Fiscal distress and banking performance: The role of macroprudential regulation

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The views expressed are those of the authors and not necessarily those of the Bank of Greece, the ECB or the Eurosystem
Tight connection between banking and sovereign credit risk

• Some examples:
  - In Greece: the likelihood of sovereign debt default devastated the banking system
  - In Ireland: the collapse of the banking system wreaked havoc on the fiscal front

• What is the link?
  - Banks’ exposure to domestic government debt is the channel of transmission from the fiscal to the banking front
  - Bank bail-outs provide the channel of transmission from the banking to the fiscal front
Relevant literature

• Two strands in the relevant literature
  ➢ Bilateral interactions between banking and sovereign risk (doom loops)
    — See Acharya et al., 2014, Fahri and Tirole, 2016, Cooper and Nikolov, 2017
  ➢ Transmission of fiscal fragility to bank lending and macroeconomic performance
    — See Bocola, 2016
Our paper

• Contributes to the latter branch. New features:

  ➢ A different transmission mechanism linking fiscal fragility to banking performance: Government bank deposit insurance guarantees
    — The amount of depositor bail-in is related to fiscal fragility

  ➢ Allow macroprudential policy – capital requirements – to vary optimally with the degree of deposit riskiness
    — Uncertainty about the amount of bail-in (fiscal uncertainty)
    — Economic uncertainty

  ➢ Allow for bank default (financial solvency risk) that varies with sovereign solvency risk
Preview of main findings

• The optimal level of capital requirements increases when fiscal fragility increases and deposits become riskier
  ➢ Net effect: A negative correlation between sovereign and financial credit risks
  ➢ The standard, positive correlation claimed in the literature is not robust under optimal policy

• Relative to constant policy:
  ➢ Higher economic activity: the recession is less severe than what it would have been in the absence of policy adjustment
  ➢ The increase in capital requirements in response to higher fiscal fragility ends up supporting a higher level of financial intermediation (in addition to helping save on direct default costs)
Preview of main findings (cont.)

• Effects of economic uncertainty on optimal capital requirements
  ➢ It is optimal to increase capital requirements when economic uncertainty increases
  ➢ Interactions: Incomplete deposit insurance amplifies the effects of greater uncertainty but...
    …the economy’s response can be mitigated if macroprudential policy is adjusted optimally
Preview of main findings (cont.)

• Implications for banking union
  ➢ If banking union means that a single union wide bank capital requirement is implemented, then its level is likely to be excessive (sub-optimally high) from the point of view of countries that are fiscally strong and/or face less economic uncertainty

  ➢ The cost for these countries may go well beyond “fiscal transfers”, since they may also experience other negative effects such as a sub-optimal decline in the amount of bank credit and economic activity

  ➢ The exact opposite calculus applies to countries that are fiscally weak and/or face a greater amount of economic uncertainty

  ➢ These properties can account for the opposing preferences of different groups of counties in the EU regarding banking union
How we work

• We establish these points in the context of a Dynamic Stochastic General Equilibrium (DSGE) model where we consider:

➢ Varying degrees of fiscal fragility and levels of economic uncertainty and their implications for the optimal level of bank capital requirements
The model: Key features

• Based on Clerc et al. (2015), we use a DSGE model that features:
  ➢ A rich financial sector afflicted by multiple agency problems
  ➢ Banking capital regulations
  ➢ Government-provided deposit insurance
    — Deposit insurance may or may not be complete due to the limited fiscal capacity of the government
  ➢ Bank default in equilibrium
  ➢ A variety of risk shocks

• Key implication of the model: Capital requirements reduce bank leverage and the default risk of banks
  ➢ Their relationship with social welfare and GDP is hump-shaped, reflecting a trade-off between bank default and underinvestment
Structure of the model (cont.)

- Deposit insurance and deposit risk premium

\[ \tilde{R}_t^D = \left(1 - \gamma_t D_t^b \right) R_{t-1}^D \]

- \( R_t^D \): Gross fixed interest rate on deposits
- \( \tilde{R}_t^D \): Actual interest rate on deposits (net of default costs)
- \( D_t^b \): Economy wide probability of bank default
- \( \gamma_t \): Fraction of deposits that is not recovered when a bank defaults

- \( \gamma_t \) represents the degree of fiscal fragility, with \( \gamma_t = 0 \) corresponding to full deposit insurance

- \( \gamma_t \) is determined according to the process:

\[ \gamma_t = \gamma_0 + \gamma_1 (b_t - b^*) + \varepsilon_t^R, \quad \gamma_0, \gamma_1 \geq 0, \quad \varepsilon_t^R = \rho^R \varepsilon_{t-1}^R + e_t \]

- \( b_t \): total credit (\( b^* \) is its steady state value)
Calibration of the model

- Calibrate the model to match key first and second moment properties of the Greek data (2000q1-2009q4)

<table>
<thead>
<tr>
<th>Description</th>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree of Fiscal Frailty</td>
<td>$\gamma$</td>
<td>0.12</td>
</tr>
<tr>
<td>Capital Requirement for Mortgage Loans</td>
<td>$\phi^H$</td>
<td>0.04</td>
</tr>
<tr>
<td>Capital Requirement for Corporate Loans</td>
<td>$\phi^F$</td>
<td>0.08</td>
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<tr>
<td>Variance of Mortgage Bank Idiosyncratic Risk Shock</td>
<td>$\sigma_H$</td>
<td>0.0163</td>
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<tr>
<td>Variance of Corporate Bank Idiosyncratic Risk Shock</td>
<td>$\sigma_F$</td>
<td>0.0331</td>
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<tr>
<td>Variance of Household Idiosyncratic Risk Shock</td>
<td>$\sigma_m$</td>
<td>0.157</td>
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<tr>
<td>Variance of Entrepreneurial Idiosyncratic Risk Shock</td>
<td>$\sigma_e$</td>
<td>0.49</td>
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</table>
Macroeconomic effects of incomplete deposit insurance

• Steady-state analysis
  ➢ Macroeconomic effects of different levels of fiscal fragility, $\gamma$, when:
    – The level of capital reserve requirements is constant
    – The level of capital requirements adjusts optimally to changes in $\gamma$
Steady-state analysis: effects of fiscal fragility (Fig. 1)
Varying $\gamma$, holding capital requirements constant at their steady state value

- Higher $\gamma$ → Riskier deposits (a higher deposit spread) → Higher bank and corporate default rates → Lower level of macroeconomic activity → Lower welfare
- The weaker economic activity is due to both direct effects (more output getting lost due to default) and indirect effects (less output being produced due to a lower level of deposits and credit)
Steady-state analysis: fiscal fragility and welfare (Fig. 2)

Varying $\gamma$, holding capital reserve requirements constant at their steady state value

Welfare is computed as a weighted average of the intertemporal welfare of the patient and impatient households

$$V \equiv \frac{c_0^s}{c_0^s + c_t^m} V^s + \frac{c_0^m}{c_0^s + c_t^m} V^m$$

where $V_t^j = u_t^j + \beta^j E_t V_{t+1}^j$, $j = s, m$

Fiscal frailty is socially detrimental (welfare is a negative, monotone function of $\gamma$)
Steady-state analysis: fiscal fragility and optimal capital requirements (Fig. 3)

Varying $\gamma$, adjusting optimal capital reserve requirements

- For each $\gamma$, we choose the level of capital requirements that maximizes steady-state welfare
- As deposits become riskier, the optimal level of capital requirements uniformly increases
Steady-state effects of fiscal fragility under optimal capital requirements (Fig. 4)

Varying $\gamma$, adjusting optimal capital reserve requirements

- The optimal use of macro-prudential regulation makes banks safer by reducing bank default
- Lessens the output contraction relative to the case where cap. requirements are constant
- This result is not trivial since higher cap. requirements could have reduced bank lending and output
For any given level of $\gamma$, welfare is higher when capital requirements adjust optimally.

The decline in welfare is smaller when policy adjusts (the gap between the two lines increases).
Effects of economic uncertainty on optimal capital requirements

• Does greater economic uncertainty (risk) call for stricter or weaker capital requirements?

• Interactions: Incomplete deposit insurance and economic uncertainty
  ➢ Does incomplete deposit insurance exaggerate the effects of greater uncertainty?
  ➢ Does the optimal adjustment of capital requirements amplify or mitigate this interaction?

• How we work:
  ➢ For different levels of economic uncertainty (variances of risk shocks) we compute optimal capital requirements by solving the model at the second order and plugging the solution into a second order approximation of the welfare function
Uncertainty and optimal capital requirements (Fig. 6)

- Optimal capital requirements increase at an increasing rate as uncertainty, which helps contain the non-linear effect of the risk shock on economic activity.
- Countries with substantial financial (or aggregate) volatility have to have higher levels of capital requirements.
- The combination of higher economic uncertainty and higher fiscal frailty has a magnifying effect on optimal requirements.
Fiscal fragility and uncertainty: Impact of risk shocks on GDP and bank default (Fig. 7)

As uncertainty increases: ↓ mean of GDP, ↑ std of GDP, ↑ mean of default rate, ↑ std of the default rate

A higher probability of depositor bail-in (high $\gamma$) amplifies these effects

The instability can be partly contained if macro-prudential policy is adjusted optimally

Low: $\gamma = 0.12, \Phi_F = 0.1086$, High constant: $\gamma = 0.24, \Phi_F = 0.1086$, High optimal: $\gamma = 0.24, \Phi_F = 0.1186$
Conclusions

• The **optimal response** of macroprudential regulation to fiscal fragility, by safeguarding the banking system, can **arrest a decline in output and welfare**

• The negative effects of **uncertainty** are exaggerated by a higher degree of fiscal fragility. The deployment of the **capital requirements** tool can **mitigate** such **negative effects**

• **When economic uncertainty is high**, optimal macro-prudential regulation is **even more effective** in severing the transmission of frailty from the fiscal sphere to the banking system
Conclusions (cont.)

• Implications for banking union

➢ Fiscal and economic uncertainty are factors that need to be considered for the computation of the costs and benefits of a banking union

➢ It is likely that fiscally weak countries will experience a decrease and fiscally strong countries an increase in their optimal capital requirements when forming a banking union

➢ Fiscally strong countries could end up ceteris paribus worse off and the weak better off in a banking union that has shared fiscal capacity for the provision of deposit insurance
Thank you!
Back up slides
Dynamic effects: bank risk shocks under optimal and constant cap. requirements (Fig. 8)

Adjusting capital requirements optimally in the face of higher fiscal fragility plays a stabilizing role: while the outcomes worsen, the optimal deployment of the macro-prudential tool can mitigate this adverse development.

Low: $\gamma = 0.12, \Phi_F = 0.1086$, High constant: $\gamma = 0.5, \Phi_F = 0.1086$, High optimal: $\gamma = 0.5, \Phi_F = 0.1186$
Dynamic effects: shock to the probability that deposit insurance will be honored under optimal and constant cap. Requirements (Fig. 9)

Adjusting capital requirements optimally in the face of higher fiscal fragility plays a stabilizing role: while the outcomes worsen, the optimal deployment of the macro-prudential tool can mitigate this adverse development
Structure of the model

- **Saving households**
  - Supply labour, supply deposits to banks and invest in housing
  - Deposits are insured by the government
  - Pay lump-sum taxes used for deposit insurance
  - In case of bank failure they incur a cost → **deposit risk premium** that raises the bank’s funding costs
Structure of the model (cont.)

- **Borrowing households**
  - Supply labour to competitive markets and invest in housing
  - Borrow from banks using their holdings of housing as collateral
  - Face idiosyncratic risk shocks
  - **Default** on their mortgage loans when the value of housing is less than the mortgage repayment:

\[ \omega_t^m q_t^H (1 - \delta_t^H) h_{t-1}^m < R_{t-1}^m b_{t-1}^m \]
Structure of the model (cont.)

➤ **Entrepreneurs** (2-period OLG agents)
  — Rent capital to consumption good producers
  — Borrow from banks using their productive capital as collateral
  — Face idiosyncratic risk shocks and default on their corporate loans when the value of the firm is less than debt repayment:
    \[ \omega_{t+1}^e (r_{t+1}^k + (1 - \delta_{t+1}) q_{t+1}^K) k_t < R_t^F b_t^e \]

➤ **Banks**
  — Two types of banks that specialize either in mortgage or corporate loans
  — Raise equity from bankers and deposits from households
  — Face idiosyncratic risk shocks and default when the value of loans falls below deposits
  — Face a regulatory capital constraint:
    \[ e_t \geq \phi_t b_t \]

\( e_t \): equity, \( \phi_t \): capital-to-assets ratio, \( b_t \): total loans
Structure of the model (cont.)

- **Bankers** (2-period OLG agents)
  - Invest their wealth as inside equity capital in firm-lending or mortgage-lending banks

- **Production sector**
  - Consumption good firms
  - Capital producers
  - Housing producers

- **Macroprudential policy**
  \[ \phi_t^j = \phi_0^j + \phi_1^j \left[ \log(b_t) - \log(\bar{b}) \right], \ j = H, F \]

- **Stochastic enviroment**
  Productivity shocks, the shocks to the variances of the idiosyncratic risk shocks and the risk premium shock follow an AR(1) stochastic process.
## Long-run solution

<table>
<thead>
<tr>
<th>Description</th>
<th>Data averages</th>
<th>Long run solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total consumption over GDP</td>
<td>0.64</td>
<td>0.6</td>
</tr>
<tr>
<td>Investment (capital good production) / GDP</td>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td>Investment in housing/ GDP</td>
<td>0.08</td>
<td>0.09</td>
</tr>
<tr>
<td>Deposit premium</td>
<td>0.23</td>
<td>0.24</td>
</tr>
<tr>
<td>Debt-to-GDP ratio of entrepreneurs (annualized)</td>
<td>0.49</td>
<td>0.49</td>
</tr>
<tr>
<td>Debt-to-GDP ratio of borrowers (annualized)</td>
<td>0.42</td>
<td>0.34</td>
</tr>
<tr>
<td>Default rate – Entrepreneurs</td>
<td>-</td>
<td>6.9%</td>
</tr>
<tr>
<td>Default rate – Mortgages</td>
<td>-</td>
<td>0.9%</td>
</tr>
<tr>
<td>Default rate – Firm lending banks</td>
<td>-</td>
<td>2%</td>
</tr>
<tr>
<td>Default rate – Mortgage lending banks</td>
<td>-</td>
<td>2%</td>
</tr>
</tbody>
</table>
• Saving households

The dynasty of patient households maximizes

\[
E_t \left[ \sum_{i=0}^{\infty} (\beta^s)^{t+i} \left[ \log(c^s_{t+i}) + \nu^s \log(h^s_{t+i-1}) - \frac{\phi^s}{1 + \eta} (l^s_{t+1})^{1+\eta} \right] \right]
\]

subject to

\[
c^s_t + q^H_t h^s_t + d_t \leq w_t l^s_t + q^H_t (1 - \delta^H_t) h^s_{t-1} + \tilde{R}^D_t d_{t-1} - T_t + \Pi^s_t
\]

where \(\tilde{R}^D_t = R^D_{t-1} (1 - \gamma PD^b_t)\)
Borrowing households

\[
\begin{align*}
\max_{\{c_{t+1}^m, h_{t+1}^m, l_{t+1}^m, x_{t+1}^m, b_{t+1}^m\}} & \quad E_t \left[ \sum_{i=0}^{\infty} (\beta^m)^{t+i} \left[ \log(c_{t+i}) + v^m \log(h_{t+i}) - \frac{\varphi^m}{1 + \eta} (l_{t+1}^m)^{1+\eta} \right] \right] \\
\text{subject to} & \quad c_t^m + q_t^H h_t^m - b_t^m \leq \omega_t l_t^m + \left( 1 - \Gamma^m \left( \frac{x_t^m}{R_{t+1}^H} \right) \right) R_{t+1}^H q_t^H h_t^m \\
& \quad E_t \left[ (1 - \Gamma^H(\bar{\omega}_{t+1}^m)) \left( \Gamma^m \left( \frac{x_t^m}{R_{t+1}^H} \right) - \mu^m G^m \left( \frac{x_t^m}{R_{t+1}^H} \right) \right) R_{t+1}^H \right] R_{t+1}^H q_t^H h_t^m = \rho_t \Phi_t b_t^m
\end{align*}
\]

\(\mu^m\): the verification cost

\(G^m(\omega_{t+1}^m) = \int_{0}^{\bar{\omega}_{t+1}^m} (\omega_{t+1}^m f(\omega_{t+1}^m)) d\omega_{t+1}^m\) : share of assets that belong to households that default

\(\Gamma^m(\bar{\omega}_{t}^m)\): share of gross returns accrued by the bank

Households default whenever \(\omega_{t}^m\) satisfies:

\[\omega_{t}^m \leq \bar{\omega}_{t}^m = \frac{x_{t-1}^m}{R_t^H} \text{ where } R_t^H = \frac{q_t^H(1-\delta_t^H)}{q_{t-1}^H} \text{ and } x_t^m = \frac{R_t^m b_t^m}{q_t^H h_t^m} \text{ is household leverage}\]
Entrepreneurs

The problem of the entrepreneurs in period $t + 1$ is:

$$\max_{\{c_{t+1}^e, n_{t+1}^e\}} (c_{t+1}^e)^x (n_{t+1}^e)^{1-x}$$

subject to

$$c_{t+1}^e + n_{t+1}^e \leq W_t^e,$$

$W_t^e$: the wealth resulting from the activity in the previous period.

The optimization problem of the entrepreneur in period $t$ is to maximize expected wealth:

$$\max_{\{k_t, b_t^e, R_t^F\}} E_t(W_{t+1}^e)$$

subject to the period $t$ resource constraint

$$q_t^K k_t - b_t^e = n_t^e$$

and the banks participation constraint

$$E_t[(1 - \Gamma^F(\bar{\omega}_{t+1}^F))(\Gamma^e(\bar{\omega}_{t+1}^e) - \mu^e G^e(\bar{\omega}_{t+1}^e))] R_{t+1}^K q_t^K k_t = \rho_t \phi_t^F (q_t^K k_t - n_t^e)$$

where $W_{t+1}^e = \max\{\omega_{t+1}^e (r_{t+1}^K + (1 - \delta_{t+1}) q_{t+1}^K) k_t - R_t^F b_t^e, 0\}$
Entrepreneurs (cont.)

Entrepreneurs default on their loans whenever

\[ \omega_{t+1}^e \left( r_{t+1}^k + (1 - \delta_{t+1})q_{t+1}^k \right) k_t < R_t^F b_t^e \]

The entrepreneur will repay their corporate loan in period \( t + 1 \) whenever the idiosyncratic shock \( \omega_{t+1}^e \) exceeds the following threshold:

\[ \bar{\omega}_{t+1}^e \equiv \frac{R_t^F b_t^e}{R_{t+1}^K q_{t+1}^K k_t} \equiv \frac{x_t^e}{R_{t+1}^K} \]

\[ R_{t+1}^K = \frac{r_{t+1}^k + (1 - \delta_{t+1})q_{t+1}^k}{q_t^k} : \text{gross return per efficiency units of capital} \]

\[ x_t^e = \frac{R_t^F b_t^e}{q_t^K k_t} : \text{entrepreneurial leverage} \]
The maximization problem of the entrepreneurs in period $t$ can be compactly written as:

$$\max_{x_t^e, k_t} E_t [(1 - \Gamma^e) \left( \frac{x_t^e}{R_{t+1}^K} \right) R_{t+1}^K q_t^K k_t]$$

subject to

$$E_t [(1 - \Gamma^F(\omega_{t+1}^F))(\Gamma^e(\omega_{t+1}^e) - \mu^e G^e(\omega_{t+1}^e))] R_{t+1}^K q_t^K k_t = \rho_t \phi_t^F(q_t^K k_t - n_t^e)$$

where

$\Gamma^e(\omega_{t+1}^e)$: share of gross returns that will accrue to the bank

$G^e(\omega_{t+1}^e) = \int_0^{\omega_{t+1}^e} (\omega_{t+1}^e f^e(\omega_{t+1}^e)) d\omega_{t+1}^e$: fraction of the returns coming from the defaulted loans of entrepreneurs

$\mu^e$: verification costs incurred by the bank and $(1 - \Gamma^F(\omega_t^F))$ is the share of assets accrued to bankers in the case of a bank default

$\omega_t^F$: default threshold level for the idiosyncratic shock of banks that specialize in corporate loans (defined below)
Bankers

The problem of the banker in period $t + 1$ is:

$$\max_{\{c_{t+1}^b, n_{t+1}^b\}} \left( c_{t+1}^b \right)^{\chi^b} \left( n_{t+1}^b \right)^{1-\chi^b}$$

subject to

$$c_{t+1}^b + n_{t+1}^b \leq W_{t+1}^b$$

$W_{t+1}^b = \tilde{\rho}_{t+1}^F e_t^F + \tilde{\rho}_{t+1}^H (n_t^b - e_t^F)$: wealth of the banker in period $t + 1$.

$e_t^F$ : amount of the initial wealth $n_t^b$ invested as inside equity in $F$ banks and the rest, $n_t^b - e_t^F$, in $H$ banks

$\tilde{\rho}_{t+1}^F, \tilde{\rho}_{t+1}^H$ : ex post gross returns on the inside equity invested in banks $F$ and $H$ respectively. The maximization problem in period $t$ is:

$$\max_{e_t^F} E_t (z_t^b W_{t+1}^b) = E_t z_t^b \left( \tilde{\rho}_{t+1}^F e_t^F + \tilde{\rho}_{t+1}^H (n_t^b - e_t^F) \right)$$

An interior solution in which both type of banks receive positive equity requires that $E_t \tilde{\rho}_{t+1}^F = E_t \tilde{\rho}_{t+1}^H = \rho_t$, where $\rho_t$ denotes the required expected gross rate of return on equity investment at time $t$
Banks

The problem of each bank $j$ can be written as:

$$\pi_{t+1}^j = \max\{\omega_{t+1}^j \tilde{R}_{t+1}^j b_t^j - R_t^D d_t^j, 0\}$$

subject to $e_t^j \geq \phi_t^j b_t^j$

In equilibrium, the constraint will be binding so that the loans and deposits can be expressed as $b_t^j = \frac{e_t^j}{\phi_t^j}$ and $d_t^j = (1 - \phi_t^j) \frac{e_t^j}{\phi_t^j}$, respectively. Accordingly, the threshold level of $\omega_t^j$ below which the bank defaults is $\bar{\omega}_{t+1}^j = (1 - \phi_t^j) \frac{R_t^D}{\tilde{R}_{t+1}^j}$

The required ex post rate of return from the bankers that invest in the bank $j$ is:

$$\tilde{\rho}_{t+1}^j = \left[1 - \Gamma^j(\bar{\omega}_{t+1}^j)\right] \frac{\tilde{R}_{t+1}^j}{\phi_t^j},$$
The macroeconomic effects of fiscal fragility (the mechanism)

• If deposit insurance is incomplete due to fiscal fragility, an increase in the probability that the government may not be able to meet its deposit guarantee pledge leads to:

↳ Bank deposits more risky
↳ Households change their savings and portfolio decisions
↳ The cost of raising funds for the banks increases
↳ Bank lending decreases, lending rates increase, the probability of firm and bank default increases
↳ The typical scenario in the literature: sovereign and financial credit risks move in tandem
↳ A contraction, with output, consumption and investment all decreasing