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# Sell or Hold? On the Value of Non-Performing Loans and Mandatory Write-Off Rules

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# Motivation

- Bank regulators introduced mandatory write-off rules for **non-performing loans (NPLs)** in the Euro-area.
- Banks can **sell**, **write-down** or **write-off** NPLs
- The regulation essentially leaves banks with two options: **sell** or **write-off**
- We investigate this decision from the perspective of a rational bank.

## Research Question

- What is the fair value of a NPL?
- When is it better to sell a NPL compared to writing it off and keeping it "off the books"?
- Do mandatory write-off rules force banks to sell NPLs they would have otherwise held on to? If so, are all banks treated the same?

# Why is this decision not trivial?

- Usually, one sells if the price is at least as high as ones valuation.
- But banks face capital constraints,
  - e.g. Basel III - CET 1 Ratio $> 4.5\%$

  equity financing is costly,
  - e.g. underwriting and legal fees, SEO underpricing, . . .

  NPL markets are plagued with asymmetric information problems and bid-ask spreads are very high
  - A news article from 2017 states that the average bid ask spread in the Italian NPL market is about 19 percentage points.
  - E.g. very low liquidity, inherent asymmetric information, . . .

# How we model this decision

- First, we take a look at the fair value of NPLs.
- Then we investigate the role of capital adequacy in the decision whether to sell or write-down/write-off a NPL.
- Lastly, the impact of mandatory write-off rules on banks — w.r.t. to this decision — is assessed.

# The fair value of non performing loans

- A NPL represents a claim on the borrower's remaining assets contingent on the recovery rate that is capped at the notional plus interest and workout cost.
- The NPL's payoff in $T$[1] is then $\mathrm{NPL}(R_T) = N \min\{R_T, K\}$,
  - where $N$ is the NPL's notional, $R_T$ is the fractional recovery rate in $T$ and $K = 1 + \text{ interest} + \text{ work out cost}$.
- We assume that the fractional recovery rate is a stochastic process with the following dynamics

$$\frac{dR_t}{R_t} = \left(\mu + \tilde{\beta}\eta\right) dt + \delta dW_t, \quad \eta \sim \mathcal{N}(0,1),$$

where $\mu$ and $\delta$ are scalars measurable in $t = 0$ and $\eta$ is observed in $T$. We think of $\tilde{\beta}\eta$ as a measurement error of the drift $\mu$, where $\tilde{\beta}$ depends on the type of agent and $\eta$ is independent of the driving Wiener process $(W_t)$.

[1] We assume that $T$ is known and fixed.

# The fair value of non performing loans (2)

- Note, this implies that expected recovery is the same for all agents.
- We assume
  - the existence of a risk free asset with dynamics $dB_t = rB_t dt$.
  - the NPL in question is only traded in $t = 0$.
  - no liquid market for $\mathrm{NPL}(R_T)$.[2]
- incomplete market $\rightarrow$ many equivalent martingale measures
- Thus, we assume the existence of markets for NPLs ( $\mathrm{NPL}(\hat{R}_T)$) sufficiently similar to the NPL we want to price ( $\mathrm{NPL}(R_T)$), in a sense that their market prices of risk are sufficiently similar.

[2] NPLs with recovery rate process $R_t$ are not traded.

# The fair value of non performing loans (3)

**Proposition 1. Fair value of a NPL**

Given an incomplete market setting as described above the price of a non performing loan in $t = 0$ is given by

$$\Pi_0 \left[ \, \mathrm{NPL}(R_T) \right] = e^{-rT} N \left( R_0 e^{(\mu - \sigma\lambda)T} - \mathbb{E}_0^Q \left[ \max\{R_T - K, 0\} \right] \right)$$

$$= e^{-rT} N \left( R_0 e^{(\mu - \sigma\lambda)T} \left(1 - \Phi(d)\right) + K \Phi \left( d - \sigma\sqrt{T} \right) \right),$$

$$d = \frac{\log\left(\frac{R_0}{K}\right) + \left(\mu - \sigma\lambda + \frac{\sigma^2}{2}\right) T}{\sigma\sqrt{T}},$$

where $\lambda = \lambda_W + \lambda_\eta$ denotes recovery's market price of risk plus the recovery estimation technology's market price of risk, which for ease of notation are assumed to be constant. Furthermore, $\sigma = \sqrt{\delta^2 + \tilde{\beta}^2 T}$.

# The fair value of non performing loans (4)

- As $\hat{R}_T \approx R_T \implies \hat{\lambda}_W \approx \lambda_W$ agents can approximate the risk premium in the pricing formula above by using market prices.
- On the other hand, $\mu$ and $\sigma$ have to be estimated from realizations of $R_T$ (or $\hat{R}_T$).
- More specifically, the drift estimated by agent $i$ is of form $\hat{\mu}_i = \mu + \tilde{\beta}_i \eta$.

**Proposition 2.**

$$\frac{\partial \Pi_0 \left[\, \mathrm{NPL}(R_T) \right]}{\partial \sigma} < 0.$$

By proposition 2 we have that the value of a NPL is decreasing in $\tilde{\beta}$. Hence, a high measurement error variance implies a lower NPL price c.p.

# Difference in valuation

- Let $\mathrm{FV}^I$ denote the invesotr's fair value and $\mathrm{FV}^B$ the bank's fair value of the NPL.
- We argue that the estimation error variance of the bank $\tilde{\beta}_B$ is smaller than the investor's $(\tilde{\beta}_I)$ — at least in $t = 0$.
- Together with Proposition 2 we have

$$\sigma^B < \sigma^I \implies \mathrm{FV}^B > \mathrm{FV}^I,$$

  as $\tilde{\beta}_B < \tilde{\beta}_I \implies \sigma^B < \sigma^I$.
- Even if buyer and seller agree on the expected recovery, the precision in the estimation of the drift of the underlying recovery process influences the fair value of the NPL.

# The role of capital adequacy

- As banks have to maintain capital adequacy the cost of selling and writing-down NPLs differ.

## Cost of selling and writing down NPLs

$$C_{\text{write-down}} = \gamma\left(\left(1-\alpha w_i\right)\Delta a\right)$$

$$C_{\text{sale}} = \max\left\{\gamma\left(\left(1-\alpha w_i\right)\Delta a - p\right), 0\right\}$$

- $\gamma$ is the cost of raising equity, $\alpha$ is the capital adequacy ratio, $w_i$ is the risk weight associated with a NPL of risk class $i$, $\Delta a$ is the change in assets,[3] $p$ is the price the bank gets when selling the NPL.

[3] If $\Delta a = N$, then a write-down is a write-off.

# The role of capital adequacy (2)

- If a bank writes down/off a NPL, it keeps the NPL off the books.
- Thus the change in bank value is what matters for the decision whether to sell or write-down/write-off a NPL.

**The change in bank value.**

$$
\begin{aligned}
\Delta \text{ Value}_{\text{ write-down}} &= -(N - \text{ FV}^B) - C_{\text{ write-down}} \\
&= -(1+\gamma)\left(N - \text{ FV}^B\right) + \gamma\alpha w_i \left(N - \text{ FV}^B\right) \\
\Delta \text{ Value}_{\text{ write-off}} &= -N - C_{\text{ write-down}} + \text{ FV}^B = -(1+\gamma)N + \gamma\alpha w_i N + \text{ FV}^B \\
\Delta \text{ Value}_{\text{ sale}} &= -N - C_{\text{ sale}} + \text{ FV}^I = -(1+\gamma)N + (1+\gamma)\text{ FV}^I + \gamma\alpha w_i N
\end{aligned}
$$

# Sale vs write-off

- Assume that mandatory write-off rules are binding.
- The bank has to decide whether to sell or write-off.

$$\Delta \text{ Value}_{\text{ write-off}} > \Delta \text{ Value}_{\text{ sale}} \iff \text{FV}^B > (1+\gamma)\,\text{FV}^I$$

- Now it becomes clear that it might be optimal to sell even if $\text{FV}^B > \text{FV}^I$,
- because $\text{FV}^I$ increases zero risk weight assets

# A world without mandatory write-off rules

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- We can compare the situation where regulation applies with its counter factual.
- A situation where banks are only forced to write down NPLs to $\mathrm{FV}^B$ instead of zero.
- $\Delta$ Value $_{\text{write-down}} > \Delta$ Value $_{\text{write-off}}$ always (as $\gamma(1-\alpha w_i)\ \mathrm{FV}^B > 0$ holds).
- Furthermore, if writing down dominates writing off, then the regulation implies some costs for the bank.
- To see this, consider:

$$\Delta \text{ Value}_{\text{ write-down}} > \Delta \text{ Value}_{\text{ sale}} \iff \mathrm{FV}^B > \frac{(1+\gamma)}{(1+\gamma(1-\alpha w_i))}\ \mathrm{FV}^I.$$

- A bank will sell less NPLs in a world without this regulation.
- It might still be beneficial to sell if $\mathrm{FV}^B > \mathrm{FV}^I$, but it becomes less likely.



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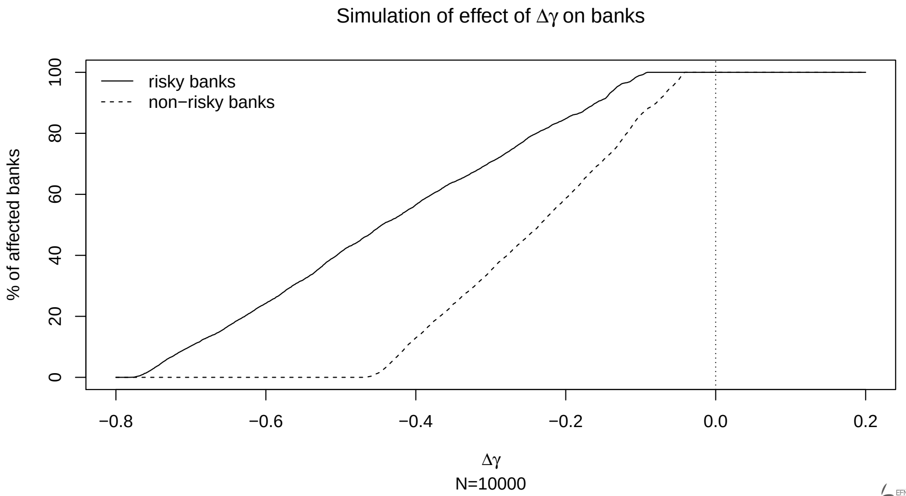
# The impact of regulation

- A bank is affected by the regulation if it would not sell a NPL in a world without mandatory write-off rules, but sells it when such rules are in force.
- Most likely refinancing conditions change
  - $\gamma_0 \ldots$ no write-off rules
  - $\gamma_1 \ldots$ mandatory write-off rules
- A bank is affected if

$$\Delta\gamma > -\frac{(1+\gamma_0)\gamma_0\,(1-\alpha w_i)}{1+\gamma_0\,(1-\alpha w_i)},$$

  where $\Delta\gamma := \gamma_1 - \gamma_0$.
- If $\Delta\gamma \geq 0$, all banks are affected.
- If the cost of raising equity do not fall by *too much*, then only risky banks are affected by the introduction of mandatory write-off rules.

# The impact of regulation (2)



# Conclusion

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**Sell-Hold decision**

- We show that if buyer and seller of NPLs agree on the expected recovery, a difference in the precision in the estimation of the drift of the underlying recovery process greatly influences the sellers (and buyers) decision making process.
- Furthermore, the decision whether or not sell a NPL depends on a bank's costs of raising equity since it faces capital requirements.

**Consequences of mandatory write-off rules**

- Banks that act fully rational are penalized
- Wealth transfer from banks to (possibly unregulated) market participants
- But regulation distinguishes between "good" and "bad" banks