Non-performing Loans' Welfare Utility Loss in Beijing Based on Low Carbon Economy

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Abstract

Bank crises and social problem came into being because of non-performing loans in Japan and Korea and US. Economist and specialist have noticed Bank non-performing loans. The paper applied a social utility function model for bank loans & non-performing loans and simulated the model in Beijing based on low carbon economy from 2003 to 2050, bank non-performing loans will cause high carbon economy. Bank non-performing loans will be harmful to economic growth and social welfare utility. The following result is obvious that from the above scatter simulation result:(1) The social utility increases from about -29042 to -65.63 units in Beijing when the non-performing loans growth rate decrease from 0.07 to 0.01 at 2050 year. (2) The social utility decrease in Beijing from 2003 to 2050 when the non-performing loans growth rate is 0.07, the social utility decrease from about -233.6 to -29042 units in Beijing when the time span is between 2040 and 2050.

1   Introduction

It is necessary to analyze bank non-performing loans to avoid reducing social welfare because of capital chain rupture and financial pollution, which results from operation failure caused by Bank non-performing loans. Bank non-performing loans are a troublesome problem for many countries. For instance, bank crisis and a series of social problems came into being because of non-performing loans in Japan and in US. Non-performing loans also trouble Korea and China government.

Japanese banking increased so quick that the total asset of Japanese banks occupied 33%

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of total asset of international banking in latter half of 1980s. At the same time, the amount of Japanese banks' non-performing loans reached 600 billion US dollars. Moreover, the ratio of non-performing loans to total loans is 6% in fiscal year of 1997 (March, 1998)[1]. It is reported by Korea government that the ratio of non-performing loans to total loans is 11.8% in fiscal year of 1997[2]. This ratio increased from 12% to 18.6% in some loose-controlled non-banking financial institutions (merchant bank, securities firms, leasing firms, and regional institutions) while the ratio is 6% in tight-controlled banks in late 1990s (these big banks' loans occupies 70% of Korean total loans), which is much higher than that of insurance companies [3]. Financial system's frangibility and bank crises mainly result from bank non-performing loans. The statistics of IMF indicates that 133 countries, which occupy 74% of all the member states have experienced serious financial problems or financial crises among the 181 member states since 1980. It is reported that 108 cases suffered form financial problems. Among them, the problems of 72 cases, which occupy 67%, originated from bank non-performing loans. There are 31 countries, which suffered from financial crises totaling 41 cases. Among these crises, 24 cases, which occupy 59%, originated from financial non-performing loans.

Therefore, bank non-performing loans are considered to be a problem concerned by economists and specialists. Obviously, it's crucial to identify bank non-performing loans model and model's application.

The subsequent content of this paper shows as follows: the author reviews the existing literature in the second part and points out the existing literature's problem as well as settlements, then the paper applied a social utility function model for bank loans & non-performing loans in the third part. The paper simulates the model in Beijing in the fourth part. As for the fifth part, there is a summary.

2   Literature Review

2.1 Classification of Non-performing Loans in The New Basle Capital Accord

It is considered that rate of capital sufficiency; supervision and market discipline are the three main elements in The New Basle Capital Accord. Among them, the rate of capital sufficiency=capital / (weighting asset of credit risk + 12.5 × capital demand of market risk + 12.5 × capital demand of operation risk). The concept of credit risk in The New Basle Capital Accord [4 -5] refers to loss risk, which is caused by default of borrowers and market dealing rivals. Operation risk defines the risk due to incorrect internal operation flow and accidents of personnel, system or external events. The concept of market risk is the risk, which results from variety of interest rate, exchange rate, securities and commodity price. Supervision means a kind of industry control, which the authorities not only supervises matching of bank capital in cash and risk amount, but also supervises matching of bank capital in cash and level of risk control in order to encourage bank development and control of risk with more advanced techniques. Market discipline is a kind of social control, and it sets up a series of compulsive regulations and suggestions.

How to measure loan risk is emphasized in The New Basle Capital Accord, but the Accord is lack of analysis of non-performing loans mechanism.

2.2 Analysis of Bank Non-performing Loans

In literature, some analysis of bank non-performing loans can be found in literature concerning bank crises. For example, Brenda Gonzales-Hermosillo (1999)[6] defines banking system frangibility extent as follows: banking system frangibility extent = (capital + loan reserves - non-performing loans) / total asset. Others can be found in literature about financial frangibility. For instance, Minsky and Hyman P. (1964, 1982, 1986, 1995)[7-10] believe that deflation and non-performing loans increase come into being since investors get into debt so excessively during economic boom period that they don't have enough cash to repay the debt during depression. The paper of Stiglitz and Weiss (1981)[11] is about credit rationing. Bernanke, Gertler (1990)[12] and Mankiw (1986)[13] hold that currency deflation is related to asymmetry information under any circumstance. Credit market may break up after the interest rate of currency market (banking refinancing cost) increases slightly due to converse choice in Mankiw's model (1986)[13]. The model of Bernanke and Gertler (1990)[12] indicates that general financial condition (credit value of borrower or bank capacity to pay) will influence macro-economy operation because of the existence of moral hazard.

In China, some literature, which analyze bank non-performing loans, have the title 'bank non-performing loans'. For example, the paper of Weiqun Yu (2001)[14] analyzes reasons for non-performing loans systematically from the point of view of institutional economics. Huiwen Fan (1998)[15] analyzes financial risk and risk control widely from various angles, such as interest rate, exchange rate, bank credit, securities, tools derive from finance, macro-financial risk, etc. Haixiao Liu (1999)[16] researches financial risk from bank credit and risk, securities market, exchange rate, etc. Shihong Zeng (2003)[17] did gambling research for non-performing loans of state-owned commercial bank. The paper doesn't analyze non-performing loans model mechanism from combination of macro-entity and micro-entity, but from micro-entity's behavior. Fang Zhao (2003) [18] mainly studies the influence of bank non-performing loans on Japanese economy.

Recent years, Bank Non-performing Loans (NPLS)'s literatures about Different countries exist, for example, Yasushi Suzuki, Md. Dulal Miah and Jinyi Yuan(2008)[19]; Yang Li, Jin-Li Hu & Hsin-Wei Liu (2009) [20]; Levon Barseghyan(2010)[21]; Bernardo Maggi, Marco Guida(2011) [22]; Karlo Kauko(2012) [23]; Shihong Zeng(2012) [24]; Dimitrios P. Louzis, Angelos T. Vouldis, Vasilios L. Metaxas(2012) [25]; Ning Zhu, Bing Wang, Yanrui Wu(2014) [26]; Lobna Abid, Med Nejib Ouertani, Sonia Zouari-Ghorbel(2014) [27].

2.3 The existing Literature's Problem and the Aim of this Paper

As 'a financial pollution', bank non-performing loans may be harmful to social welfare. There regularly is a social welfare function with loan and bank non-performing loans cited in existing literature.

The above literature doesn't study bank non-performing loans' influence on social welfare from the point of view of the simulation. This paper applied a social utility function model for bank loans & non-performing loans [24]and simulate the model in Beijing.

3   Utility Function (Loss Function)

As the loan balance (L) can increase production and service capacities, it increases total consumption (C) and social utility. However, since the bank non-performing loan (N) is "a financial pollution (P)" and is harmful to social welfare, it decreases social utility. The process is described below. Let

$$C = C(L) \quad (\ C' > 0 \ , \ C'' < 0\ )$$
$$P = P(N) \quad (\ P' > 0 \ , \ P'' > 0\ )$$

Where $C(L) = (uL^\theta)^{\frac{1}{\eta}}$, and $P\ (\ N\ ) =\ -vN^m$

Thus, $[C(L)]^\eta = uL^\theta$

As the social utility function is dependent upon the total consumption (C) and bank non-performing loans (N), it is reasonable to obtain the following relationship:

$$U = U(C(L), P(N))$$

For a simple illustration, we derive the social utility function as follows. If

$$U = U(C(L), P(N)) = [C(L)]^\eta - P(N)$$

Substitute $[C(L)]^\eta = uL^\theta$ And $P\ (\ N\ ) =\ vN^m$ Into $U = [C(L)]^\eta - P(N)$,
Then, the utility function becomes

$$U = C^\eta - vN^m = uL^\theta - vN^m ,$$

Where $0 < \theta < 1 \circ 0 < \eta < 1$ ， $v > 0$.

It can be seen that the loan balance (L) results in a positive social utility, which is given by uL^θ , and the bank non-performing loans (N) leads to a negative social utility, which is $-vN^m$.

More analyses can be performed as shown below:

If $u > 0, L > 0$ Then $\dfrac{\partial U}{\partial L} = u\theta L^{\theta-1} > 0$

$$\frac{\partial^2 U}{\partial L^2} = u\theta(\theta-1)L^{\theta-2} < 0$$

The above implies that the marginal utility of loan balance (L) is an increasing function and that the social utility (U) function is concave relative to loan balance (L).

The other scenario can be also analyzed below:

If $m > 1, N > 0$, Then $\dfrac{\partial U}{\partial N} = -vmN^{m-1} < 0$

$$\frac{\partial^2 U}{\partial N^2} = -vm(m-1)N^{m-2} < 0$$

Similarly, the above analyses indicate that the marginal utility of bank non-performing loans (N) is positive and a decreasing function and that the social utility (U) function is concave relative to bank non-performing loans (N).

4 Simulation

The social utility can simulated by the formula $U = C^\eta - vN^m = uL^\theta - vN^m$ when parameter vary from 2003 to 2050

$$U = C^\eta - vN^m = uL^\theta - vN^m,$$
$$0 < \theta < 1 \cdot 0 < \eta < 1 \, \cdot \, v > 0 . m > 1, N > 0, u > 0, L > 0$$

Presume

(1). $u = 0.5, \theta = 0.5, v = 0.5, m = 1.5$

(2). $L = L_0(1 + \lg)^t$, $L_0 = 1080$ (billion RMB), lg is the loan balance growth rate,

L_0 is the loan balance at the end of the fourth month in 2003 in Beijing. $t = 0,1,2,3,4,.......48$ from 2003 to 2050

(3). $N = N_0(1 + ng)^t$, $N_0 = 63$ (billion RMB), ng is the non-performing loans growth rate, N_0 is the non-performing loans balance at the end of the fourth month in 2003 in Beijing. $t = 0,1,2,3,4,.......48$ from 2003 to 2050

So, $U = C^\eta - vN^m = uL^\theta - vN^m$
$$= 0.5[L_0(1 + \lg)^t]^{0.5} - 0.5[N_0(1 + ng)^t]^{1.5}$$
$$= 0.5 * [1.08(1 + \lg)^t]^{0.5} - 0.5 * [0.063(1 + ng)^t]^{1.5}$$

The following is the scatter simulation formula language when parameter (the non-performing loans growth rate) varies

A. $\lg = 0.15$, $ng = 0.07$
UA=0.5*[1080*(1+0.15)^t]^0.5-0.5*[63*(1+0.07)^t]^1.5
B. $\lg = 0.15$, $ng = 0.05$
UB=0.5*[1080*(1+0.15)^t]^0.5-0.5*[63*(1+0.05)^t]^1.5
C. $\lg = 0.15$, $ng = 0.03$
UC=0.5*[1080*(1+0.15)^t]^0.5-0.5*[63*(1+0.03)^t]^1.5
D. $\lg = 0.15$, $ng = 0.01$
UD=0.5*[1080*(1+0.15)^t]^0.5-0.5*[63*(1+0.01)^t]^1.5

E. lg = 0.15, *ng* = 0
UE=0.5*[1080*(1+0.15)^t]^0.5-0.5*[63*(1+0)^t]^1.5
F. lg = 0.15, *ng* = −0.01
UF=0.5*[1080*(1+0.15)^t]^0.5-0.5*[63*(1-0.01)^t]^1.5
G. lg = 0.15, *ng* = −0.03
UG=0.5*[1080*(1+0.15)^t]^0.5-0.5*[63*(1-0.03)^t]^1.5
H. lg = 0.15, *ng* = −0.05
UH=0.5*[1080*(1+0.15)^t]^0.5-0.5*[63*(1-0.05)^t]^1.5
I. lg = 0.15, *ng* = −0.5
UI=0.5*[1080*(1+0.15)^t]^0.5-0.5*[63*(1-0.5)^t]^1.5

The following Figure 1 and table 1 is scatter simulation result. The horizontal axes is time from 2003 to 2050, vertical axes is scatter simulation result of the social utility in Figure 1.
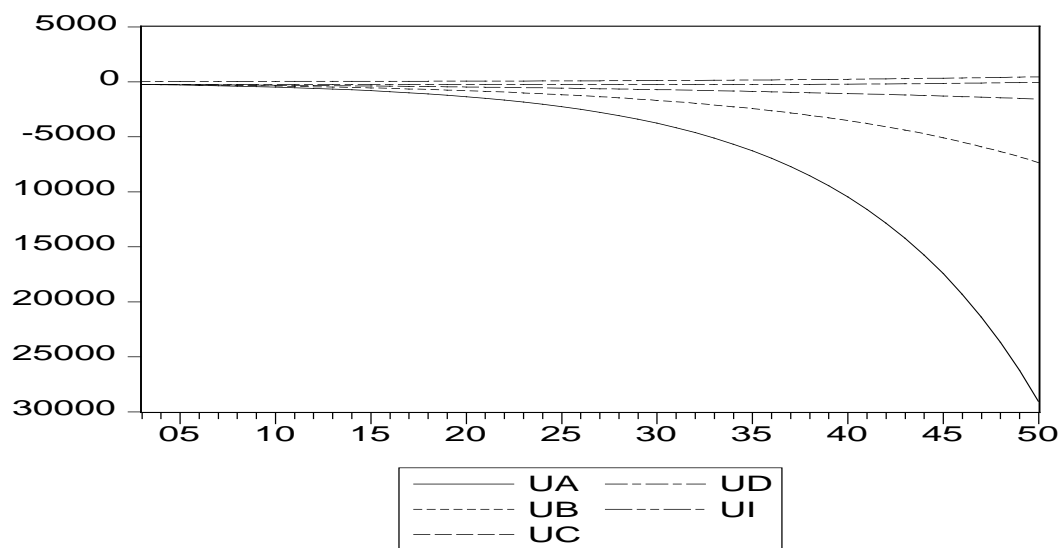

Figure 1: Scatter simulation result when non-performing loans growth rate varies

Table 1: scatter simulation result when non-performing loans growth rate varies from 2003 to 2050

obs	UA	UB	UC	UD	UE	UF	UG	UH
2003	-233.6	-233.6	-233.6	-233.6	-233.6	-233.6	-233.6	-233.6
2004	-259.1	-251.4	-243.7	-236.2	-232.4	-228.7	-221.2	-213.9
2005	-287.4	-270.5	-254.3	-238.7	-231.1	-223.7	-209.3	-195.5
2006	-318.7	-291.1	-265.3	-241.2	-229.8	-218.7	-197.7	-178.2
2007	-353.5	-313.3	-276.8	-243.7	-228.3	-213.7	-186.5	-162.1
2008	-392	-337.2	-288.8	-246.1	-226.7	-208.6	-175.7	-146.9
2009	-434.7	-362.9	-301.2	-248.5	-225	-203.4	-165.1	-132.6
2010	-482	-390.5	-314.2	-250.8	-223.2	-198.2	-154.8	-119.1
2011	-534.4	-420.3	-327.7	-253	-221.3	-192.9	-144.7	-106.4
2012	-592.4	-452.3	-341.8	-255.2	-219.2	-187.5	-134.9	-94.28
2013	-656.8	-486.7	-356.5	-257.2	-217	-182	-125.3	-82.78
2014	-728.1	-523.8	-371.7	-259.2	-214.6	-176.4	-115.8	-71.81
2015	-807.1	-563.7	-387.6	-261.1	-212	-170.6	-106.5	-61.31
2016	-894.6	-606.6	-404.2	-262.8	-209.3	-164.8	-97.29	-51.2
2017	-991.5	-652.8	-421.4	-264.4	-206.3	-158.7	-88.17	-41.44
2018	-1099	-702.6	-439.3	-265.9	-203.2	-152.5	-79.12	-31.97
2019	-1218	-756.1	-458	-267.2	-199.8	-146.2	-70.1	-22.74
2020	-1350	-813.7	-477.4	-268.3	-196.1	-139.6	-61.09	-13.69
2021	-1496	-875.6	-497.6	-269.3	-192.2	-132.8	-52.05	-4.787
2022	-1658	-942.3	-518.6	-270	-188	-125.8	-42.96	4.0318
2023	-1837	-1014	-540.4	-270.5	-183.5	-118.5	-33.79	12.811
2024	-2035	-1091	-563.1	-270.8	-178.7	-110.9	-24.5	21.596
2025	-2255	-1174	-586.7	-270.8	-173.6	-103	-15.06	30.436
2026	-2499	-1264	-611.2	-270.4	-168	-94.78	-5.439	39.376
2027	-2768	-1360	-636.7	-269.8	-162.1	-86.21	4.3988	48.465
2028	-3067	-1464	-663.2	-268.8	-155.7	-77.24	14.492	57.75
2029	-3398	-1575	-690.7	-267.5	-148.9	-67.85	24.879	67.278
2030	-3764	-1695	-719.3	-265.7	-141.6	-58	35.601	77.101
2031	-4170	-1824	-749	-263.5	-133.8	-47.66	46.7	87.267
2032	-4620	-1963	-779.8	-260.8	-125.3	-36.8	58.222	97.83
2033	-5117	-2113	-811.8	-257.5	-116.3	-25.36	70.215	108.84
2034	-5669	-2274	-845	-253.7	-106.6	-13.3	82.728	120.36
2035	-6279	-2447	-879.4	-249.3	-96.26	-0.576	95.815	132.45
2036	-6955	-2633	-915.1	-244.3	-85.13	12.863	109.53	145.15
2037	-7704	-2834	-952.1	-238.5	-73.2	27.073	123.94	158.55
2038	-8533	-3049	-990.5	-231.9	-60.4	42.112	139.1	172.7
2039	-9451	-3282	-1030	-224.5	-46.67	58.044	155.08	187.68
2040	-10467	-3532	-1072	-216.3	-31.96	74.937	171.96	203.56
2041	-11593	-3800	-1114	-207	-16.17	92.862	189.8	220.42
2042	-12839	-4090	-1158	-196.7	0.7547	111.9	208.69	238.34
2043	-14219	-4401	-1204	-185.3	18.906	132.13	228.72	257.41
2044	-15747	-4736	-1251	-172.7	38.371	153.64	249.99	277.73
2045	-17439	-5097	-1300	-158.7	59.246	176.53	272.57	299.39
2046	-19313	-5485	-1351	-143.4	81.631	200.9	296.6	322.51
2047	-21387	-5903	-1403	-126.5	105.64	226.86	322.17	347.19
2048	-23684	-6352	-1457	-108	131.38	254.53	349.41	373.56
2049	-26227	-6836	-1513	-87.76	158.98	284.04	378.44	401.75
2050	-29042	-7357	-1571	-65.63	188.59	315.51	409.41	431.89

5   Conclusion

The following result is obvious that from the above scatter simulation result: (1) The social utility increases from about -29042 to -65.63 units in Beijing when the non-performing loans growth rate decrease from 0.07 to 0.01 at 2050 year; (2) The social utility decrease in Beijing from 2003 to 2050 when the non-performing loans growth rate is 0.07, the social utility decrease from about -233.6 to -29042 units. The bank non-performing loans will be high carbon economy. Bank non-performing loans will be harmful to economic growth and social welfare utility. Bank non-performing loans will case price fluctuation, including carbon emission permit price fluctuation. We will research the complicated relation between bank non-performing loans and carbon emission permit price in the future.

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