Washington in November 2008, Hank Paulson, then US Treasury

Secretary, referred to 'global imbalances that fuelled recent excesses'. While the G20 leaders did not agree on the origins of imbalances, they nonetheless noted that 'inconsistent and insufficiently coordinated macroeconomic policies' had led to 'unsustainable global macroeconomic outcomes. These developments, together, contributed to excesses and ultimately resulted in severe market disruptions.'[1]

Essentially the United States was able to increase its debt dramatically without suffering from an inability to finance it. Surplus countries continued to buy US government securities, driving down long-term rates. The imbalances gave rise to what has been called a 'savings glut' in developing countries which held interest rate low. Investors sought bond-like instruments offering a spread above risk-free rate, in an attempt to offset the decline in that rate. That demand for yield was met by a wave of financial innovation, centered on the creation of securitized debt instruments, offering a higher yield. This process drove up the capital values of risky instruments across the board. The impact of this excess liquidity was not offset by monetary policy. Central banks focusing on retail price inflation took comfort from the fact that it remained low, held down by competitive imports from China and elsewhere.

Considerable support for this line of argument has emerged in the last three years. Obstfeld and Rogoff (2009), in a thorough exploration of the relationship between imbalances and the crisis, argue that the two are intimately connected. They note that the US ability to finance macroeconomic imbalances through easy foreign borrowing allowed it to postpone tough policy choices. Foreign banks provided a ready source of external funding for the US deficit. So they see the imbalances as a symptom of flawed macroeconomic policy, rather than the cause of the crisis.

Not everyone agrees. Caballero and Krishnamurthy (2009), for example, argue that 'the root imbalance was not the global imbalance but a safe asset imbalance: The entire world…had an insatiable demand for safe debt instruments which put an enormous pressure on the US financial system.' It was this demand for safe assets that stimulated the securitized boon, and the creation of synthetic AAA instruments.

Whatever the precise order of causation between flawed macroeconomic policies, existing literature has alludes that the combination of large current account imbalances and investor demand for apparently low risk assets played a significant part in the build-up to the crisis. Our study is intended to provide another factor that causes international economic instability. By drawing upon the implication of dynamic evolution of Chinese 'Chi' or 'Tao', weconstruct a dynamic preference theory from which we can explore how a country's utility evolves from the opening up of international trade. Since a country's utility growth rate greatly hinges on the

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[1] See statement from the G-20 Summit on Financial Markets and the World Economy. 15 November 2008. www.g20.org.

utility level of its trading partner, the build-up of trade imbalance will create an instability force on the bilateral trading system.

III. Dynamic Equation of Chi

In the beginning we define "Chi" (abbreviated as C) as something like concentration of one's volition which may be caused by the biochemical movement of ions across the membrane of one's nerve system. The interplay of physical and biochemical approaches to life science has borne significant fruits in interpreting how our nerve impulses work. We will not go to the details of this discussion. Instead, we will derive an equation of Chi's movement in a more general sense.

Suppose we know the number of elements at each point along the x axis at time t, as N(x), where the element can stand for the constituent of "Chi" and the distance x is measured along the conduit of our mental body. How many elements will move across unit area from the point x to the point $x+\varepsilon$?

N(x)	:	N(x+ε)
x	:	$x+\varepsilon$

First of all, we assume that there is no other external force so that the elements will behave like a random walk. At time $t+\tau$, half the element at x will have stepped across the dashed line from left to right, and half the elements at $x+\varepsilon$ will have stepped across the dashed line from right to left. The assumption of "randomness" is made here to accord with the Tao's spirit of self-negating force inherent in our universe (反者道之動也). The net number crossing to the right will be

$$\frac{1}{2}[N(x+\varepsilon)-N(x)].$$

In addition to this randomness nature there exist two counteracting forces to drive our chi movement. One is the negative self-effacing force (say S) as interpreted in the second law of thermodynamics (i.e., entropy). The other is the net increase in the external force (say F) that injects into our body to fortress our Chi. These two forces can be synthesized as $E=I-O$ where we stands for input (e.g., income) and O stands for output (e.g., expenditure or entropy dissipation) . The self-effacing force S is implicitly incorporated as part of O. Consequently the above equation can be modified in the following:

$$[\frac{1}{2}+\pi(E)]N(x+\varepsilon)-[\frac{1}{2}-\pi(E)]N(x).$$

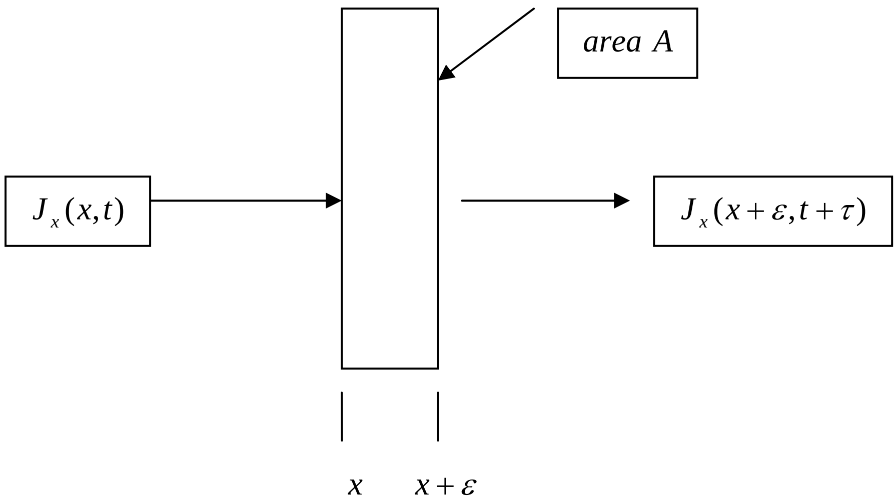
where the thrust function $\pi(E)$ is positively related to the net external input E. If the above term turns out to be negative, there will be more elements crossing to the left than to the right. To obtain the net flux, we divide the net number above by the area normal to the x axis, A [2], and by the time interval, τ ,

$$J_x = \{[\frac{1}{2} + \pi(E)]N(x+\varepsilon) - [\frac{1}{2} - \pi(E)]N(x)\} / A\tau$$
$$= \frac{\varepsilon^2}{\tau}\frac{1}{\varepsilon}\{\frac{1}{2}\left[\frac{N(x+\varepsilon)}{A\varepsilon} - \frac{N(x)}{A\varepsilon}\right] + \pi(E)\left[\frac{N(x+\varepsilon)}{A\varepsilon} + \frac{N(x)}{A\varepsilon}\right]\}$$
$$= D\frac{1}{\varepsilon}[C(x+\varepsilon) - C(x)] + \frac{\varepsilon}{\tau}\cdot\pi(E)\cdot\left[C(x+\varepsilon) + C(x)\right]$$

Where $D \equiv \varepsilon^2 / 2\tau$ is the diffusion coefficient, and $C(x+\varepsilon) = N(x+\varepsilon)/A\varepsilon$ & $C(x) = N(x)/A\varepsilon$ are the number of elements per unit volume at the points $x+\varepsilon$ & x respectively. Let the speed of movement be $\nu_d = \varepsilon / \tau$. In the limit $\varepsilon \to 0$, we obtain

$$J_x = D\frac{\partial C}{\partial x} + 2\cdot\nu_d\cdot\pi(E)\cdot C(x). \qquad (1)$$

Assume that the total number of elements is conserved as shown in Figure below.



Consider the box in the figure. In a period of time τ, $J_x(x)A\tau$ elements will enter from the left and $J_x(x+\varepsilon)A\tau$ elements will leave from the right. The volume of the box is $A\varepsilon$. If the elements are neither created nor destroyed, the number of elements per unit volume in the box must increase at the rate

$$\frac{1}{\tau}[C(t+\tau) - C(t)] = -\frac{1}{\tau}[J_x(x+\varepsilon) - J_x(x)]A\tau / A\varepsilon$$
$$= -\frac{1}{\varepsilon}[J_x(x+\varepsilon) - J_x(x)]$$

In the limit $\tau \to 0$ and $\varepsilon \to 0$, this means that

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[2] A is the cross-section area of the "Chi" aqueduct. It is considered here for the sake of easy derivation. The final formulation of our "Chi" equation will not depend on A..

$$\frac{\partial C}{\partial t} = -\frac{\partial J_x}{\partial x} \qquad (2)$$

By substituting equation (1) into equation (2), we get the equation of Chi's movement as

$$\frac{\partial C}{\partial t} = -D\frac{\partial^2 C}{\partial x^2} - 2 \cdot v_d \cdot \pi(E) \cdot \frac{\partial C}{\partial x} \qquad (3)$$

IV. Converting Chi Equation into the Dynamics of Economic Satisfaction

I define one's satisfaction (or utility) μ as the underlying force that consumes (or depreciates) one's Chi and moves in the direction of Chi's dissipation. It can be written as $\mu \equiv -\partial C / \partial x$. The speed of Chi increase is measured by $dx/dt (= \varepsilon / \tau = v_d)$ which characterizes the temperament of the specific party or person in the text and is assumed to be constant for simplicity. Then $\partial C / \partial t = -\mu(t) \cdot v_d$, and $\partial C^2 / \partial x^2 = -d\mu / dt \cdot dt / dx = (-1/v_d) \cdot d\mu / dt$. Putting all these together we can rewrite equation (3) as

$$-\mu(t) \cdot v_d = \frac{D}{v_d} \cdot \frac{d\mu(t)}{dt} + 2v_d \cdot \pi(E) \cdot \mu(t) \qquad (4)$$

The solution for the above first-order differential equation is

$$\mu(t) = \mu(0)) \cdot \exp[-\frac{{v_d}^2(1+2\pi(E))}{D} \cdot t]$$

where $\mu(0)$ is determined by the boundary condition at t = 0. Assume that we increase consumption Y of good or service[3] in the very beginning so that dE = - Y. Hence, $\mu(t)$ is a function of Y. As the time goes on, $\mu(t)$ will evolve according to

$$\mu(t;Y) = \mu(0) \cdot \exp[-\frac{{v_d}^2(1+2\pi(E_0 - Y))}{D} \cdot t], \qquad (5)$$

where E_0 is the initial net external forces exerted on the system at t = 0. The marginal satisfaction (utility) from the consumption of Y will evolve as follows:

$$\frac{\partial \mu(t;Y)}{\partial Y} = \mu(0) \cdot \exp[-\frac{{v_d}^2(1+2\pi(E_0 - Y))}{D} \cdot t] \cdot (\frac{2v_d^2 \pi'(E_0 - Y) \cdot t}{D}) \; (> 0) \qquad (6)$$

When t approaches infinite, the marginal utility above will approach zero by applying the L'Hospital's rule below:

$$\lim_{t\to\infty} \frac{\partial \mu(t;Y)}{\partial t} = \mu(0) \cdot \lim_{t\to\infty} \frac{\partial[2v_d^2 \pi'(E_0 - Y) \cdot t / D] / \partial t}{\partial\{\exp[v_v^2(1+2\pi(E_0 - Y)) \cdot t / D]\} / \partial t}$$
$$= \frac{2\mu(0)\pi'(E_0 - Y)}{1+2\pi(E_0 - Y)} \cdot \frac{1}{\lim_{t\leftarrow\infty} \exp[v_v^2(1+2\pi)t/D]} = 0.$$

[3] Note that consumption Y is a part of output O in the net external injection to the system E (= I – O)

By taking the derivative of the marginal utility above with respect to time we can further explore the dynamic behavior of one's preference as shown below:

$$\frac{\partial^2 \mu(t;Y)}{\partial Y \partial t} = \mu(0) \cdot \exp[-\frac{{v_d}^2(1+2\pi(E_0 - Y))}{D} \cdot t] \cdot (\frac{2v_d^2 \pi'(E_0 - Y) \cdot t}{D}) \cdot \left\{1 - \frac{v_d^2(1+2\pi(E_0 - Y))}{D} \cdot t\right\}$$

In the very beginning (i.e., when $t < \frac{D}{v_d^2(1+2\pi(E_0 - Y))}$) we will observe an increase in one's marginal utility from the initial consumption of Y. However, as the time goes on, the marginal utility will decline gradually to zero. Similarly, we can differentiate the marginal utility with respect to either v_d^2 *or* $1/D$ and obtain the same conclusion that when v_d^2 *or* $1/D$ is small, an increase in v_d^2 *or* $1/D$ will lead to an increased marginal utility. However, a continuous increase in v_d^2 *or* $1/D$ will reduce marginal utility eventually.

We summarize these findings in the following proposition:

Proposition 1: *The utility of consuming commodity or service Y is derived from the consumption (or depreciation) of our Chi (or dopamine). Its marginal utility which is positive all the time will increase initially (more specifically when* $t < \frac{D}{v_d^2(1+2\pi(E_0 - Y))}$*) and then decline to zero as the time goes on. On the same token, when* v_d *(the measurement of the speed of Chi movement) or 1/D (the measurement of the reverse of Chi diffusion) is small, an increase in* v_d *or* $1/D$ *will enhance one's marginal utility. However, further increase in either* v_d *or* $1/D$ *will then deplete one's marginal utility instead.*

We now solve the dynamic process of Chi in equation (3). Assume the following boundary conditions: when $t = 0,$ *then* $x = x_0, C = C_0$ & $\mu(0) = \mu_0$. Let the solution to equation (3) be written in the form of

$$C(t) = \exp(\alpha \cdot x + \beta \cdot t + \gamma)\ . \qquad (7)$$

By substituting this solution into the above partial differential equation, it can be readily derived that

$$\alpha = -\mu_0 / C_0;$$

$$\beta = -D \cdot \frac{\mu_0^2}{C_0^2} + 2\nu_d \cdot \pi(E) \cdot \frac{\mu_0}{C_0}$$

$$\gamma = C_0 \cdot \ln C_0 + + \mu_0 \cdot x_0$$

V. Interaction of Two Entities

All of economic activities involve the interaction of more than two entities. We are particularly concerned with the problem of whether these different entities can get along harmoniously and constructively. In the beginning we need to address how the other entity impacts a specific entity's utility whose dynamics is shown in equation (3). The best candidate for the interaction effect is through the thrust function π. Besides the net external input E the thrust function π is also influenced by the other entity's utility. When the other entity's utility increases, we are most likely instigated or inspired to mentally drive forward harder. In other words, the thrust function will be written as $\pi(E, w)$, where w stands for the other entity's utility.

Let the utility for the two entities be u and w specifically. According to equation (3) the dynamics of u and w will become

$$\frac{du}{dt} = f(u, w), \frac{dw}{dt} = g(u, w), \qquad (8)$$

where f and g are nonlinear and expressed as follows:

$$f(u, w) = -\frac{[1 + 2\pi(E_1, w)] \cdot \nu_{d1}^2}{D_1} \cdot u$$

$$g(u, w) = -\frac{[1 + 2\pi(E_2, u)] \cdot \nu_{d2}^2}{D_2} \cdot w$$

where subscripts 1 and 2 in the parameters ν_d & D and external input E are written to characterize the two entities, 1 and 2, specifically.

Steady state solutions (u_0, w_0) of (8) are given by

$$f(u_0, w_0) = g(u_0, w_0) = 0.$$

Linearizing about (u_0, w_0) we have

$$\begin{pmatrix} \dfrac{d(u-u_0)}{dt} \\ \dfrac{d(v-w_0)}{dt} \end{pmatrix} = A\begin{pmatrix} u-u_0 \\ w-w_0 \end{pmatrix}, \quad A = \begin{pmatrix} f_u & f_w \\ g_u & g_w \end{pmatrix}_{u_0,w_0} \qquad (9)$$

The linear stability of (u_0, w_0) is determined by the eigenvalues λ of the stability matrix A, given by

$$\begin{aligned} |A-\lambda I| = 0 \quad &\Rightarrow \quad \lambda^2 - (trA)\lambda + |A| = 0 \\ &\Rightarrow \quad \lambda = \frac{1}{2}\{trA \pm [(trA)^2 - 4|A|]^{1/2}\}. \end{aligned} \qquad (10)$$

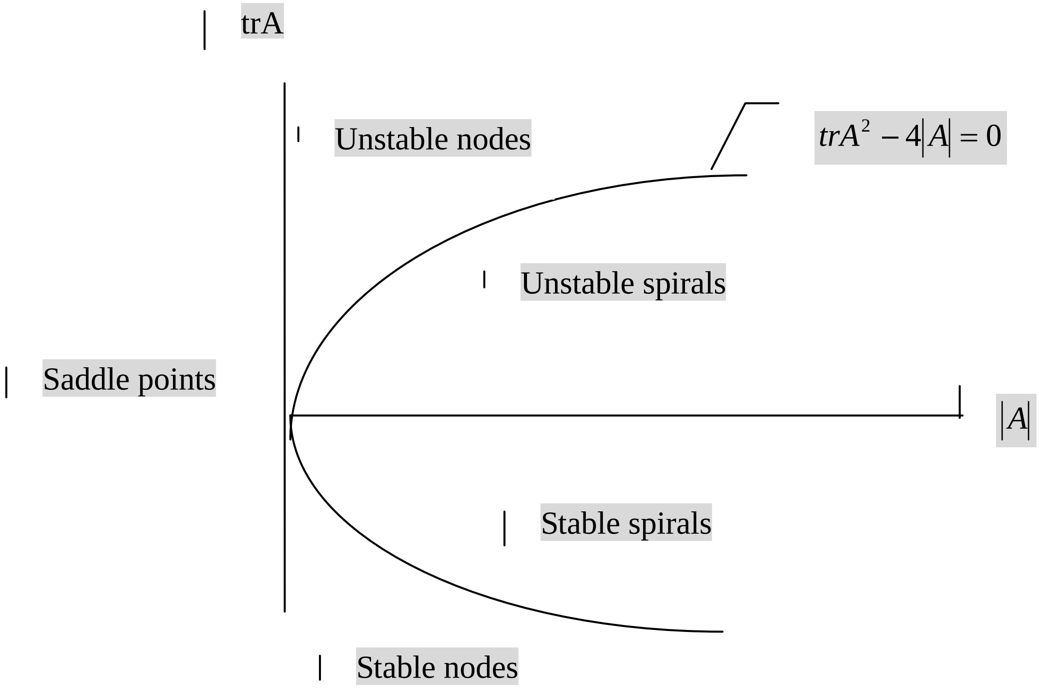
Necessary and sufficient conditions for stability are

$$trA = f_u + g_w < 0, \quad |A| = f_u g_w - f_w g_u > 0 \qquad (11)$$

where the derivatives are evaluated at the steady state (u_0, w_0).

f_u & g_w reflect how the utility growth rate is affected by the proportional increase in utility itself. According to the dynamic nature of marginal utility in our model, these two terms will turn up to be negative eventually. Therefore, akin to the diminishing marginal utility assumption made in our conventional economic model as the basis for a stable economic system, the first term in $|A|$, *i.e.*, $f_u g_w$, is always positive and provide the stable force to our interactive economic system. The seed to plant unstable force is primarily stemming from the interactive term, i.e., f_w & g_u. The greater effect on the utility growth exerted by interactive force, the high likelihood the system will collapse in the end.

Various combination of trA & $|A|$ can generate different outcomes of type and stability of the fixed points (u_0, w_0) in the following diagram:



By the Poincare-Bendixson theorem, limit cycle solutions exist if (u_0, w_0) is an unstable spiral or node, but not if it is a saddle point. For an unstable node or spiral to occur, we require

$$trA > 0, \quad |A| > 0, \quad (trA)^2 > 4|A| \Rightarrow \textit{unstable node}$$
$$(trA)^2 < 4|A| \Rightarrow \textit{unstable spiral} \qquad (12)$$

From the definition of functions f and g above we can get

$$f_u = -\frac{[1+2\pi(E_1,w)]\cdot \nu_{d1}^2}{D_1},$$
$$f_w = -\frac{2\pi_w(E_1,w)\cdot \nu_{d1}^2 \cdot u}{D_1},$$

$$g_w = -\frac{[1+2\pi(E_2,u)]\cdot \nu_{d2}^2}{D_2},$$
$$g_u = -\frac{2\pi_u(E_2,u)\cdot \nu_{d2}^2 \cdot w}{D_2}.$$

It can be easily shown that $trA = f_u + g_w < 0$, and

$$|A| = f_u g_w - f_w g_u = \frac{\nu_{d1}^2 \cdot \nu_{d2}^2}{D_1 \cdot D_2} \cdot \{[1+2\pi(E_1,w)][1+2\pi(E_2,u)] - 4u\cdot w\cdot \pi_w(E_1,w)\cdot \pi_u(E_2,u)\}$$

Therefore we can derive the following conclusion:

Proposition 2: *The interaction between the two entities that are empowered with net external impulses,* E_1 & E_2 *, and retain utility levels,* u & w *, specifically will achieve a long term stable relationship as long as the their thrust functions satisfy the following condition:*

$$\{[1+2\pi(E_1,w)][1+2\pi(E_2,u)]-4u\cdot w\cdot\pi_w(E_1,w)\cdot\pi_u(E_2,u)\}>0\,. \qquad (13)$$

Otherwise, their relationship will break up eventually.

VI. Common Value and the Formation of Bubble

The formation of bubble roots in one's uncertainty or ambivalence toward the genuine value of the target goods. To ascertain or justify the price an individual needs to pay he would usually rely upon the offer by his peers or competitors. One example is the open auction of an asset, say antique. The competitive environment the auctioneer and participants create will influence the formation of one's reservation value and bidding strategy. The degree of one's uncertainty about the subject and the extent of his receptiveness toward others' opinion or offer will have a great effect on the likely escalation of the asset price. In other words, the "interdependence" of one's utility with others is the essence to form an asset bubble.

We can illustrate this argument from the implication of proposition 2 above. First of all we assume a logistic function form for our thrust function, i.e.,

$$\pi(E,u^*)=\frac{1}{1+\exp[-(aE+bu^*)]}\,. \qquad (14)$$

By substituting the logistic function above into equation (13) we obtain

$$\{1+\frac{2}{1+\exp[-(aE+bu^*)]}\}\{1+\frac{2}{1+\exp[-(aE^*+bu)]}\}-4uu^*\cdot\frac{b^2\cdot\exp[-a(E+E^*)-b(u+u^*)]}{[1+\exp(-aE-bu^*)]^2[1+\exp(-aE^*-bu)]^2}\,,$$

where the subscript * stands for other persons whose preference will stir an impetus on one's thrust function. We are intended to examine how an increase in the degree of one's receptiveness toward others, i.e., a greater b, will affect the stability condition above. It can readily be shown that an increase in b will reduce the stability condition above so as to increase the likelihood of system instability. We can come to the following conclusion:

Lemma 1: *When one's utility toward a specific asset is more dependent on how others' preference or opinion would be, the ultimate market value of the asset will be more likely to diverge from the original value and facilitate the formation of asset bubble.*

VII. Application in the Impact of International Imbalance on Economic Crisis

We can also draw upon the implication of this proposition to examine how international trade imbalance affects the long term relationship of the trading partners. For simplicity, we measure the net external force exerting on the system, i.e., E, by the same unit as the initial utility, i.e., u, for the entity and let the discrepancy of measurement units between E and u be taken care by the coefficients a and b.

We use a Ricardian model to describe international trade between home and foreign countries with labor endowment of $\tilde{L}$ & $\tilde{L}^*$ respectively. A superscript * stands for foreign country from now on. When we allow for the existence of unemployment, the effective labor forces employed in the two countries will be less than the total labor forces and are denoted as L & L^*. Two products X and Y are traded and consumed. Each unit of X goods requires $\alpha(\alpha^*)$ units of labor inputs for home (foreign) country, while one unit of Y goods requires $\beta(\beta^*)$ units of labor in domestic (foreign) country. Assume that $\alpha/\beta < \alpha^*/\beta^*$ so the home country will completely specialize in the production of X goods while the foreign country specializes in producing Y goods. Let p stand for the international price of good Y relative to good X, and let the price of good X be the numeraire. The home and foreign wages in the equilibrium should be determined by $1 = \alpha w$,& $p = \beta^* w^*$. p can also be gauged as the real exchange rate (e) that measures the number of domestic goods (X) to be exchanged for one unit of foreign goods (Y), i.e., $p = e$ in the discussion below.

Let the per capita income for the foreign country be $I^* = w^* \cdot L^* / \tilde{L}^* = \frac{e}{\beta^*} \cdot \frac{L^*}{\tilde{L}^*}$, and $I = w \cdot L / \tilde{L} = \frac{1}{\alpha} \cdot \frac{L}{\tilde{L}}$ for the home country. We assume a homothetic utility function for both countries, resulting in per capita demand functions of X and Y for the home country as $d_X(1/e, I) = \frac{1}{\alpha} \cdot \frac{L}{\tilde{L}} \cdot d_x(1/e)$ & $d_Y(e, I) = \frac{1}{\alpha} \cdot \frac{L}{\tilde{L}} \cdot d_Y(e)$ and $d_X^*(1/e, I^*) = \frac{e}{\beta^*} \cdot \frac{L^*}{\tilde{L}^*} \cdot d_x^*(1/e)$ & $d_Y^*(e, I^*) = \frac{e}{\beta^*} \cdot \frac{L^*}{\tilde{L}^*} \cdot d_Y^*(e)$ for the foreign country, respectively. Since the export of X goods in the home country must be equal to the import of X goods in the foreign country,

$$\frac{L}{\alpha} - \tilde{L} \cdot \mathrm{d_X}(1/\mathrm{e}, \mathrm{I}) = \frac{\mathrm{L}}{\alpha}[1 - \mathrm{d_X}(1/\mathrm{e})] = \tilde{\mathrm{L}}^* \cdot \mathrm{d_X}^*(1/\mathrm{e}, \mathrm{I}^*) = \frac{\mathrm{e} \cdot \mathrm{L}^*}{\beta^*} \cdot \mathrm{d_X}^*(1/\mathrm{e}) . \qquad (A)$$

which can be rewritten as $\frac{L}{L^*} = \frac{e \cdot \alpha}{\beta^*} \frac{d_X^*(1/e)}{1 - d_X(1/e)}$. Similarly, the fact that the export of Y goods in the foreign country equals the import of Y goods in the home country implies

$$\frac{L^*}{\beta^*} - \tilde{L}^* \cdot d_Y{}^*(e, I^*) = \frac{L^*}{\beta^*}[1 - e \cdot d_Y{}^*(e)] = \tilde{L} \cdot d_Y(e, I) = \frac{L}{\alpha} \cdot d_Y(e) \qquad \text{(B)}$$

Once we allow imbalance of trade between the two countries, the net trade balance for the home country, denoted by R, is equal to

$$R = \frac{L}{\alpha} - \tilde{L} \cdot d_X(1/e, I) - \tilde{L} \cdot e \cdot d_Y(e, I) = \frac{L}{\alpha}\left[1 - d_X(1/e) - e \cdot d_Y(e)\right] \qquad (15-1)$$

$$\& \quad R = \tilde{L}^* \cdot d_X{}^*(1/e, I^*) + \tilde{L}^* \cdot e \cdot d_Y{}^*(e, I^*) - \frac{L^*}{\beta^*} \cdot e = \frac{L^* e}{\beta^*}\left[d_X{}^*(1/e) + e \cdot d_Y{}^*(e) - 1\right] \quad (15-2)$$

Note that equations (A), (B) & (15-1) imply equation (15-2). Hence the three independent equations (A), (B) and (15-1) can thus be used to solve the three variables of real exchange rate, and employed labor forces for both countries, i.e., e, L & L^*.

The depreciation in home's real exchange rate, i.e. an increase in e, will lead to an increase in L/L* as can be seen from equation (A). In other words, a country will tend to depreciate her currency in order to beef up the opportunity of domestic employment. It is noted that a positive R in equation (15) means a net trade surplus for the home country while a negative R implies a trade deficit.

As for the impact of real exchange rate on the net trade, it hinges on the elasticity of total demand with respect to the price level p (or real exchange rate e). Let $\frac{d[d_X(1/e) + e \cdot d_Y(e)]}{de} = \eta$ and $\frac{d[d_X{}^*(1/e) + e \cdot d_Y{}^*(e)]}{d(1/e)} = \eta^*$. The impact of real exchange rate on net trade can be examined by the following equation:

$$\frac{dR}{de} = \frac{dL}{de} \cdot \frac{1 - d_X(1/d) - e \cdot d_Y(e)}{\alpha} + \frac{L}{\alpha} \cdot (-\eta).$$

Since dL/de > 0, we can readily derive the following conclusion:

Lemma 2: ***(i)*** *When a country incurs a trade surplus (i.e., R > 0 or* $1 - d_X(1/e) - e \cdot d_Y(e) > 0$ *), a depreciation in her currency (i.e., an increasing e) would further improve her trade surplus unless her total demand is substantially inelastic such that* $\eta > \frac{\alpha}{L}\left\{\frac{dL}{de} \cdot \frac{1 - d_X(1/e) - e \cdot d_Y(e)}{\alpha}\right\}$*. In the latter case she should let her currency appreciate to improve net trade.*

(ii) *When a country incurs trade deficit (i.e., R < 0 or* $1 - d_X(1/e) - e \cdot d_Y(e) < 0$ *), an* *appreciation in her currency (i.e., a declining e) would improve her trade deficit unless her total demand is substantially elastic such that* $\eta < \frac{\alpha}{L}\left\{\frac{dL}{de}\cdot\frac{1-d_X(1/e)-e\cdot d_Y(e)}{\alpha}\right\} < 0$. *In the latter case she should let her currency depreciate to improve net trade.*

Accordingly the net external force as well as the initial utility level for average person (or representative individual) of the home country becomes

$$E = u = \frac{L}{\tilde{L}}w - \frac{R}{\tilde{L}} = \frac{L}{\tilde{L}}\{\frac{1}{\alpha} - [\frac{1}{\alpha} - d_x(1/e, I) - e\cdot d_Y(e.I)]\} = (\frac{L}{\tilde{L}})^2\cdot\frac{1}{\alpha}[d_x(1/e) + e\cdot d_Y(e)]$$

. (16)

And the external force and the initial utility level for the representative individual of foreign country is

$$E^* = u^* = \frac{L^*}{\tilde{L}^*}w^* + \frac{R}{\tilde{L}^*} = \frac{L^*}{\tilde{L}^*}\{\frac{e}{\beta^*} + [d_x^*(1/e, I^*) + e\cdot d_Y^*(e, I^*) - \frac{e}{\beta^*}]\} = (\frac{L^*}{\tilde{L}^*})^2\,\frac{e}{\beta^*}[d_x^*(1/e) + e\cdot d_Y^*(e)] \quad (17)$$

From equations (16) & (17) we can understand why the government in each trading country will do her best to depreciate her currency so as to maximize the employment level (or reduce unemployment rate).

As far as the impact of real exchange rate on the initial utility level, it can be examined through the following derivation:

$$\frac{dE}{de} = 2\cdot\frac{L}{\tilde{L}^2}\cdot\frac{1}{\alpha}\cdot\left[d_X(1/e) + d_Y(e)\right]\cdot\frac{dL}{de} + \left(\frac{L}{\tilde{L}}\right)^2\frac{1}{\alpha}\cdot\eta \text{, and}$$

$$\frac{dE^*}{d(1/e)} = 2\cdot\frac{L^*}{\tilde{L}^{*2}}\cdot\frac{e}{\beta}\cdot\left[d_X^*(1/e) + d_Y^*(e)\right]\cdot\frac{dL^*}{d(1/e)} + \left(\frac{L^{**}}{\tilde{L}}\right)^2\frac{1}{\beta}\cdot\eta^*.$$

Since $\frac{dL}{de} > 0$ & $\frac{dL^*}{d(1/e)} > 0$, a depreciation in one's currency will improve her initial utility level unless the demand for her total trade is very elastic as summarized in the lemma below:

Lemma 3: *A country will adopt the policy of currency depreciationin order to improve her employment level as well as her initial utility unless the demand for total commodity expenditure is very elastic such that* $\eta < -\frac{2[d_X(1/e) + e\cdot d_Y(e)]}{L}\cdot\frac{dL}{de} < 0$

for the home country or $\eta^* < -\frac{2}{L^*}\left[\frac{d_X^*(1/e) + e \cdot d_Y^*(e)}{1/e}\right] \cdot \frac{dL^*}{d(1/e)} < 0$.

Assume that R > 0 without loss of generality. Therefore $1 - d_X(1/e) - d_Y(e) > 0$ & $d_X^*(1/e) + d_Y^*(e) - 1 > 0$ according to equations (15-1) and (15-2). Let the ratio of net trade toward gross product for both countries be $\frac{R}{Lw} = \gamma$ & $\frac{R}{L^* w^*} = \gamma^*$ respectively. Then the initial utility for both countries becomes

$$E = u = \frac{R}{\tilde{L}} \cdot \frac{1-\gamma}{1 - d_X(1/e) - e \cdot d_Y(e)} \qquad (16')$$

And

$$E^* = u^* = \frac{R}{\tilde{L}^*} \cdot \frac{1-\gamma^*}{d_X{}^*(1/e) + e \cdot d_Y{}^*(e) - 1} \qquad (17')$$

Based on the logistic function form expressed in equation (14) we can rewrite the criterion for stability, equation (13), as W =

$$\{1 + \frac{2}{1 + \exp[-(aE + bu^*)]}\}\{1 + \frac{2}{1 + \exp[-(aE^* + bu)]}\} - 4uu^* \cdot \frac{b^2 \cdot \exp[-a(E + E^*) - b(u + u^*)]}{[1 + \exp(-aE - bu^*)]^2 [1 + \exp(-aE^* - bu)]^2} \qquad (18)$$

By substituting equations (16') and (17') into the criterion equation (18) above, we can tell that our financial stability is influenced by the following parameters: (1) per capita reserve in both countries (i.e., $r \equiv R/\tilde{L}$ for the home country and $r^* \equiv R^*/\tilde{L} = -R/\tilde{L}$ for the foreign country); (2) per capita saving (in terms of X goods) in both countries (i.e., $s \equiv 1 - d_X(1/e) - e \cdot d_Y(e)$ for the home country and $s^* \equiv 1 - d_X^*(1/e) - d_Y^*(e)$ for the foreign country); (3) ratio of reverse toward GDP for both countries (i.e., γ for the home country and γ^* for the foreign country); (4) sensitivities of Chi impulse toward internal as well as external utility level (i.e., *a* and *b*) which can be distinguished for the home and foreign country.

Once we substitute $E = r(1-\gamma)/s$ & $E^* = r^*(\gamma^* - 1)/s^*$ into the indicator from equation (18), we can check whether our trading system can sustain the threat of collapse and design a prudent imbalance threshold, i.e. γ & γ^*, for the member countries of WTO to follow.

The recent battles in the currency war look no visible resolution. China accused the US of destabilizing emerging economies by allowing ultra-loose monetary policy to flood the emerging world with money while the US insisted the IMF should intensify its focus on exchange rates on the reserve accumulation of China. The lack of any substantive agreements and brinkmanship on proposed reforms to the IMF is likely to exacerbate currency volatility.

We know that the exchange rate, interest rate and income level are jointly determined by a country's real commodity, monetary and exchange markets together. When a country chooses its specific exchange rate policy (fixed, pegging, completely floating or dirty float, etc), it will automatically bring in the consequence of its accompanying inflation level, income growth (or unemployment rate), and accumulated reserve level. We cannot condemn any country of wrongdoing in its exchange rate manipulation. However, this study points out an additional indicator, i.e., W in equation (18), which measures the degree of international financial stability, needs to be watched meticulously. When a country's exchange rate policy creates a significant international trade imbalance so that financial stability in the international trade system is undermined, a global coordinated effort and mechanism should be put in force.

VIII. Empirical Results

In order to examine the stability indicator provided in previous section, we collect the data in country level during 1980 to 2008 from World Bank database (World Development Indicator & Global Development Finance). Those countries suffered global banking crisis defined by Reinhart and Rogoff (2008) during 1991-1992, 1994-1995, 1997-1998 and 2007 to present[4]. We separate two countries by treating the home country as one while the foreign country is defined by the world data excluding the home country. For example, GDP in foreign country is calculated by world GDP minus GDP in home country. Thus, we can derive each component (i.e. reserve (measured by net trade balance of goods and services) per labor, savings per capital and ratio of reverse toward GDP for both countries) in equation (16) & (17). The sensitivities of Chi impulse toward internal as well as external utility level (i.e., *a* and *b*) which can be distinguished for the home and foreign country is normalized between 0 to 1 ($b=1-a$). When $a=1$, $b=1-a=0$, this situation means the home country cares his own utility only, the degree of foreign country's receptiveness toward home is zero. We assume that these values hold constant during the whole period and we report the data using $a=0.5$ and $b=0.5$. The changes in *a* and *b* will not change the time serious trend of the stability indicators.

The data statistics of each country's average number during 1980 to 2009 are

[4] We didn't include the countries during 1981 to 1982 because half of them are included in other crises while another half countries didn't have available data in WDI.

provided in table 1. Ireland has the highest average savings per labor $161,35 while Swaziland has the lowest $230. Ireland also has the highest net trade of goods and services per labor $4,916 while Greece has the lowest $-2,072. Regarding the ratio of net trade of goods and services toward GDP, Malaysia, Hong Kong and Ireland are the top three countries with 8.61%, 7.84% and 6.91% respectively. Swaziland, Egypt and Greece have the least ratio of net trade of goods and services toward GDP with -16.43%, -8.8% and -6.9% respectively. Then we can get the initial utility level of each country using equation (16) and (17). Though we use home country compared with the other countries treating as a whole foreign country, the ratio of net trade balance toward GDP may be smaller far less than the home country, the utility level derived from the model of foreign may be just smaller than 5 times the utility level of home country (Japan 5.29% vs. Foreign country 1.15%).

The financial stability indicators of these countries are provided in figure 1 to 4. In fact, the stability indicators deriving from equation (18) are always positive which mean these financial crises didn't break out our financial system eventually, and this is the truth. Nevertheless, we can still observe the trend of changes among the indicators. During 1991-1992 financial crises (Figure 1), these countries except Egypt and Poland had a declining trend of the stability indicators. Before the crises happened, these indicators had a declining trend. We also observe that Greece has a significant drop after 2004, there is financial crisis in Greece during these two years.

Figure 1. Countries with Financail Crisis druing 1991-1992

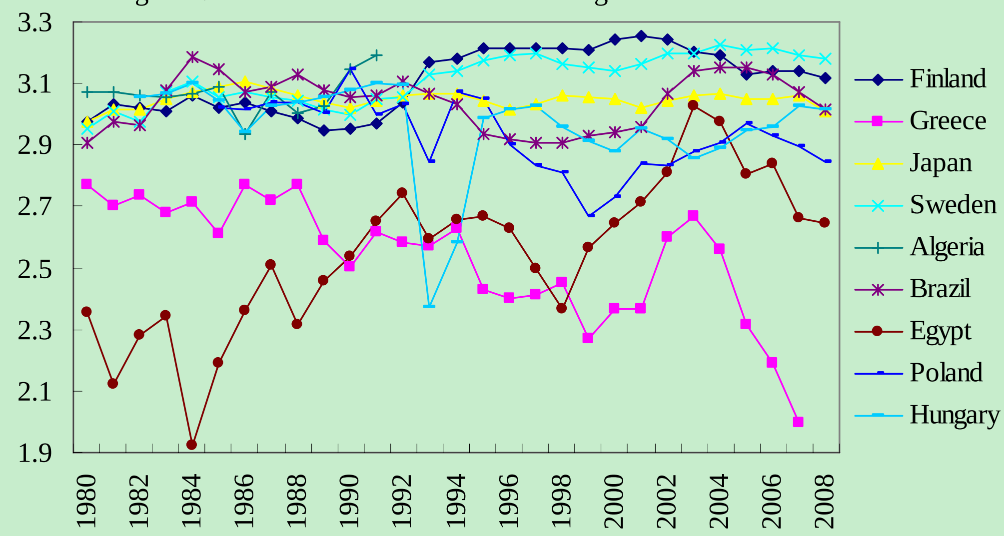
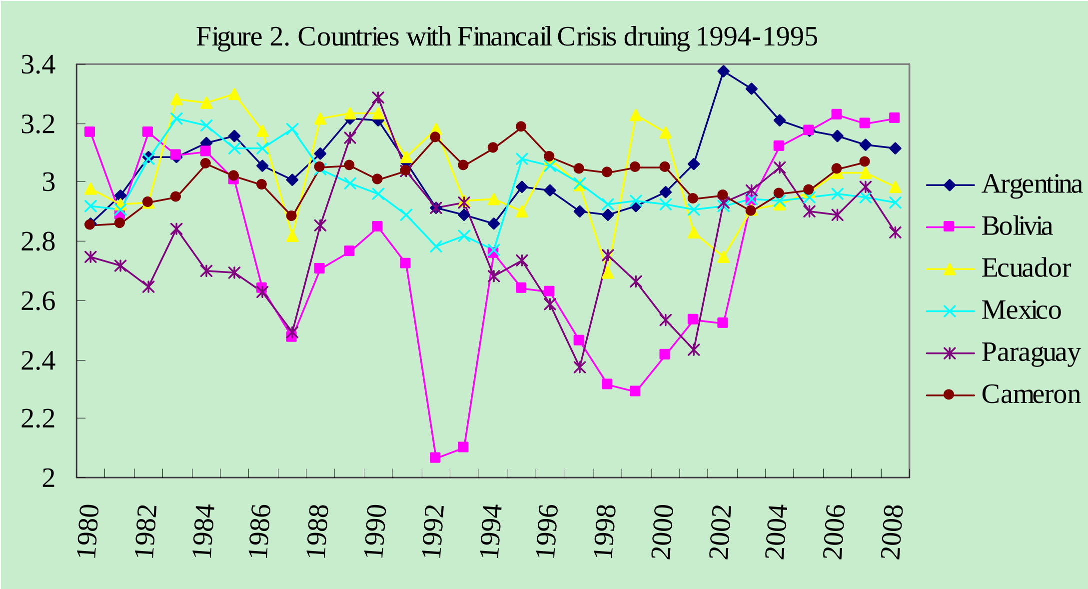


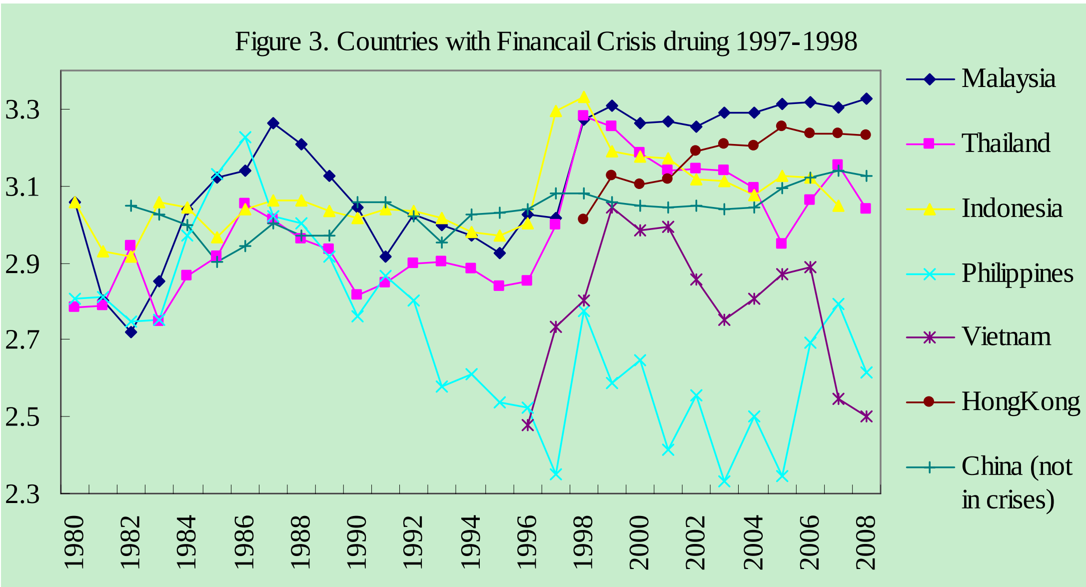
Table 1. Summary of each country's data

	Savings per labor	Savings* per labor	BOP per labor	BOP* per labor	BOP/GDP	BOP/GDP*	E	E*
Algeria	2,952	1,612	273	0.74	3.17%	0.011%	8.57%	0.047%
Argentina	2,456	2,335	172	1.06	2.43%	0.009%	7.78%	0.041%
Bolivia	316	2,339	-38	-0.04	-2.25%	0.000%	-35.06%	-0.002%
Brazil	1,494	2,362	82	2.46	1.37%	0.023%	5.24%	0.102%
Cameroon	447	2,340	1	0.00	0.13%	0.000%	2.27%	0.000%
China	673	3,037	64	21.86	2.11%	0.108%	4.27%	0.530%
Ecuador	989	2,338	26	0.03	1.17%	0.001%	4.20%	0.003%
Egypt	467	2,350	-247	-1.87	-8.80%	-0.021%	-66.15%	-0.091%
Finland	12,416	2,326	2246	2.11	4.10%	0.017%	14.11%	0.077%
Germany	10,542	2,209	1340	19.85	2.54%	0.176%	10.99%	0.793%
Greece	3,035	2,327	-2072	-3.64	-6.90%	-0.032%	-67.29%	-0.142%
Hong Kong	15,737	3,037	3992	4.80	7.84%	0.033%	22.58%	0.153%
Hungary	2,949	2,406	-136	-0.19	-0.61%	-0.001%	-5.87%	-0.006%
Iceland	9,266	2,336	-1607	-0.10	-1.58%	-0.001%	-11.43%	-0.003%
Indonesia	606	2,432	57	2.06	2.86%	0.015%	9.33%	0.070%
Ireland	16,135	2,327	4916	3.18	6.91%	0.024%	13.23%	0.108%
Japan	14,927	2,005	815	21.38	1.58%	0.242%	5.29%	1.150%
Malaysia	3,503	2,332	970	3.51	8.61%	0.025%	15.19%	0.113%
Mexico	2,728	2,331	-123	-1.88	-0.19%	-0.010%	-2.93%	-0.044%
Paraguay	530	2,337	-135	-0.10	-3.81%	-0.001%	-29.36%	-0.005%
Philippines	380	2,358	-148	-1.69	-5.91%	-0.015%	-40.87%	-0.066%
Poland	1,670	2,341	-205	-1.23	-1.46%	-0.009%	-9.66%	-0.041%
Spain	7,633	2,300	-876	-6.14	-1.88%	-0.046%	-8.50%	-0.207%
Swaziland	230	2,336	-613	-0.07	-16.43%	-0.001%	-358.15%	-0.003%
Sweden	12,415	2,318	2424	4.08	3.85%	0.032%	14.88%	0.147%
Thailand	1,100	2,352	19	0.20	-0.19%	-0.002%	-2.65%	-0.006%
United Kingdom	6,881	2,285	-814	-8.63	-1.29%	-0.063%	-8.89%	-0.286%
United States	8,620	1,977	-1657	-92.39	-2.60%	-1.037%	-17.55%	-4.278%
Vietnam	281	3,028	-81	-1.17	-6.51%	-0.007%	-29.57%	-0.034%

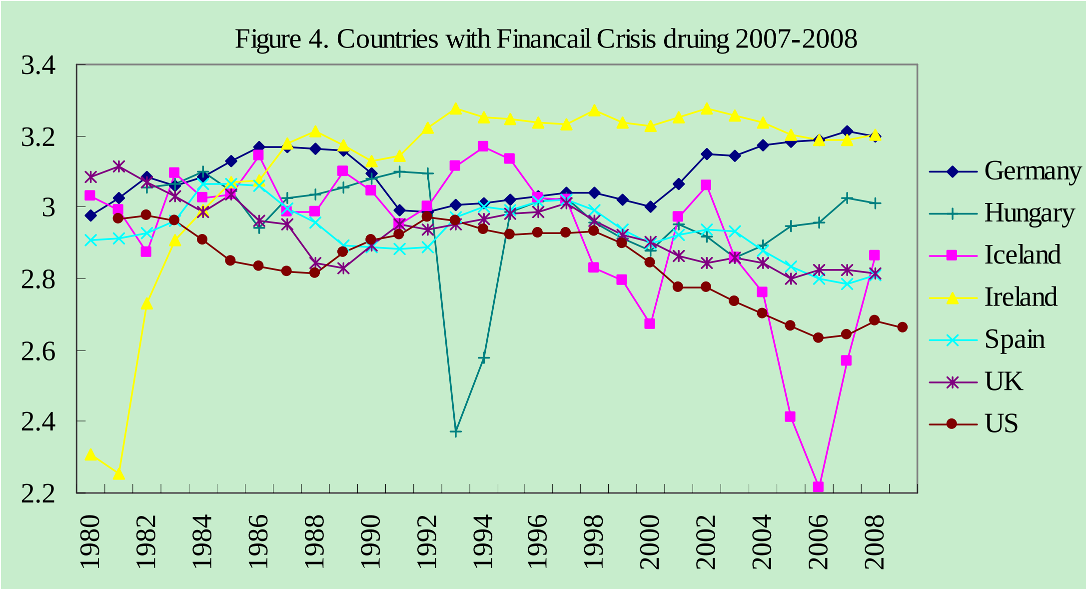
* indicate the foreign country corresponding to the home country.



In figure 2, during 1994-1995 financial crises, Bolivia had the lowest value of this indicator in previous two years. The indicators also provide good predication of the crises except Cameron.



During 1997-1998 Asian financial crises, we also observe a declining trend before crises, especially Philippines. After the crises, the indicators reversed to an upward trend. Vietnam and Hong Kong only have available data after 1996 and 1998; both countries also had the upward trend after the crises. From figure 3, Philippines also approached the lowest level (around 2.43) in 1997, 2003 and 2005 while only 1997 suffered financial crisis. This stability indicator of Vietnam also had a significant declining trend in recent years, but Vietnam is communist country and the government controlled the exchange rate. Maybe our model is not good at this kind of country such as China which has a quite stable indicator.



Recent financial crises starting from 2007 came from U.S sub-prime real estate bubble and other real estate bubble in advanced countries. Except Germany, Ireland and Hungary (which also suffered 1991-1992 crises), our indicators also provide well prediction on these crises. The indicators had been declined for several years before 2007.

In summary, our model provides financial stability prediction in financial crises. We would attribute the root problem to the unchecked trade imbalance that results from the incompatibility of "national" vs. "world's" economic interest.

VIIII. Concluding Remarks

When China decides to stem rapid appreciation of its currency, it can prevent the adverse impact on the export sector. However, this exchange rate policy implicitly encourages the capital inflow into as well as credit expansion in certain asset markets (real estate and stock) at expense of middle-class consumers' welfare. IMF should have no right to dictate the choice of exchange rate policy for its member countries. However, this study provides another indicator (W) to gauge whether a country's trade imbalance would jeopardize the global financial stability or not. When trade imbalance is too big to violate the financial stability condition, IMF should impose a ban.

The trend of polarization of the world economy is the main cause that steps up trade imbalance and of grave concern for us in the awake of the 2008 financial crisis. On one hand the emerging markets pinpoint the development of their manufacturing sectors to boost economic growth with excess supply exporting to the rich countries while pouring the capital surplus from trade into developed countries so as to contain the currency appreciation. On the other hand, the developed countries concentrate their industrial structure in the service-oriented sectors, especially financial industry. By drawing the capital from all of world they provide very competitive and innovative financial products trading in a supposedly efficient capital market. The principle of specialization of capital and labor in the utilization of global production resources between the developed and developing countries, which was strongly advocated by Adam Smith as a way to enhance the wealth of nation, should be added with some caveat. Without profound and reliable regulation on global financial system an unwieldy build-up of trade (and reserve) imbalance among countries would become the fault line of incessant financial rises afflicting our global economy.

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