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How does shadow banking wealth management product affect bank performance under government capital injection?

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1. Introduction

Background:

Why the shadow banking activities involved by banks?

- The ratio of shadow banking to commercial banks' total financial assets was rising from approximately 52% in 1990s to 200% in 2007. (Panetti , 2014)
- The collapse of shadow banking in 2007 to 2008 played a critical role in undermining the regulated banking sector, and in bringing about the financial crisis(Gennaioli et al. 2013).
- Offer rate of return well above regulated deposit interest rate and are often used to fund investments in sectors where bank credit is restricted (Plantin, 2015).

- Financial institutions received a government aggregate infusion of $125 billion on October 14, 2008 (Bayazitova and Shivdasani, 2012).
- Capital enhances a bank's survival probability (Allen et al, 2011).
- A growing body of literature examines capital affecting bank performance during a financial crisis. Our study focuses on one related issue: bank efficiency gain/loss from shadow banking activities and bankruptcy prediction under government capital injections.

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There are at least two reasons where a thorough understanding of WMPs is essential.

- Actively managed by banks, a part of the shadow banking system in

  China, few are recorded on banks' balance sheets.
- Issuance of Chinese WMPs has grown rapidly in recent years, around 17-19% . it does represent a part of the shadow bank activities that have been particularly important at some point in time (Perry and Weltewitz, 2015).

Bank performance

Two key issues that concern bank managers:

- **Bank interest margin**, as a proxy for the **efficiency** (Saunders and Schumacher, 2000).
- **Bank survival** related to **default risk** is central for banks and regulators in banking stability (Berger and Bouwman, 2013)

Purpose of the paper

We develops a contingent claim model to examine how shadow banking wealth management products (WMPs) affect a bank’s performance (efficiency, default risk) under government capital injection.

Contributions to the literature

- 1) the growing literature linking bank interest margin and WMPs, particularly a deeper justification about the collapse of shadow banking in 2007 to 2008.
- 2) an alternative explanation of deteriorating bank interest margins by focusing on WMPs .
- 3) an alternative explanation of the viewpoint from Pozsar et al., 2013.

(the link between the regular banking and the shadow banking may create higher contagion and systemic risks, which in turn may affect banking stability.)

Framework of paper

- Section 1: introduction
- Section 2: literature review
- Section 3: basic structure of the proposed model
- Section 4: derives model solution and comparative static analysis
- Section 5: numerical analysis
- Section 6: conclusion

2. Related literature: three related strands

- 1) regular banks with shadow banking activities:

  # Pozsar et al. (2013): features of shadow banks, economic roles, relation to traditional banks.

  # Jeffers and Baicu (2013): interconnections between affect the stability of the financial system.

  # Li and Lin (2016): bank interest margin management when the bank conducts regular lending and shadow-banking entrusted lending activities under capital regulation.

Our focus: bank interest margin management aspects of shadow-banking WMPs

2. Related literature: three related strands

- 2) interest margin:
- #Wong (1997): is positively related to the bank's market power, credit risk, and interest rate risk.
- #While Williams (2007): negative relationship between credit risk and bank interest margin.
- #Hawtrey and Liang (2008): negative impact of managerial efficiency on bank interest margins.
- #Ewijk (2012): an explanation for the decline in bank interest margins in many developed countries.
- Our focus: effects of shadow banking activities on bank interest margin under government capital injection that these papers are silent on.

2. Related literature: three related strands

- 3) government capital injection:
- #Bayazitova and Shivdasani (2012): less stable funding mixes more likely receive government capital infusions.
- # Chang and Chen (2016): interactions between government capital injections and credit risk transfers.
- # Chen and Lin (2016) :impacts on bank interest margin, bank default risk, and borrower default risk from government's capital injection.
- Our focus: commingling of regular banking with shadow banking under government capital injection, and in particular, the emphasis we put on the interconnections between the two systems in the context of bank interest margin management.

3. Model framework

Our model proceeds in the following main **assumptions** to capture all the real-life dimensions of bank valuation and regulation:

- Except the loan market faced by the bank, perfectly competitive markets are assumed for all financial assets.
- Financial markets are assumed to be complete.
- Investors and regulators are risk-neutral
- The Federal Deposit Insurance Corporation (FDIC) plays both the roles of insurer and receiver for administering and resolving failing banks.
- We only focus on direct government capital injection

3. Model framework

- a. Equity valuation
- b. Efficiency gain from shadow banking
- c. Default risk

3. 1 Equity valuation

Table 1

Simplified balance-sheet and shadow banking activities at $t = 0$.

Assets		Liabilities	
Balance-sheet activities:			
Loan	L	deposit	D
liquid asset	B	government equity	
		capital injection	θK
		equity	K
Shadow banking activities:			
risky asset	αW	wealth management	
liquid asset	$(1-\alpha)W$	product	W

Notes: $\theta > 0$, and $0 < \alpha < 1$.

3. 1 Equity valuation

- Consider a bank that makes decisions in a single period horizon with two dates, 0 and 1, $t \in [0,1]$. The bank, at $t = 0$, has the following balance sheet:

$$L + B = D + K + \theta K \qquad (1)$$

where

L: risky loans

B: liquid assets

D: deposits

θK: government capital injections

3. 1 Equity valuation

- The bank’s loans mature at $t = 1$.
- Equity capital with government capital injections $(1+\theta)K$ held by the bank is tied by regulation to be fixed proportion of its deposits q

$$(1+\theta)K \geq qD$$ (Wong, 1997).

when the capital constraints binding, Eq.(1) can be expressed as

$$L + B = (1+\theta)K(1/q + 1)$$

In addition to balance-sheet activities, at $t = 0$, the bank also holds an amount of WMPs $W > 0$

3. 1 Equity valuation

$$(1+\theta)K = L + B + \alpha W + (1-\alpha)W - D - W \qquad (2)$$

$$L = L(R_L)$$

where

W: WMPs $\qquad \alpha W$: risky assets in WMPs $\qquad R_L$: loan rate chosen by bank

This paper takes a path-dependent barrier option approach to the market valuation of equity in a bank.

The default can occur at any time before the maturity date. Bank equity can be priced as a down-and-out call (DOC) option.

When the value of the bank's assets is less than the strike price, the value of the bank's equity is zero.

3. 1 Equity valuation

The market value of the bank's underlying assets follows a geometric Brownian motion of the form :

$$dV = \mu V dt + \sigma V dM \qquad (3)$$

where

$$V = (1+R_L)L + \alpha(1+R_W)W$$

V: the value of the asset portfolio

R_W: constant market rate of WMPs return

3. 1 Equity valuation

The market value of the bank's equity S:

$$S = SC - DIC \qquad (4)$$

where

$SC = VN(d_1) - Ze^{-\delta} N(d_2)$, as the market value of the bank's assets V and present value of the net-obligation payments Z, using the standard call option view of the bank.

$DIC = V(\frac{H}{V})^{2\eta} N(a_1) - Ze^{-\delta} (\frac{H}{V})^{2\eta - 2} N(a_2)$, down-and-in call activated only if the barrier is breached.

$H = \beta Z$: the knock-out value of the bank. β is the barrier-to-debt ratio, and $N(\cdot) \equiv$ the standard normal cumulative distribution function.

3. 2 Efficiency gain from shadow banking activities

- variance of the bank return(Ronn and Verma 1986):

$$\sigma_S = \frac{\partial S}{\partial V}\frac{V}{S}\sigma \qquad (5)$$

- efficiency gain from WMPs can be measured by the RV differential (Ergungor, 2005):

$$\Delta RV = RW(WW) - RV(OW) \qquad (6)$$

where

$$RV(WW) = \frac{S(W>0)}{\sigma_S(W>0)}$$

$$RV(OW) = \frac{S(W=0)}{\sigma_S(W=0)}$$

$\Delta RV > 0$ can be explained as efficiency gain from involving the shadow banking activities, whereas $\Delta RV < 0$ can be explained as deficiency.

3. 3 Default risk

- The D framework offers a very useful measure for predicting bankruptcy.
- probability of default (risk-neutral):

$$P_S = N(h_1) + e^{h_2}(1 - N(h_3)) \qquad (7)$$

where

$$h_1 = \frac{1}{\sigma}\left(\ln\frac{\beta Z}{V} - \delta + \frac{\sigma^2}{2}\right)$$

$$h_2 = \frac{2}{\sigma^2}\left(\delta - \frac{\sigma^2}{2}\right)\ln\frac{\beta Z}{V}$$

$$h_3 = -\frac{1}{\sigma}\left(\ln\frac{\beta Z}{V} + \delta - \frac{\sigma^2}{2}\right)$$

3. 3 Default risk

- **It is important to note that we use our measure of default risk to examine the relation between default risk and equity returns rather than price.**

4. Solution and result

The first-order condition for the equity maximization are:

$$\frac{\partial S}{\partial R_L}=\frac{\partial SC}{\partial R_L}-\frac{\partial DIC}{\partial R_L}=0 \qquad (8)$$

Eq.(8) determines the optimal loan rate, thus the optimal bank **interest margin,** proxy **efficiency** of the banking intermediation

4.1 Increases in **risky investment** from WMPs funding :

$$\frac{\partial R_L}{\partial \alpha} = -\frac{\partial^2 S}{\partial R_L \partial \alpha} / \frac{\partial^2 S}{\partial R_L} \quad (9)$$

$$\frac{dP_S}{d\alpha} = \frac{\partial P_S}{\partial \alpha} + \frac{\partial P_S}{\partial R_L}\frac{\partial R_L}{\partial \alpha} \quad (10)$$

4.2 Increases **in WMPs**

$$\frac{\partial R_L}{\partial W} = -\frac{\partial^2 S}{\partial R_L \partial W} / \frac{\partial^2 S}{\partial R_L^2} \qquad (11)$$

$$\frac{\partial \Delta RV}{\partial W} = \frac{\partial \Delta RV}{\partial W} + \frac{\partial \Delta RV}{\partial R_L}\frac{\partial R_L}{\partial W} \qquad (12)$$

$$\frac{\partial P_S}{\partial W} = \frac{\partial P_S}{\partial W} + \frac{\partial P_S}{\partial R_L}\frac{\partial R_L}{\partial W} \qquad (13)$$

4.3 Increases in government **capital injection**

$$\frac{\partial R_L}{\partial \theta} = -\frac{\partial^2 S}{\partial R_L \partial \theta} \Big/ \frac{\partial^2 S}{\partial R_L^2} \qquad (14)$$

$$\frac{\partial P_S}{\partial \theta} = \frac{\partial P_S}{\partial \theta} + \frac{\partial P}{\partial R_L}\frac{\partial R_L}{\partial \theta} \qquad (15)$$

5. Numerical results

Table 2
Responsiveness of bank interest margin to allocated coefficient.

α	$(R_L\ (\%), L)$ (4.50, 200)	(4.60, 199)	(4.70, 197)	(4.80, 194)	(4.90, 190)	(5.00, 185)	(5.10, 179)
	$DIC\ (10^{-6})$						
0.30	3.9776	3.8626	3.6996	3.4925	3.2459	2.9652	2.6563
0.32	4.0105	3.8950	3.7313	3.5234	3.2759	2.9939	2.6836
0.34	4.0436	3.9275	3.7632	3.5545	3.3059	3.0227	2.7110
0.36	4.0767	3.9602	3.7952	3.5856	3.3360	3.0517	2.7386
0.38	4.1100	3.9929	3.8273	3.6169	3.3663	3.0808	2.7663
0.40	4.1433	4.0258	3.8595	3.6483	3.3967	3.1100	2.7941
0.42	4.1768	4.0587	3.8918	3.6797	3.4272	3.1393	2.8221
	$S = SC - DIC$						
0.30	38.0025	38.0140	37.8954	37.6454	37.2625	36.7459	36.0947
0.32	38.0772	38.0887	37.9700	37.7197	37.3366	36.8197	36.1682
0.34	38.1520	38.1634	38.0445	37.7941	37.4108	36.8935	36.2417
0.36	38.2269	38.2381	38.1191	37.8685	37.4849	36.9674	36.3153
0.38	38.3017	38.3128	38.1937	37.9429	37.5591	37.0414	36.3888
0.40	38.3766	38.3876	38.2684	38.0174	37.6334	37.1153	36.4624
0.42	38.4515	38.4624	38.3430	38.0918	37.7076	37.1893	36.5361
	$\partial R_L / \partial \alpha\ (10^{-3})$						
0.30→0.32	-	-3.9719	-5.3715	-6.9023	-8.6468	-10.7130	-
0.32→0.34	-	-3.9446	-5.3311	-6.8469	-8.5736	-10.6180	-
0.34→0.36	-	-3.9176	-5.2911	-6.7923	-8.5013	-10.5230	-
0.36→0.38	-	-3.8908	-5.2516	-6.7382	-8.4298	-10.4300	-
0.38→0.40	-	-3.8643	-5.2125	-6.6847	-8.3592	-10.3380	-
0.40→0.42	-	-3.8381	-5.1738	-6.6319	-8.2893	-10.2470	-

Notes: Unless otherwise indicated, $R = 3.50\%$, $R_D = 2.50\%$, $R_W = 4.00\%$, $R_P = 3.00\%$, $W = 30$, $K = 15$, $q = 8.00\%$, $\sigma = 0.30$, $\theta = 0.10$, and $\beta = 0.50$. The computed results of $\partial^2 S / \partial R_L^2 < 0$ meet the required second-order condition. The shaded areas indicate that the optimal loan rate is approximately at the rate of 4.60%.

Result 1. An increase in bank investment funded by the shadow banking WMPs leads to increase bank loan portfolio at a reduced margin.

Table 3
Responsiveness of default risk to allocated coefficient.

α	$(R_L\ (\%), L)$ (4.50, 200)	(4.60, 199)	(4.70, 197)	(4.80, 194)	(4.90, 190)	(5.00, 185)	(5.10, 179)
	$P_S\ (10^{-2})$						
0.30	1.0805	1.0664	1.0476	1.0241	0.9958	0.9623	0.9233
0.32	1.0835	1.0694	1.0507	1.0272	0.9990	0.9656	0.9267
0.34	1.0865	1.0725	1.0538	1.0304	1.0021	0.9688	0.9301
0.36	1.0895	1.0755	1.0568	1.0335	1.0053	0.9721	0.9335
0.38	1.0925	1.0785	1.0598	1.0366	1.0085	0.9754	0.9369
0.40	1.0955	1.0815	1.0629	1.0396	1.0116	0.9786	0.9402
0.42	1.0984	1.0844	1.0659	1.0427	1.0148	0.9819	0.9436
	$dP_S / d\alpha$: *total effect* (10^{-3})						
0.30→0.32	-	1.5218	1.5455	1.5796	1.6251	1.6833	-
0.32→0.34	-	1.5165	1.5400	1.5740	1.6193	1.6772	-
0.34→0.36	-	1.5111	1.5346	1.5684	1.6135	1.6712	-
0.36→0.38	-	1.5058	1.5292	1.5629	1.6078	1.6652	-
0.38→0.40	-	1.5005	1.5238	1.5574	1.6021	1.6592	-
0.40→0.42	-	1.4953	1.5185	1.5519	1.5964	1.6532	-

Notes: Unless otherwise indicated, $R = 3.50\%$, $R_D = 2.50\%$, $R_W = 4.00\%$, $R_P = 3.00\%$, $W = 30$, $K = 15$, $q = 8.00\%$, $\sigma = 0.30$, $\theta = 0.10$, and $\beta = 0.50$. The shaded areas demonstrate that the values are computed at the optimal loan rate of 4.60%. Both the direct effect, $\partial P_S / \partial \alpha$, and the indirect effect, $(\partial P_S / \partial R_L)(\partial R_L / \partial \alpha)$, are positive.

Result 2. An increase in the bank investment funded by the shadow banking WMPs increases the default risk in the bank's equity returns.

Table 4

Responsiveness of bank interest margin to WMP_s.

W	$(R_L\ (\%), L)$ (4.50, 200)	(4.60, 199)	(4.70, 197)	(4.80, 194)	(4.90, 190)	(5.00, 185)	(5.10, 179)
	S						
30	38.0025	38.0140	37.8954	37.6454	37.2625	36.7459	36.0947
32	38.0831	38.0945	37.9759	37.7256	37.3426	36.8257	36.1742
34	38.1637	38.1751	38.0563	37.8059	37.4226	36.9055	36.2538
36	38.2443	38.2556	38.1367	37.8862	37.5027	36.9854	36.3333
38	38.3250	38.3362	38.2172	37.9665	37.5829	37.0653	36.4129
40	38.4057	38.4168	38.2977	38.0468	37.6630	37.1452	36.4925
42	38.4864	38.4974	38.3781	38.1272	37.7432	37.2251	36.5722
	$\partial R_L / \partial W (10^{-5})$						
30→32	-	-3.2916	-4.4658	-5.7616	-7.2524	-9.0351	-
32→34	-	-3.2696	-4.4336	-5.7175	-7.1939	-8.9584	-
34→36	-	-3.2478	-4.4016	-5.6739	-7.1361	-8.8826	-
36→38	-	-3.2263	-4.3700	-5.6308	-7.0790	-8.8077	-
38→40	-	-3.2049	-4.3388	-5.5881	-7.0225	-8.7337	-
40→42	-	-3.1838	-4.3078	-5.5459	-6.9667	-8.6606	-

Notes: Unless otherwise indicated, $R = 3.50\%$, $R_D = 2.50\%$, $R_W = 4.00\%$, $R_P = 3.00\%$, $\alpha = 0.30$, $K = 15$, $q = 8.00\%$, $\sigma = 0.30$, $\theta = 0.10$, and $\beta = 0.50$. The computed results of $\partial^2 S / \partial R_L^2 < 0$ meet the required second-order condition. The shaded areas indicate that the optimal loan rate is approximately at the rate of 4.60%.

Result 3. Increases in WMPs decrease the bank interest margin.

Table 5
Responsiveness of bank efficiency gain to WMP_s.

W	$(R_L\ (\%), L)$ (4.50, 200)	(4.60, 199)	(4.70, 197)	(4.80, 194)	(4.90, 190)	(5.00, 185)	(5.10, 179)
	ΔRV						
30	0.8394	0.8363	0.8320	0.8263	0.8190	0.8097	0.7979
32	0.8957	0.8924	0.8878	0.8817	0.8740	0.8641	0.8516
34	0.9520	0.9485	0.9436	0.9372	0.9290	0.9186	0.9053
36	1.0083	1.0046	0.9995	0.9927	0.9841	0.9731	0.9591
38	1.0646	1.0607	1.0554	1.0483	1.0392	1.0276	1.0130
40	1.1210	1.1169	1.1113	1.1039	1.0943	1.0822	1.0669
42	1.1774	1.1732	1.1673	1.1595	1.1495	1.1369	1.1208
	$d\Delta RV / dW$: *total effect* (10^{-2})						
30→32	-	2.8280	2.8318	2.8337	2.8324	2.8265	-
32→34	-	2.8296	2.8333	2.8353	2.8339	2.8281	-
34→36	-	2.8312	2.8349	2.8368	2.8355	2.8297	-
36→38	-	2.8328	2.8364	2.8383	2.8370	2.8313	-
38→40	-	2.8343	2.8380	2.8398	2.8386	2.8329	-
40→42	-	2.8359	2.8395	2.8413	2.8401	2.8344	-

Notes: Unless otherwise indicated, $R = 3.50\%$, $R_D = 2.50\%$, $R_W = 4.00\%$, $R_P = 3.00\%$, $\alpha = 0.30$, $K = 15$, $q = 8.00\%$, $\sigma = 0.30$, $\theta = 0.10$, and $\beta = 0.50$. The shaded areas indicate that the optimal loan rate is approximately at the rate of 4.60%. The direct effect, $\partial \Delta RV / \partial W$, and the indirect effect, $(\partial \Delta RV / \partial R_L)(\partial R_L / \partial W)$, are consistently positive in sign.

Result 4. Increases in WMPs increase the bank's efficiency gain from shadow banking involvement.

Table 6
Responsiveness of bank default risk to WMP$_s$.

	(R_L (%), L)						
W	(4.50, 200)	(4.60, 199)	(4.70, 197)	(4.80, 194)	(4.90, 190)	(5.00, 185)	(5.10, 179)
	P_S (10^{-2})						
30	1.0805	1.0664	1.0476	1.0241	0.9958	0.9623	0.9233
32	1.0830	1.0689	1.0502	1.0267	0.9984	0.9651	0.9262
34	1.0855	1.0714	1.0527	1.0293	1.0011	0.9678	0.9291
36	1.0880	1.0739	1.0553	1.0319	1.0038	0.9706	0.9320
38	1.0904	1.0764	1.0578	1.0345	1.0065	0.9733	0.9348
40	1.0929	1.0789	1.0603	1.0371	1.0091	0.9761	0.9377
42	1.0953	1.0814	1.0628	1.0397	1.0117	0.9788	0.9405
	dP_S / dW : *total effect* (10^{-5})						
30→32	-	1.2625	1.2868	1.3209	1.3659	1.4230	-
32→34	-	1.2576	1.2817	1.3157	1.3605	1.4173	-
34→36	-	1.2527	1.2767	1.3106	1.3551	1.4116	-
36→38	-	1.2479	1.2718	1.3055	1.3498	1.4060	-
38→40	-	1.2430	1.2668	1.3004	1.3445	1.4004	-
40→42	-	1.2382	1.2619	1.2953	1.3392	1.3948	-

Notes: Unless otherwise indicated, $R = 3.50\%$, $R_D = 2.50\%$, $R_W = 4.00\%$, $R_P = 3.00\%$, $\alpha = 0.30$, $K = 15$, $q = 8.00\%$, $\sigma = 0.30$, $\theta = 0.10$, and $\beta = 0.50$. The shaded areas indicate that P_s and dP_s / dW are evaluated at the optimal loan rate of 4.60%. Both the direct effect, $\partial P_s / \partial W$, and the indirect effect, $(\partial P_s / \partial R_L)(\partial R_L / \partial W)$, are positive.

Result 5. Increases in WMPs increase the default risk in the bank's equity returns.

Table 7

Responsiveness of bank interest margin and bank default risk to government capital injections.

θ	(R_L (%), L) (4.50, 200)	(4.60, 199)	(4.70, 197)	(4.80, 194)	(4.90, 190)	(5.00, 185)	(5.10, 179)
	S						
0.10	38.0025	38.0140	37.8954	37.6454	37.2625	36.7459	36.0947
0.20	39.0277	39.0424	38.9281	38.6834	38.3073	37.7988	37.1575
0.30	40.0727	40.0906	39.9807	39.7418	39.3728	38.8730	38.2421
0.40	41.1375	41.1587	41.0534	40.8205	40.4590	39.9683	39.3485
0.50	42.2220	42.2466	42.1461	41.9194	41.5658	41.0848	40.4768
0.60	43.3263	43.3543	43.2588	43.0386	42.6933	42.2225	41.6267
	$\partial R_L / \partial\theta (10^{-3})$						
0.10→0.20	-	1.2040	1.6170	2.0477	2.5127	3.0327	-
0.20→0.30	-	1.2458	1.7004	2.1750	2.6885	3.2645	-
0.30→0.40	-	1.2883	1.7853	2.3048	2.8683	3.5023	-
0.40→0.50	-	1.3314	1.8716	2.4372	3.0521	3.7463	-
0.50→0.60	-	1.3751	1.9594	2.5722	3.2399	3.9967	-
	P_S (10^{-3})						
0.10	10.8050	10.6640	10.4760	10.2410	9.9575	9.6226	9.2329
0.20	9.9289	9.7935	9.6106	9.3796	9.0993	8.7674	8.3807
0.30	9.1094	8.9798	8.8022	8.5761	8.3004	7.9733	7.5919
0.40	8.3441	8.2204	8.0484	7.8279	7.5581	7.2372	6.8631
0.50	7.6305	7.5126	7.3466	7.1324	6.8694	6.5562	6.1912
0.60	6.9662	6.8541	6.6943	6.4870	6.2316	5.9274	5.5730
	$dP_S / d\theta$: *total effect* (10^{-4})						
0.10→0.20	-	-4.3694	-4.3585	-4.3561	-4.3623	-4.3776	-
0.20→0.30	-	-4.0854	-4.0732	-4.0679	-4.0697	-4.0789	-
0.30→0.40	-	-3.8140	-3.8008	-3.7930	-3.7909	-3.7948	-
0.40→0.50	-	-3.5552	-3.5411	-3.5313	-3.5258	-3.5251	-
0.50→0.60	-	-3.3087	-3.2939	-3.2823	-3.2740	-3.2695	-

Notes: Unless otherwise indicated, $R = 3.50\%$, $R_D = 2.50\%$, $R_W = 4.00\%$, $R_P = 3.00\%$, $\alpha = 0.30$, $W = 30$, $K = 15$, $q = 8.00\%$, $\sigma = 0.30$ and $\beta = 0.50$. The computed results of $\partial^2 S / \partial R_L^2 < 0$ meet the required second-order condition. The shaded areas indicate that the optimal loan rate is approximately at the rate of 4.60%. Both the direct effect, $\partial P_S / \partial\theta$, and the indirect effect, $(\partial P_S / \partial R_L)(\partial R_L / \partial\theta)$, are negative.

Result 6. Increases in the capital injection by the government increase in the bank interest margin, and decrease the default risk in the bank's equity returns

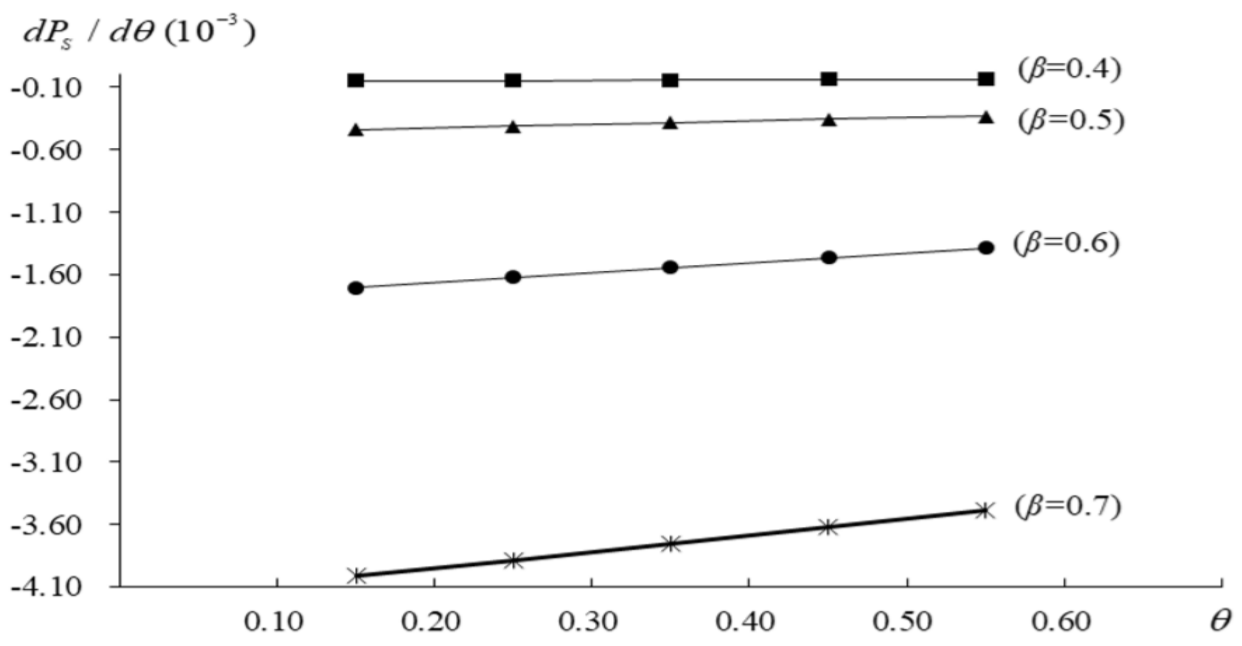

Figure 1

Responsiveness of bank default risk to government capital injects at various levels of barrier.

Results 7. Higher government capital injection has a significant effect on a bank's survival likelihood in particular during a financial crisis.

6. Conclusions

- 1) Increases in WMPs increase bank loan portfolio at a reduced interest margin. WMPs hurt the bank to decrease its probability of survival.
- 2) Increases in the government's capital injection decrease bank loan portfolio at an increased margin. Government capital injection helps the bank to increase its probability of survival particularly during a severely financial crisis.
- 3) We suggest that shadow credit intermediation should be regulated.
- 4) Our suggestion contributes to the growing literature on explaining the collapse of shadow banking in 2007 to 2008.
- 5) Several results are derived that should be of interest to investors, analysts, and policy makers.

THANKS