Equity versus Bail-in Debt in Banking: An Agency Perspective

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Introduction

- Capital deficits revealed during the crisis have led to unprecedented reinforcement in banks' loss-absorbing capacity
  - Basel III increases minimum Tier 1 capital requirement from 4% of RWA to 6% (since 2015) and 8.5% (since 2019)
  - FSB prescribes Total Loss-Absorbing Capacity (TLAC) of at least 16% (since 2019) and 18% (since 2022)
- Policy-makers expect a significant fraction of TLAC to consist on liabilities other than equity, e.g. bail-in debt
- Their intention is (i) to enhance the credibility of the commitment not to bail-out the banks, and (ii) to increase market discipline
- Academic literature has paid some attention to (going-concern) coco bonds but almost no attention to (gone-concern) bail-in debt

- Double-decker model of the determinants of the optimal level and composition of banks' loss-absorbing liabilities

  1. Buffer size determinants:
     - Insured deposits provide liquidity services to their holders
       [Source of value / cheap funding source]
     - But defaulting on them causes differential default costs
       [Bankruptcy cost or, perhaps, excess cost of public funds]

  2. Buffer composition determinants

     To start with, equity & bail-in debt are equally good regarding buffer-size trade-off, but differ when dealing with agency problems

     a) Risk shifting: equity works better
        (Jensen-Meckling 1976; Stiglitz-Weiss 1981; Repullo 2004)

     b) Managerial effort / private benefit taking: debt works better
        (Innes 1990)

- Key results

  1. Insured deposits imply need for loss absorbency requirements since bail-out subsidy makes banks tempted to operate without buffers

  2. Trade-offs in the model imply the existence of interior solutions:

     – For the level & composition of TLAC that maximize net social surplus generated by banks

     – For the composition of TLAC that maximizes bank owners' value (if only subject to an overall TLAC requirement)

  3. Under the current calibration:

     – Optimal total buffer size is in line with current regulations (pre-crisis levels were too low)

     – Optimal composition includes more bail-in debt than current regulatory proposals

Literature review

- Policy proposals on contingent convertibles (Flannery 2005), capital insurance (Kashyap-Rajan-Stein 2008) or bail-in debt (French-et-al 2010)

  [Prepackaged recapitalization reduces incidence of bail-outs, ex post debt overhang problems & negative ex ante incentive effects]

- Most academic discussion centers on contingent convertibles:

  Choice of triggers (McDonald 2013), conversion rates (Pennacchi-Vermaelen-Wolff 2014), multiple equilibria (Sundaresan-Wang 2015), risk shifting (Pennacchi 2010; Martynova-Perotti 2014)

- Typical approach: adding ad hoc amount of cocos to given capital structure...

  Instead, we look at bail-in debt and address capital structure & optimal regulation problems altogether

Presentation outline

1. Model details
2. Calibration
3. Single-friction case: Risk shifting
4. Single-friction case: Private benefits
5. Full model
6. Comparison with current regulation

Model details

- Simple static setup ($t = 0, 1$)
- Risk-neutral agents with discount factor β
- A *bank* tightly controlled by penniless *insiders*

  Invests at $t = 0$ in one unit of assets that at $t = 1$ yield

  $$\tilde{R}_i = (1 - \Delta - h(\varepsilon))R_A \exp(\sigma_i z - \sigma_i^2/2),$$

  where

  $z \sim N(0, 1)$: idiosyncratic bank-performance shock

  $i = 0, 1$: dichotomic risk state, with $\sigma_0 < \sigma_1$

  Δ: insiders' unobservable private benefit taking decision

  ε: insiders' unobservable risk shifting decision ($=\Pr(i=1)$)

  $h(\varepsilon)$: increasing and convex "cost" of risk shifting

- Insiders derive utility from final consumption and private benefits

$$U = \beta c + g(\Delta)$$

- Funding is raised among deep-pocketed *outside investors*:
  - Insured deposits $1–\chi–\phi$ pay interest rate R_D +liquidity yield ψ
  - Bail-in debt χ promises gross interest rate R_B
  - Common equity ϕ, of which fraction γ is retained by insiders
- Insolvency occurs if the bank defaults on deposits

$$\rightarrow \text{ losses to DIA are } \widetilde{DI} = R_D(1–\chi–\phi) - (1-\mu)\tilde{R}$$

(μ: asset repossession cost)

- Haircuts on bail-in debt imply no deadweight cost (later relaxed)
- Regulation imposes minimum capital requirement, $\phi \geq \overline{\phi}$, and minimum TLAC requirement, $\phi + \chi \geq \overline{\tau} \geqslant \overline{\phi}$

The bank's capital structure problem

At $t = 0$ overarching contract fixes ϕ, χ, γ, R_B, R_D and, implicitly, insiders' subsequent private choices of Δ and ε

$$
\begin{array}{lll}
\max_{\phi,\chi,\gamma,R_B,\Delta,\varepsilon} & \gamma E + g(\Delta) & \\
\text{s.t.:} & (1-\gamma)\, E \geq \phi & [PC^E] \\
 & J - E \geq \chi & [PC^B] \\
 & \Delta = \arg\max_{\Delta} \left[\gamma E + g\left(\Delta\right)\right] & [IC^{\Delta}] \\
 & \varepsilon = \arg\max_{\varepsilon} \left[\gamma E + g\left(\Delta\right)\right] & [IC^{\varepsilon}] \\
 & \phi \geqslant \overline{\phi} & [CR] \\
 & \phi + \chi \geqslant \overline{\tau} & [TLAC]
\end{array}
$$

where

E : overall value of equity at $t = 0$

J: joint value of equity & bail-in debt ($\Rightarrow$ bail-in debt is worth J-E)

[Full insurance $\Rightarrow R_D = 1/\beta - \psi$]

Black-Scholes type formulas for E and J

Conditional on each risk state, gross asset returns are log-normal...

$$E = \beta \sum_{i=0,1} \varepsilon_i \left[(1 - \Delta - h(\varepsilon)) R_A F(s_i) - B F(s_i - \sigma_i) \right]$$

$$J = \beta \sum_{i=0,1} \varepsilon_i \left[(1 - \Delta - h(\varepsilon)) R_A F(w_i) - R_D (1 - \phi - \chi) F(w_i - \sigma_i) \right]$$

where
$$B = R_D(1 - \phi - \chi) + R_B \chi$$

$$s_i = \frac{1}{\sigma_i} \left[\ln(1 - \Delta - h(\varepsilon)) + \ln R_A - \ln B + \sigma_i^2/2 \right]$$

$$w_i = \frac{1}{\sigma_i} \left[\ln(1 - \Delta - h(\varepsilon)) + \ln R_A - \ln R_D - \ln(1 - \phi - \chi) + \sigma_i^2/2 \right]$$

$F(\cdot)$: CDF of $N(0, 1)$

Other formulas

- Cost of the deposit insurance

$$DI = \beta \sum_{i=0,1} \varepsilon_i \left[R_D (1-\phi-\chi)(1 - F(w_i-\sigma_i)) \right. \\ \left. -(1-\mu)(1 - \Delta-h(\varepsilon)) R_A (1-F(w_i)) \right]$$

- Deadweight losses due to bankruptcy

$$DWL = \beta\mu \sum_{i=0,1} \varepsilon_i (1-\Delta-h(\varepsilon)) R_A (1-F(w_i)) .$$

- Net social surplus generated by the bank

$$W = U - DI$$

Calibration

- Functional forms

$$g(\Delta) = g_1 \Delta^{g_2} - g_3 \Delta$$

$$h(\varepsilon) = \frac{\zeta}{2}\varepsilon^2$$

with $g_1 \geq 0, \quad 0 < g_2 < 1, \quad g_3 \geq g_1 g_2, \quad \zeta > 0$

- Main purpose:
  - Illustrate key qualitative properties to the model
  - Yet baseline parameterization empirically plausible

$\Rightarrow$ Table 1 (one period = one year)

Table 1: Baseline parameter values

Investors' discount factor	β	0.98	risk-free rate: 2%
Gross return on bank assets (if Δ=ε=0)	R_A	1.0278	maximum E(intermediation margin): 150bp
Private benefit level parameter	g_1	0.0062	insiders' U (including PB): 1.37%
Private benefit elasticity parameter	g_2	0.25	inside ownership: 23.9%, see [1] & [2]
Private benefit extra curvature parameter	g_3	0.025	Just enough to avoid corner solutions
Cost of risk shifting parameter	ζ	0.44	$\Pr($risky state$)$=5% ($<$ freq recessions)
Deposits' liquidity convenience yield	ψ	0.0072	Krishnamurthy-Vising-Jorgenssen 2012
Deadweight loss from bank default	μ	0.15	Bennet-Unal 2014 (FDIC resolutions 86-07)
Asset risk in the safe state	σ_0	0.034	$\Pr($bank default$)$=0.25% in safe state
Asset risk in the risky state	σ_1	0.1075	$\Pr($bank default$)$=20% in risky state
Capital requirement	$\bar{\phi}$	0.04	minimum Tier 1 in Basel II
TLAC requirement	$\overline{\tau}$	0.08	minimum Tier 1 + Tier 2 in Basel II

Notes:

[1] Berger-Bonaccorsi 2006 (US banks, 1990-1995): Direct management ownership (including family) 9.3%. Plus institutional shareholders and other large shareholders 17.2%

[2] Caprio-Laeven-Levine 2007 (244 banks from 44 countries): 26%

Intermediation margin$=R_A - 1/\beta + \psi$

Table 2: Baseline results (%)

Common equity as % of assets	ϕ	4.0
Bail-in debt as % of assets	χ	4.0
Insider equity as % of total equity	γ	23.9
Fraction of asset returns lost due to PB taking	Δ	**0.12**
Probability of the risky state realizing	ε	**5.0**
Bank default probability in the safe state	P^0	0.25
Bank default probability in the risky state	P^1	20.0
Deposit insurance subsidy as % of assets	DI	**0.22**
Deadweight default losses as % of assets	DWL	0.16
Private value of the bank as % of assets	U	1.37
Social value of the bank as % of assets	W	**1.15**

Comments:

- Decomposition of insiders' gains: $\gamma E = \bar{\phi} \times \gamma/(1-\gamma)$=1.26%, PB=0.11%
- Agency costs: 0.12% due to PB & 0.055% due to risk-shifting
- DI costs are 0.22% of total bank assets and realize mostly in risky times (3.4%)
  [Laeven-Valencia' s crises DI is 2.1% (advanced economies) to 12.7% (all economies)]

Single-friction case: Risk shifting

Assume Δ is fully contractible. We explore changes in $\bar{\phi}$ & $\overline{\tau}$

Table 3: Comparative statics of the risk shifting model (%)

	ϕ	χ	γ	Δ	ε	P^0	P^1	DI	DWL	U	W
Baseline regime*	8.00	0.00	14.6	0.02	2.3	0.22	19.7	0.11	0.09	1.44	1.33
$\bar{\phi}=\overline{\tau}=0$	0.00	0.00	100	0.06	9.7	32.89	46.4	5.94	4.78	2.89	-3.05
$\bar{\phi}=\overline{\tau}=0.08$	8.00	0.00	14.6	0.02	2.3	0.22	19.7	0.11	0.09	1.44	1.33
$\bar{\phi}=0,\overline{\tau}=0.08$	8.00	0.00	14.6	0.02	2.3	0.22	19.7	0.11	0.09	1.44	1.33
$\bar{\phi}=0,\overline{\tau}=0.12$	12.00	0.00	9.98	0.02	1.0	0.00	10.3	0.02	0.01	1.40	1.38
Optimal regime**	12.00	0.00	9.98	0.02	1.0	0.00	10.3	0.02	0.01	1.40	1.38

* In the baseline regime $(\bar{\phi}, \overline{\tau}) = (0.04, 0.08)$. ** In the optimal regime $(\bar{\phi}, \overline{\tau}) = (0.12, 0)$

Comments

- Row 1. Baseline requirements. PB taking is lower, PDs are lower, W is higher. Bank voluntarily makes $\phi = \overline{\tau} = 0.08$ (all TLAC is equity)
- Row 2. No requirements $\Rightarrow$ maximum leverage, large PDs, large risk taking, $W < 0$
- Rows 3-5. Equity dominates bail-in debt. Lower PDs, lower risk taking
- Row 6. Optimal regime involves $\max(\bar{\phi}, \overline{\tau}) = 12\%$; almost zero PD in safe state

Single-friction case: Private benefits

We fix ε to exogenous value (5% as in baseline)

Table 4: Comparative statics of the private benefits model (%)

	ϕ	χ	γ	Δ	ε	P^0	P^1	DI	DWL	U	W
Baseline regime*	4.00	4.00	24.8	0.11	5.0	0.24	19.9	0.21	0.16	1.43	1.21
$\bar{\phi}$=$\overline{\tau}$=0	0.00	0.00	100	0.03	5.0	34.7	47.0	6.03	4.98	2.39	-3.64
$\bar{\phi}$=$\overline{\tau}$=0.08	8.00	0.00	13.2	0.21	5.0	0.26	20.2	0.22	0.16	1.34	1.12
$\bar{\phi}$=0,$\overline{\tau}$=0.08	0.00	8.00	100	0.05	5.0	0.22	19.8	0.21	0.15	1.47	1.26
$\bar{\phi}$=0,$\overline{\tau}$=0.12	0.00	12.0	100	0.05	5.0	0.00	10.3	0.09	0.06	1.41	1.32
Optimal regime**	0.00	15.5	100	0.05	5.0	0.00	5.04	0.04	0.03	1.37	1.33

* In the baseline regime $(\bar{\phi}, \overline{\tau}) = (0.04, 0.08)$. ** In the optimal regime $(\bar{\phi}, \overline{\tau}) = (0, 0.155)$.

Comments

- Row 1. Baseline requirements. Similar to full model.
- Row 2. No requirements $\Rightarrow$ maximum leverage, large PDs; low PB taking; $W < 0$
- Rows 3-5. Outside bail-in debt dominates outside equity (=less skin in the game). Innes 1990
- Row 6. Optimal regime involves $\overline{\tau}$ only (15.5%); again almost zero PD in safe state

Full model

Combines intuitions from each of the special cases

Table 5: Comparative statics of the full model (%)

	ϕ	χ	γ	Δ	ε	P^0	P^1	DI	DWL	U	W
Baseline regime*	4.00	4.00	23.9	0.12	5.0	0.25	20.0	0.22	0.16	1.37	1.15
$\bar{\phi}$=$\bar{\tau}$=0	0.00	0.00	100	0.03	10.2	37.2	47.8	6.68	5.39	2.39	-4.28
$\bar{\phi}$=0.08, $\bar{\tau}$=0.08	8.00	0.00	12.7	0.22	2.4	0.27	20.2	0.13	0.10	1.30	1.17
$\bar{\phi}$=0.12, $\bar{\tau}$=0.12	12.0	0.00	7.36	0.39	1.1	0.00	10.9	0.02	0.01	1.10	1.08
$\bar{\phi}$=0.0, $\bar{\tau}$=0.08	3.56	4.44	26.2	0.10	5.5	0.25	20.0	0.23	0.17	1.37	1.14
$\bar{\phi}$=0.0, $\bar{\tau}$=0.12	4.05	7.94	22.7	0.12	5.0	0.00	10.5	0.09	0.06	1.30	1.21
Optimal regime**	5.10	8.32	18.5	0.15	4.1	0.00	8.04	0.05	0.04	1.28	1.22

* In the baseline regime $(\bar{\phi}, \bar{\tau}) = (0.04, 0.08)$. ** In the optimal regime $(\bar{\phi}, \bar{\tau}) = (0.051, 0.134)$

Comments

- Setting a very high capital requirement is not the best solution
- Optimal regime involves differentiated capital (5.1%) & TLAC requirements (13.4%)
- Significant risk shifting ($\varepsilon = 0.041$) & bank failure risk in the risky state (8%)
- Row 5 shows that even with $\bar{\phi} = 0$, banks may want to set $\phi > 0$ (market discipline effect)

How relevant is the capital requirement?

Table 6 examines the impact of fixing $\bar{\phi}$=0

Table 6: Capital requirements are needed at the optimum (%)

	ϕ	χ	γ	Δ	ε	P^0	P^1	DI	DWL	U	W
Optimal regime*	5.10	8.32	18.5	0.15	4.1	0.00	8.04	0.05	0.04	1.28	1.22
$\bar{\phi}=0.0, \overline{\tau}=0.134$	4.15	9.25	22.0	0.13	4.9	0.00	8.06	0.07	0.05	1.28	1.22

* In the optimal regime $(\bar{\phi}, \overline{\tau}) = (0.051, 0.134)$

Comments

- Banks still choose $\phi > 0$
- Qualitatively, PB taking improves and RS worsens; quantitatively the impact is quite small

Optimal regulation without bail-in debt

Table 7 examines the impact of fixing χ=0 (or $\bar{\phi}=\overline{\tau}$)

Table 7: Optimal regulation without bail-in debt (%)

Optimal regimes	ϕ	χ	γ	Δ	ε	P^0	P^1	DI	DWL	U	W
Unrestricted*	5.10	8.32	18.5	0.15	4.1	0.00	8.04	0.05	0.04	1.28	1.22
Restricted (χ=0)**	8.65	0.00	11.6	0.24	2.1	0.14	18.5	0.09	0.07	1.27	1.18

* $(\bar{\phi}, \overline{\tau}) = (0.051, 0.134)$. ** $(\bar{\phi}, \overline{\tau}) = (0.087, 0.087)$.

Comments

- Less risk shifting & more private benefit taking
- Lower TLAC; more likely bank failure; small welfare loss

Comparison with current regulation

- Basel III imposes a minimum Tier 1 capital requirement of 8.5% (once the capital conservation buffer gets fully loaded in 2019)
- FSB prescribes minimum TLAC of 16% (by 2019) & 18% (by 2022)

  Our results point to slightly lower levels of TLAC and a composition less tilted towards equity

  Which additional ingredients would allow us to reconcile the implications of the model with current regulatory prescriptions?

- We explore two:
  - External social cost of bank failure μ^S
  - Bankruptcy cost if bail-in debt is not paid back fully μ^T

Table 8: Optimal policy under extended parameterizations (%)

	ϕ	χ	γ	Δ	ε	P^0	P^1	DI^*	DWL	U	W
μ^S=μ^T=0	5.10	8.32	18.5	0.15	4.1	0.00	8.04	0.05	0.04	1.28	1.22
μ^S=0.3, μ^T=0	4.80	14.8	18.6	0.15	4.4	0.00	1.84	0.03	0.01	1.22	1.19
μ^S=0, μ^T=0.075	8.80	1.30	10.8	0.26	2.1	0.03	14.8	0.06	0.07	1.20	1.14
μ^S=0.3, μ^T=0.075	8.80	6.20	10.2	0.28	2.1	0.03	5.89	0.05	0.05	1.14	1.09

* DI now also includes the social cost of bank failure, if present.

- Adding just μ^S, rises $\overline{\tau}$ but lowers $\overline{\phi}$. Impact of $\overline{\tau}$ on profitability worsens incentives and requires lowering $\overline{\phi}$ to gain skin-in-the-game
- Adding just μ^T, increases cost of bail-in debt, leading to $\uparrow \overline{\phi}$ and $\downarrow \overline{\tau}$ (= much less bail-in debt); RS falls and PB taking increases
- Adding both μ^S and μ^T $\Rightarrow$ level & composition of TLAC similar to current regulations

Conclusions

- Increase in CRs & revision of regulation regarding other components of TLAC are central aspects of post-crisis regulation

- We build a banking model in the spirit of Merton (1977) and insert in it a number of frictions, including two relevant agency problems (risk shifting & private benefit taking)

  - Deposits are cheap due to deposit insurance & the liquidity services that they provide to their holders

  - However, defaulting on them produces large social deadweight costs, providing a role for liabilities with loss-absorbing capability

- In our model equity and bail-in debt work similarly as loss absorbers but have very different effects on insiders' incentives

- Equity is superior when dealing with RS, while bail-in debt is superior when dealing with PB taking $\Rightarrow$ optimal composition

- Under our calibration, the optimal capital and overall TLAC requirements are 5.1% and 13.4% respectively

  [Once overall buffers are large enough, PB taking becomes a more serious threat to the social value of the bank than RS]

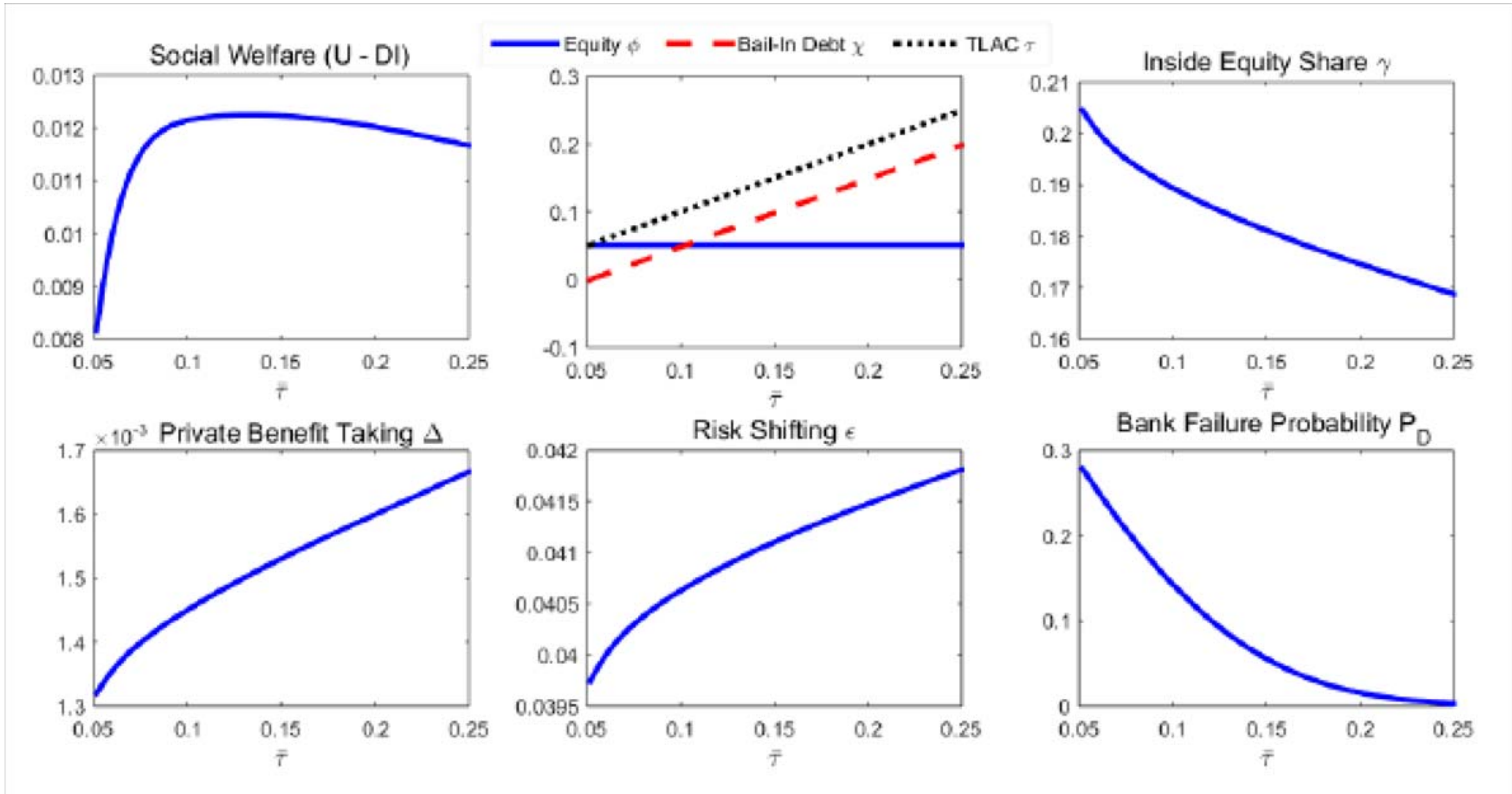
- Some additional ingredients might bring our normative prescriptions closer to current policy proposals

  - The optimal capital requirement grows quite a bit if writing off bail-in debt also implies deadweight costs

  - When such cost gets combined with an external cost of bank failure, our prescriptions become very similar to current regulation

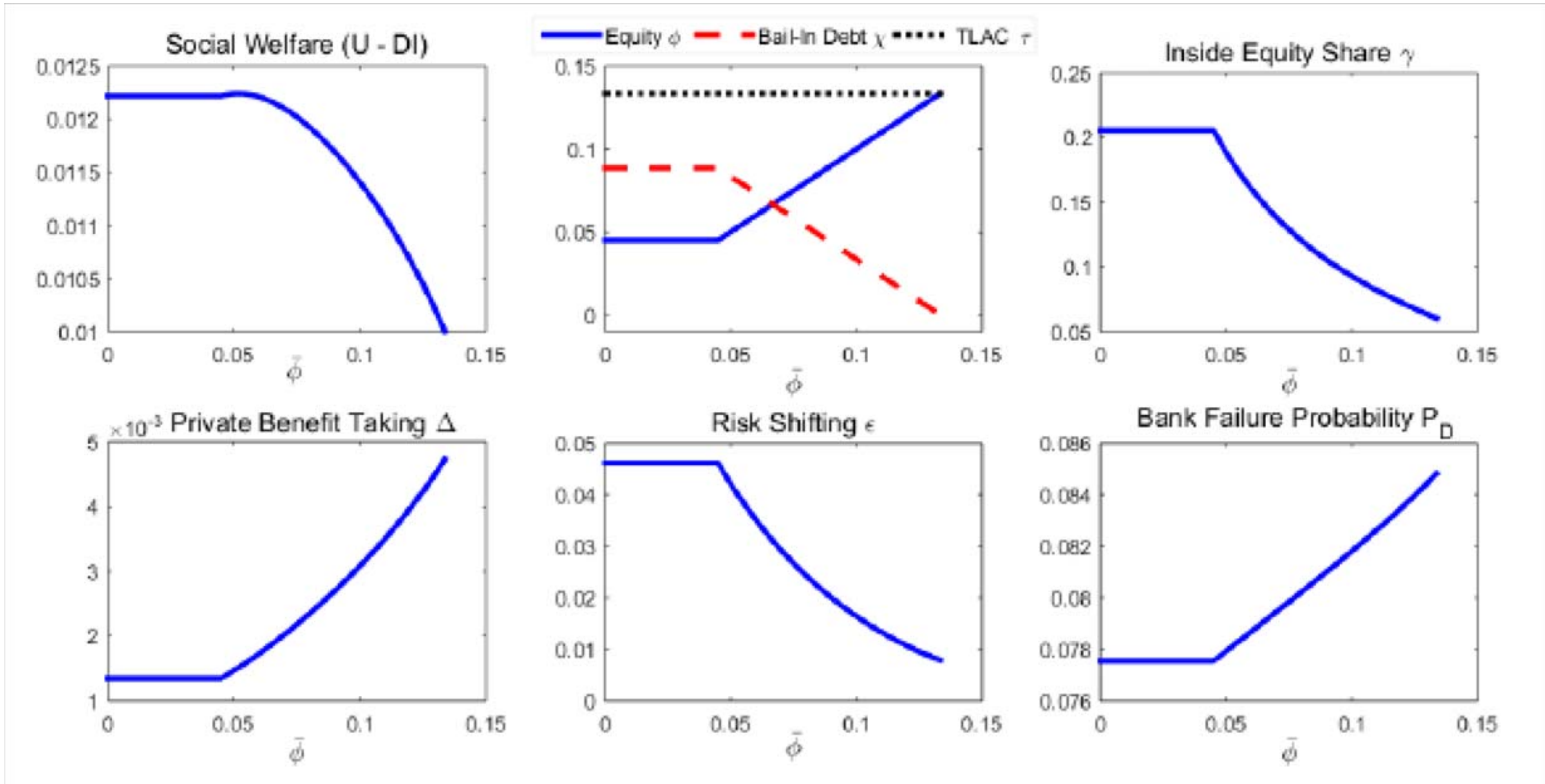
ADDITIONAL RESULTS

Effects of TLAC requirement around optimal regime (F1)



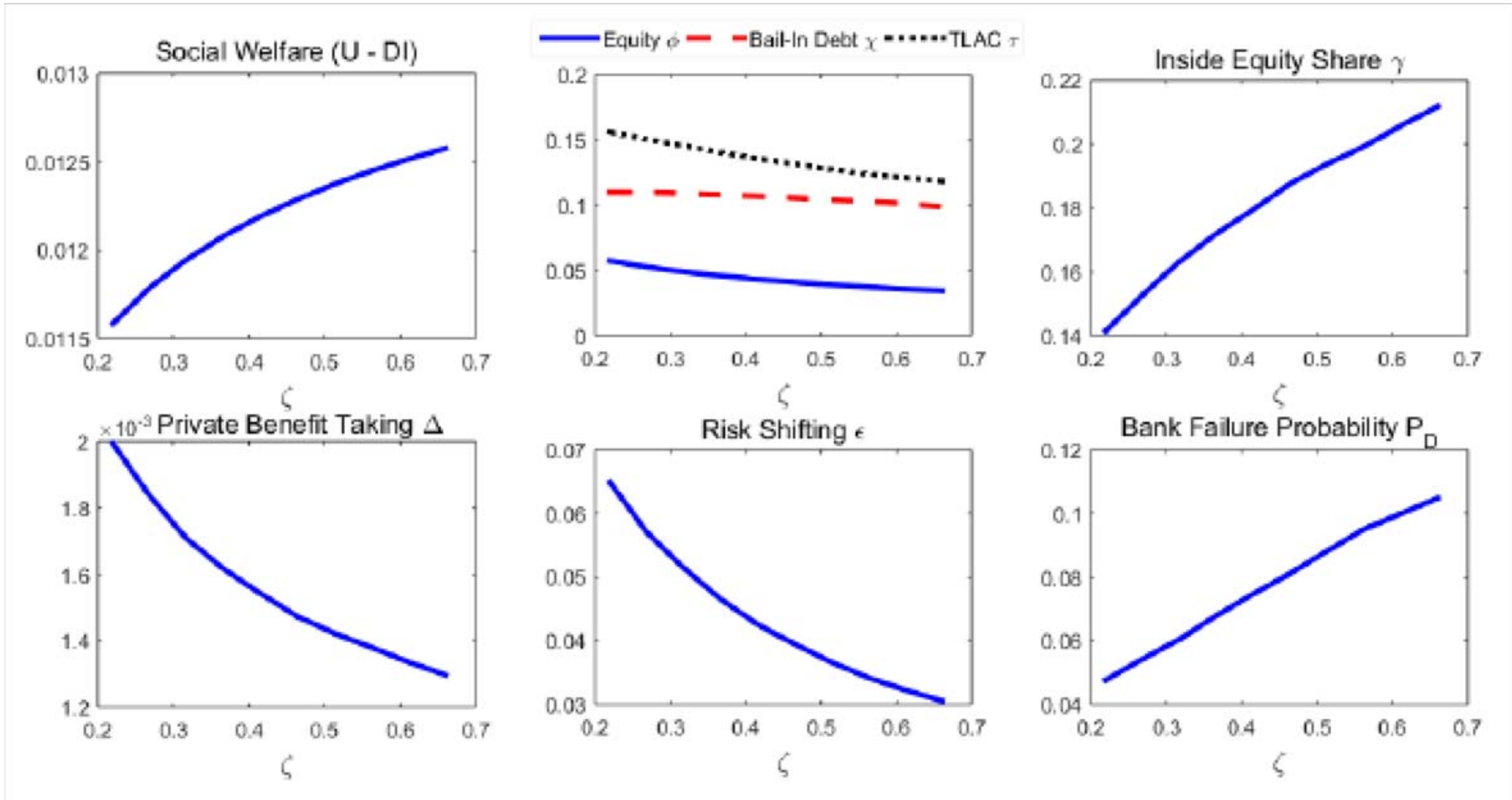
- The fall in welfare when $\overline{\tau}$ increases above its socially optimal value happens relatively slowly
- Increasing $\overline{\tau}$ mainly reduces the unconditional bank failure probability (P_D)
- It also reduces profitability, implies greater dilution of insiders' incentives and worsens agency problems (quantitatively, by little)

Effects capital requirement around optimal regime (F2)



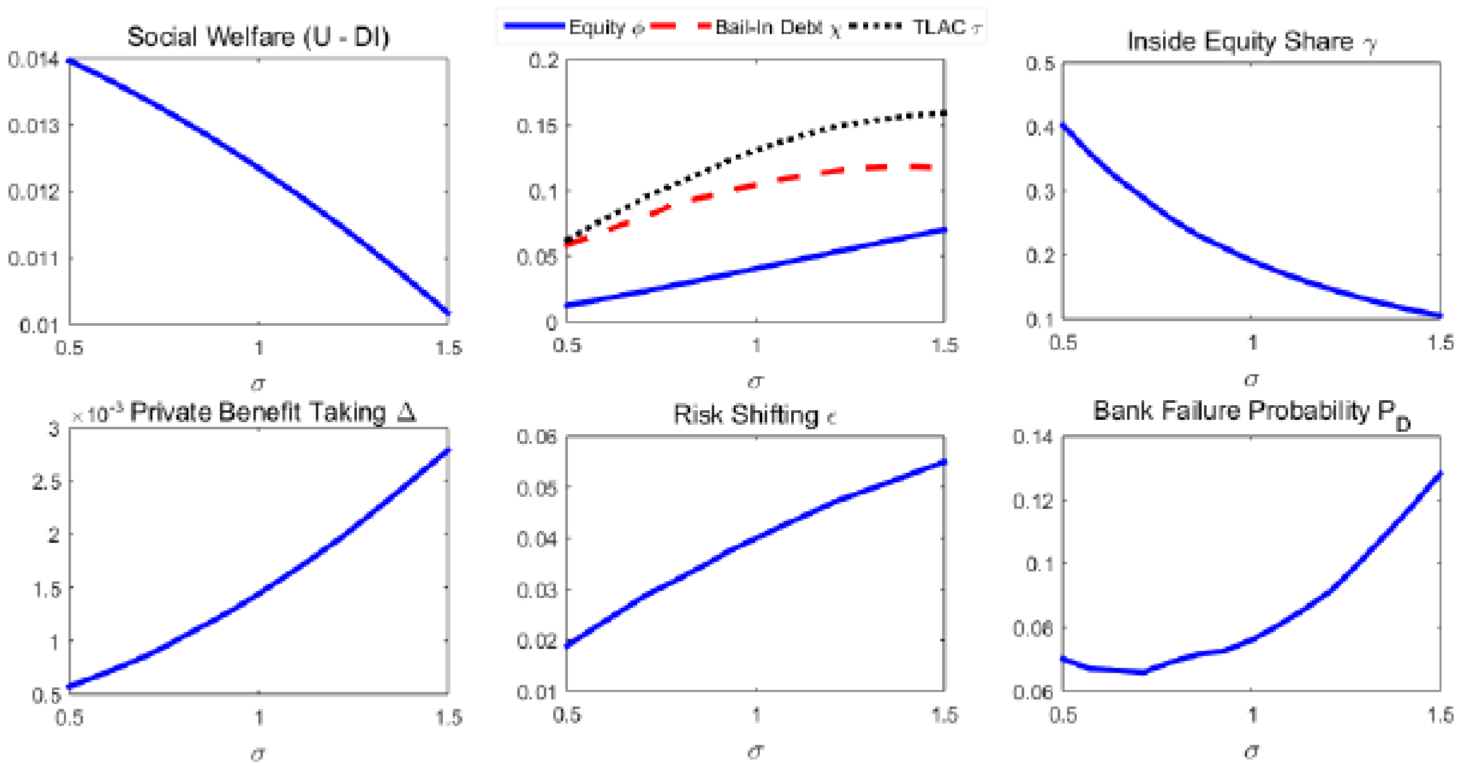
- The minimum CR becomes not binding once it is lower than 4.15%
- Rising $\bar{\phi}$ above the optimal value reduces RS at the cost of increasing PB taking...it marginally increases bank failure probabilities

Sensitivity to the asset return cost of risk shifting (ζ) (F3)



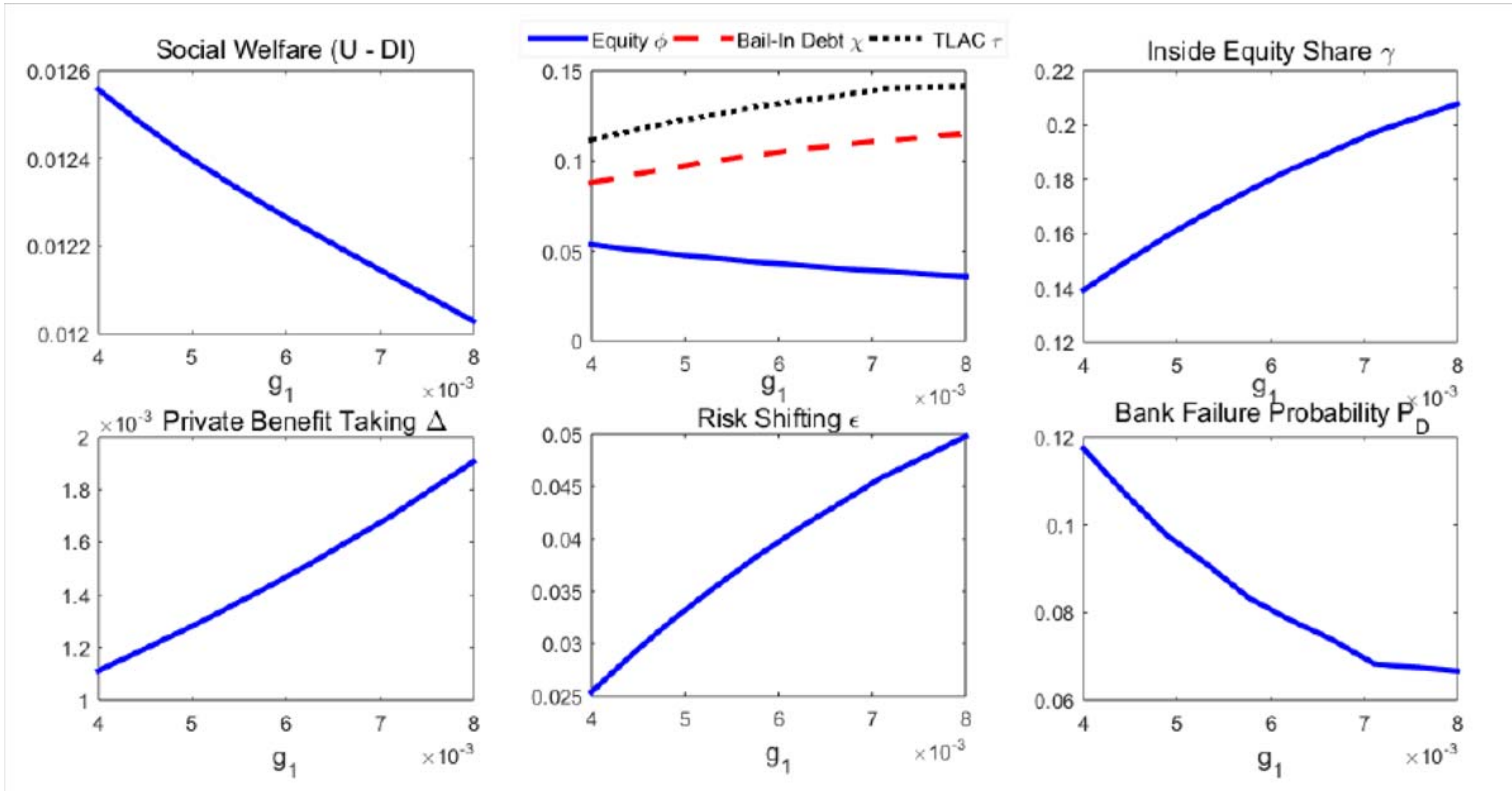
- ζ increases from 0.2 to 0.7, reducing relative importance of RS
- $\overline{\phi}$ (and the overall TLAC requirement $\overline{\tau}$) are decreasing in ζ
- Lower $\overline{\phi}$ allows insiders to retain more equity, PB taking falls, P_D increases

Sensitivity to the volatility of asset returns (σ_0 & σ_1) (F4)



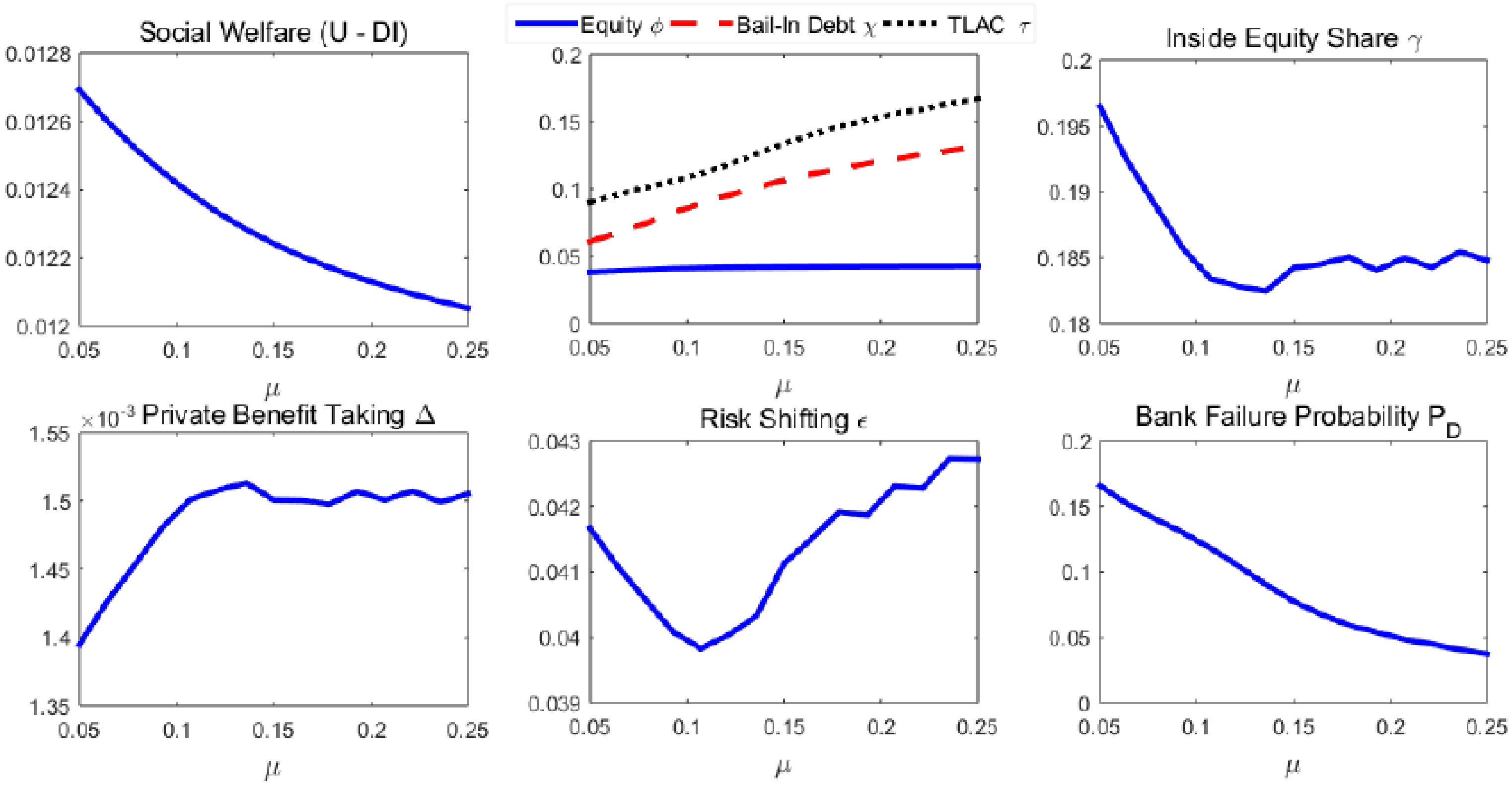
- σ_0 & σ_1 get multiplied by factor σ (baseline =1)
- ($\overline{\phi}$,$\overline{\tau}$)=(1%,6%) with σ=0.5 & ($\overline{\phi}, \overline{\tau}$)=(7%,17%) with σ=1.5
- σ increases P_D & temptation to shift risk; rising $\overline{\phi}$ increases PB taking

Sensitivity to attractiveness of private benefit taking (g_1) (F5)



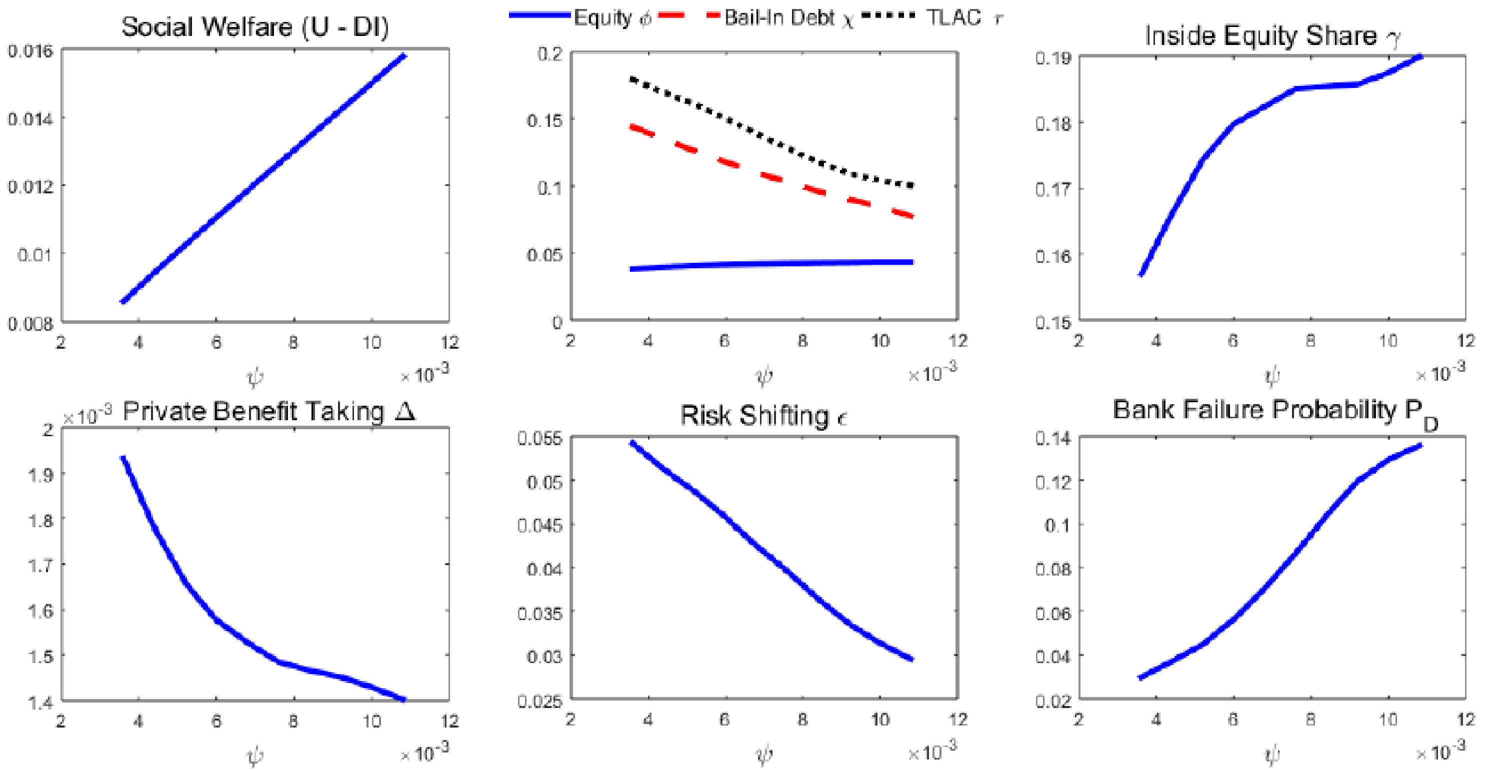
- Optimal regulatory response is to reduce portion of TLAC covered with equity
- Insiders' temptation to take more PB is not fully offset and RS also increases
- Regulatory response is to also increase $\overline{\tau}$, up to point that P_D actually falls

Sensitivity to bank default costs of (μ) (F6)



- Optimal $\overline{\tau}$ increases with μ, while $\overline{\phi}$ is barely sensitive to μ
- Optimal to sacrifice some liquidity provision to make banks safer
- This reduces profitability and increases need for skin-in-the-game, eventually at cost of RS

Sensitivity to the deposit convenience yield (ψ) (F7)



- Increasing ψ increases profitability (which improves incentives)
- This rises opportunity cost of TLAC requirement
- All in all, W increases but P_D increases slightly