

A MODEL OF MORAL-HAZARD CREDIT CYCLES

[The following text is extremely faint and largely illegible due to heavy noise and low contrast. It appears to be a title or introductory sentence.]

Abstract: *[The following text is extremely faint and largely illegible due to heavy noise and low contrast. It appears to be an abstract or summary of the paper.]*

I. Introduction

[The following text is extremely faint and largely illegible due to heavy noise and low contrast. It appears to be the beginning of the introduction section.]

[The following text is extremely faint and largely illegible due to heavy noise and low contrast. It appears to be the remainder of the introduction section.]

... b ... e ... b ... e ...
... e ... e ... e ... e ...
... e ... e ... e ... e ...

... of \mathbb{C}^n ...

... α β ...

... α β ...

... α β ...

... α β ...

... b e ...
e b ... b

$\sigma_{t+s+1} = \rho / \alpha - \alpha^{s+1} b_{t+s+1} / \rho^{s+1} - \alpha^n b_n / \rho^n$
 $\sigma_{t+s+1} \geq \rho / \alpha \quad \forall s$

$$\sum_{s \in \{0, \dots, n-1\}} \alpha^{s+1} b_{t+s+1} / \rho^{s+1} - \rho / \alpha - \alpha^n b_n / \rho^n$$

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 $\sigma_{t+s+1} \geq \rho / \alpha \quad \forall s$

... $b_n \alpha / \rho^{n-(s+1)}$...

... b_n ...

$$b_n \alpha / \rho^{n-(s+1)} \geq \xi$$

... b_n ...

$$s \cdot b_n \alpha / \rho^{n-(s+1)} \wedge$$

... 0 ...

$$b_n \wedge \rho / \alpha^{n-1} \dots s \quad \rho / \alpha^s \quad \forall$$

... b ... b ... b ...

... ρ / α ... b ... α ...

... b ... ρ ...

... b ... b ...

... b ... b ...

... b ... b ...

... b ... b ...

... b ... b ...

... b_n ...

... b_n ...

$$\sum_{s \in \{0, \dots, n-1\}} t+s+1 \triangleright = \rho / \alpha \alpha / \rho \rightarrow \alpha / \rho$$

... b ...

... b ... b ...

... b ... b ...

... b ... b ...

... b ... b ...

... b ... b ...

... b ... b ...

$$\sum_{s \in \{0, \dots, n-1\}} t+s+1 \triangleright = \rho / \alpha \wedge$$

... b ... b ... b ...

... b ... b ... b ...

... b ... b ... b ...

$\sigma_{t+s+1} = \rho \sigma_t + \epsilon_{t+s+1}$

$$\sigma_{t+s+1} - \rho \sigma_t = \epsilon_{t+s+1}$$

$\sigma_{t+s+1} = \rho \sigma_t + \epsilon_{t+s+1}$

where $\mathbf{b} = \sum_{s=0}^{t-1} \rho^{t-s} \mathbf{e}_s$ and $\mathbf{e}_s = \mathbf{e}_s$ for $s \leq t-1$ and $\mathbf{e}_s = \mathbf{0}$ for $s > t-1$.

$$\mathbf{e}_t = \sum_{s \in \{t-(n-1), \dots, t\}} \rho^{t-s} \mathbf{e}_s \quad \forall t.$$

It follows that $\mathbf{e}_t = \rho \mathbf{e}_{t-1} + \mathbf{e}_t$ for $t \leq n-1$ and $\mathbf{e}_t = \rho \mathbf{e}_{t-1} + \mathbf{e}_t$ for $t \geq n$. For $t \leq n-1$, we have $\mathbf{e}_t = \rho \mathbf{e}_{t-1} + \mathbf{e}_t$ and for $t \geq n$, we have $\mathbf{e}_t = \rho \mathbf{e}_{t-1} + \mathbf{e}_t$. This implies that $\mathbf{e}_t = \rho \mathbf{e}_{t-1} + \mathbf{e}_t$ for $t \leq n-1$ and $\mathbf{e}_t = \rho \mathbf{e}_{t-1} + \mathbf{e}_t$ for $t \geq n$. This implies that $\mathbf{e}_t = \rho \mathbf{e}_{t-1} + \mathbf{e}_t$ for $t \leq n-1$ and $\mathbf{e}_t = \rho \mathbf{e}_{t-1} + \mathbf{e}_t$ for $t \geq n$.

$$\mathbf{e}_t = \rho \mathbf{e}_{t-1} + \mathbf{e}_t / \rho^n \quad \forall t.$$

It follows that $\mathbf{e}_t = \rho \mathbf{e}_{t-1} + \mathbf{e}_t$ for $t \leq n-1$ and $\mathbf{e}_t = \rho \mathbf{e}_{t-1} + \mathbf{e}_t$ for $t \geq n$.

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$$\mathbf{e}_t \leq \rho \mathbf{e}_{t-1} \quad \forall t.$$

It follows that $\mathbf{e}_t = \rho \mathbf{e}_{t-1} + \mathbf{e}_t$ for $t \leq n-1$ and $\mathbf{e}_t = \rho \mathbf{e}_{t-1} + \mathbf{e}_t$ for $t \geq n$. This implies that $\mathbf{e}_t = \rho \mathbf{e}_{t-1} + \mathbf{e}_t$ for $t \leq n-1$ and $\mathbf{e}_t = \rho \mathbf{e}_{t-1} + \mathbf{e}_t$ for $t \geq n$. This implies that $\mathbf{e}_t = \rho \mathbf{e}_{t-1} + \mathbf{e}_t$ for $t \leq n-1$ and $\mathbf{e}_t = \rho \mathbf{e}_{t-1} + \mathbf{e}_t$ for $t \geq n$.

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$$\mathbf{e}_{t+1} \geq \rho \mathbf{e}_t \quad \forall t.$$

It follows that $\mathbf{e}_t = \rho \mathbf{e}_{t-1} + \mathbf{e}_t$ for $t \leq n-1$ and $\mathbf{e}_t = \rho \mathbf{e}_{t-1} + \mathbf{e}_t$ for $t \geq n$.

Definition: *n-period equilibrium credit cycle* is a sequence of $\mathbf{e}_0, \mathbf{e}_1, \dots, \mathbf{e}_{n-1}$ and $\mathbf{e}_n, \mathbf{e}_{n+1}, \dots$ such that $\mathbf{e}_t = \rho \mathbf{e}_{t-1} + \mathbf{e}_t$ for $t \leq n-1$ and $\mathbf{e}_t = \rho \mathbf{e}_{t-1} + \mathbf{e}_t$ for $t \geq n$.

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$1 \leq t \leq n$ $\theta_t = \theta_{t-1} + \alpha \epsilon_t$ $\epsilon_t = \rho \epsilon_{t-1} + \sigma_{t+1}$
 $0 \leq t \leq n-1$ $\theta_0 = \theta_{n-1}$ $\sigma_{t+1} \sim \mathcal{N}(0, \sigma^2)$

$$\Delta t = \epsilon_t - \epsilon_{t-1} \quad \forall t$$

The process θ_t is a random walk with drift. The parameter θ_t is updated at each time step t based on the current observation ϵ_t and the previous value θ_{t-1} . The noise term σ_{t+1} represents the uncertainty in the observations.

The initial condition $\theta_1 = \theta_{n-1}$ suggests a stationary or periodic process. The parameters ρ and σ are key to understanding the dynamics of the system.

$$\rho^{-s} \theta_s / \rho^s = \theta_s - \sigma^2 \sum_{i=1}^s \rho^{-2i}$$

This equation shows the relationship between the current state θ_s and its expected value given the noise structure. The term ρ^{-s} indicates exponential decay or growth depending on the value of ρ .

The process can be analyzed using state transition matrices. The state vector θ_t evolves according to a linear stochastic difference equation. The transition matrix A is ρ , and the process noise w_t is σ_{t+1} .

The state transition matrix A is ρ , and the process noise w_t is σ_{t+1} . The observation matrix H is 1 , and the observation noise v_t is ϵ_t .

$$\sum_{t \in \{0, \dots, n-1\}} (\sum_{s \in \{0, \dots, n-1\}} \rho^s) \rho^{-t} = \rho / \alpha$$

$$\rho^0 \geq \rho^{-t} \geq \rho^{-n}$$

The state transition matrix A is ρ , and the process noise w_t is σ_{t+1} . The observation matrix H is 1 , and the observation noise v_t is ϵ_t . The state vector θ_t is updated at each time step t based on the current observation ϵ_t and the previous value θ_{t-1} .

$$\begin{aligned}
 \sum_{t \in \{0, \dots, n-1\}} & \left(\sum_{s \in \{0, \dots, n-1\}} \rho^{s} \right) \tau - \rho / \alpha \leq \tau \\
 & \dots \tau \leq \dots \leq \tau \leq \dots \\
 \sum_{t \in \{0, \dots, n-1\}} & \left(\sum_{s \in \{0, \dots, n-1\}} \rho^{s} \right) \tau - \rho / \alpha \leq \tau \\
 \tau & \geq \dots \tau \geq \dots \geq
 \end{aligned}$$

... b ... e ... b ...
... b ... e ... b ... b ... b ...
... e ... e ... e ... e ... e ...
... b ... e ... e ... e ... b ...
... e ... b ... b ... e ... e ... e ...
... e ... e ... e ... e ... e ...
... b ... b ... e ... e ... e ...
... e ... e ... e ... e ... e ...
... b ... b ... e ... e ... e ...
... e ... e ... e ... e ... e ...
... b ... e ... e ... e ... e ...

1. $b_{11} = \epsilon_{11} = b_{11} = \dots = 1$ * $\rho / \alpha_p = \dots = 1$

2. $b_{12} = \rho / \alpha_p \cdot \epsilon_{12} = \dots$

3. $b_{13} = \epsilon_{13} = b_{13} = \dots = \epsilon_{13}$
4. $b_{14} = \epsilon_{14} = b_{14} = \dots = \epsilon_{14}$
5. $b_{15} = \epsilon_{15} = b_{15} = \dots = \epsilon_{15}$
6. $b_{16} = \epsilon_{16} = b_{16} = \dots = \epsilon_{16}$
7. $b_{17} = \epsilon_{17} = b_{17} = \dots = \epsilon_{17}$
8. $b_{18} = \epsilon_{18} = b_{18} = \dots = \epsilon_{18}$
9. $b_{19} = \epsilon_{19} = b_{19} = \dots = \epsilon_{19}$
10. $b_{10} = \epsilon_{10} = b_{10} = \dots = \epsilon_{10}$
11. $b_{11} = \epsilon_{11} = b_{11} = \dots = 1$
12. $b_{12} = \rho / \alpha_p \cdot \epsilon_{12} = \dots$

13. $b_{13} = \epsilon_{13} = b_{13} = \dots = \epsilon_{13}$

$$\rho / \alpha_p \cdot \epsilon_{12} = \dots$$

14. $b_{14} = \epsilon_{14} = b_{14} = \dots = \epsilon_{14}$

$$\alpha \psi - \rho / \alpha_p \cdot \epsilon_{12} = \dots$$

15. $b_{15} = \epsilon_{15} = b_{15} = \dots = \epsilon_{15}$

$$\pi \alpha^2 \cdot \epsilon_{12} = \dots$$

16. $b_{16} = \epsilon_{16} = b_{16} = \dots = \epsilon_{16}$

$$\alpha_t \cdot \epsilon_{12} = \dots$$

17. $b_{17} = \epsilon_{17} = b_{17} = \dots = \epsilon_{17}$

$$\rho / \alpha \alpha_t \cdot \epsilon_{12} = \dots$$

18. $b_{18} = \epsilon_{18} = b_{18} = \dots = \epsilon_{18}$

19. $b_{19} = \epsilon_{19} = b_{19} = \dots = \epsilon_{19}$

Theorem 1. Let $\mathbf{a}, \mathbf{b} \in \mathbb{R}^n$ and $\mathbf{c} \in \mathbb{R}^m$. Then $\mathbf{a} \cdot \mathbf{b} = \|\mathbf{a}\| \|\mathbf{b}\| \cos \theta$, where θ is the angle between \mathbf{a} and \mathbf{b} .

Proof. Let $\mathbf{a} = \|\mathbf{a}\| \mathbf{u}$ and $\mathbf{b} = \|\mathbf{b}\| \mathbf{v}$, where \mathbf{u} and \mathbf{v} are unit vectors. Then $\mathbf{a} \cdot \mathbf{b} = \|\mathbf{a}\| \|\mathbf{b}\| \mathbf{u} \cdot \mathbf{v}$. Since $\mathbf{u} \cdot \mathbf{v} = \cos \theta$, the result follows.

Corollary 1. If \mathbf{a} and \mathbf{b} are orthogonal, then $\mathbf{a} \cdot \mathbf{b} = 0$.

Corollary 2. If \mathbf{a} and \mathbf{b} are parallel, then $\mathbf{a} \cdot \mathbf{b} = \pm \|\mathbf{a}\| \|\mathbf{b}\|$.

Example 1. Let $\mathbf{a} = (1, 2, 3)$ and $\mathbf{b} = (4, 5, 6)$. Then $\mathbf{a} \cdot \mathbf{b} = 1 \cdot 4 + 2 \cdot 5 + 3 \cdot 6 = 4 + 10 + 18 = 32$.

Example 2. Let $\mathbf{a} = (1, 0, 0)$ and $\mathbf{b} = (0, 1, 0)$. Then $\mathbf{a} \cdot \mathbf{b} = 1 \cdot 0 + 0 \cdot 1 + 0 \cdot 0 = 0$, so \mathbf{a} and \mathbf{b} are orthogonal.

Example 3. Let $\mathbf{a} = (1, 0, 0)$ and $\mathbf{b} = (1, 0, 0)$. Then $\mathbf{a} \cdot \mathbf{b} = 1 \cdot 1 + 0 \cdot 0 + 0 \cdot 0 = 1$, so \mathbf{a} and \mathbf{b} are parallel.

$\rho_{t-s} = \rho_{t-s} \prod_{s=0}^{t-1} \frac{1}{\alpha} = \rho_{t-s} \alpha^{-s}$

$\sum_{t \in \{0, \dots, n-1\}} \rho_{t-s} = \sum_{s \in \{0, \dots, n-1\}} \rho_{t-s} \alpha^{-s} = \rho / \alpha^s \quad \forall 0 \leq s < n$

$\sum_{t \in \{1, \dots, n\}} \rho_{t-s} = \sum_{s \in \{0, \dots, n-1\}} \rho_{t-s} \alpha^{-s} = \rho / \alpha^s$

$\rho_{t-s} \geq \rho_{t-n} \alpha^{-s} = \rho_{t-n} \alpha^{-s}$

[Insert Figure 3 about here]

$\theta_1 = \theta_9$

$\rho_{t-s} = \rho_{t-s} \prod_{s=0}^{t-1} \frac{1}{\alpha} = \rho_{t-s} \alpha^{-s}$

$\sum_{t \in \{0, \dots, n-1\}} \rho_{t-s} = \sum_{s \in \{0, \dots, n-1\}} \rho_{t-s} \alpha^{-s} = \rho / \alpha^s \quad \forall 0 \leq s < n$

$\sum_{t \in \{1, \dots, n\}} \rho_{t-s} = \sum_{s \in \{0, \dots, n-1\}} \rho_{t-s} \alpha^{-s} = \rho / \alpha^s$

$\rho_{t-s} \geq \rho_{t-n} \alpha^{-s} = \rho_{t-n} \alpha^{-s}$

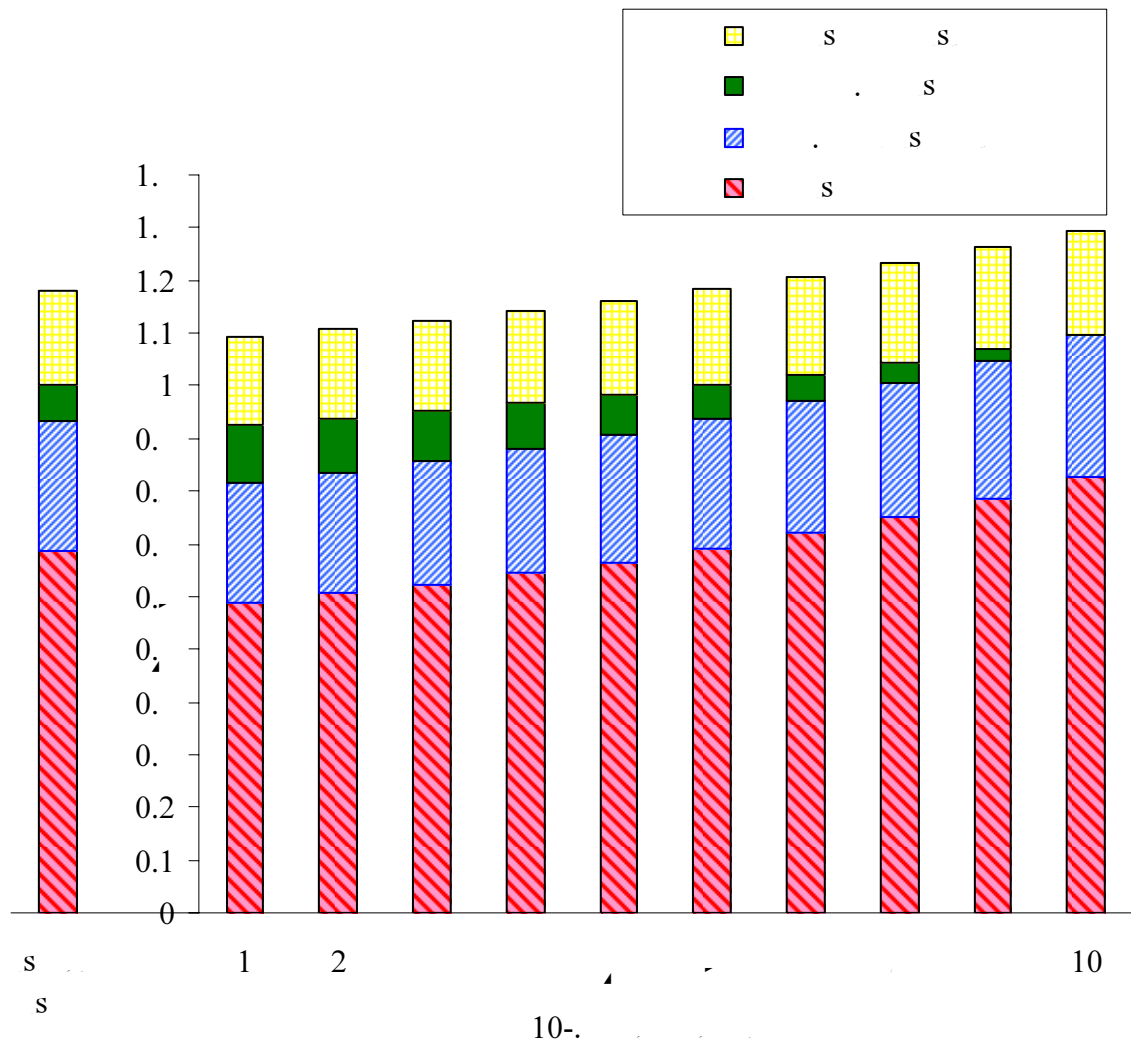
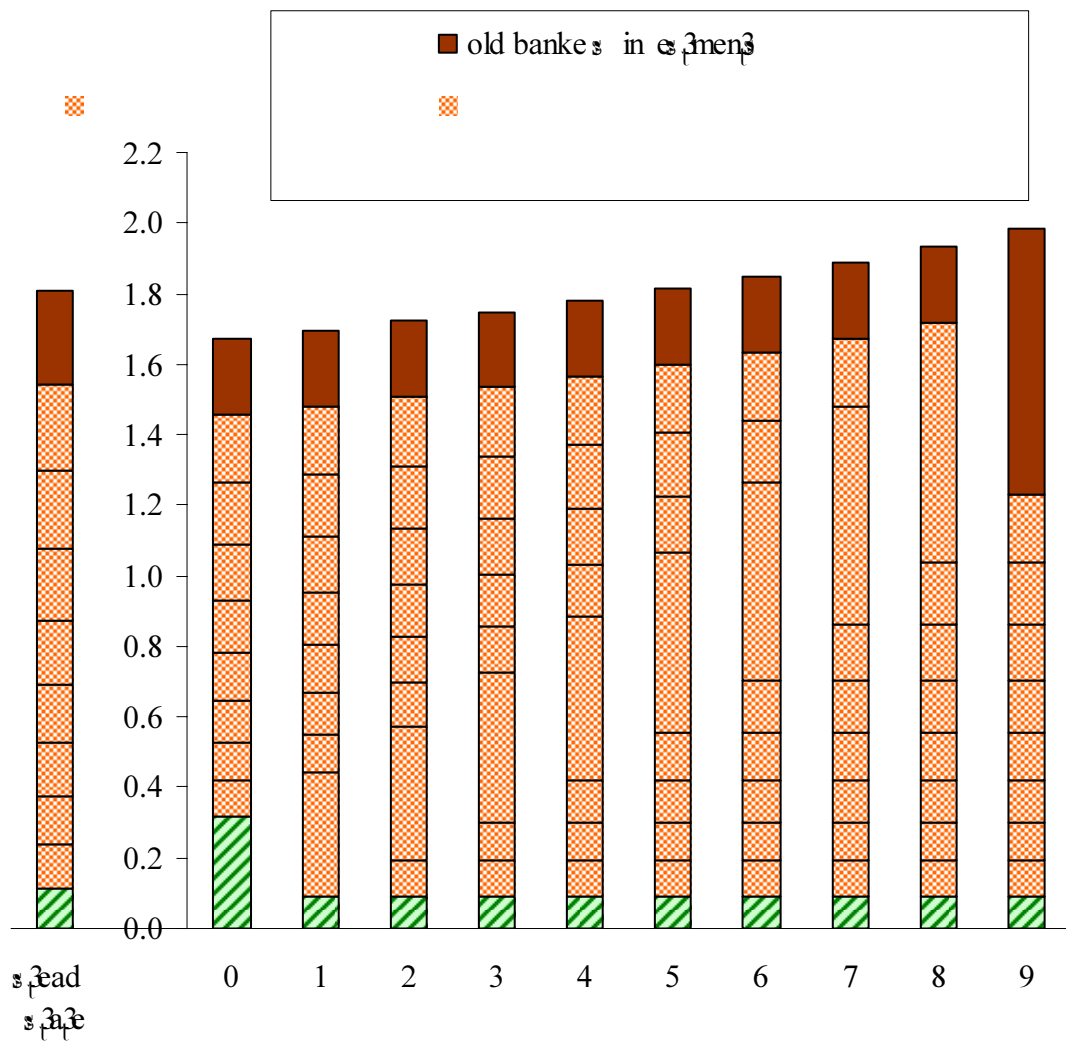
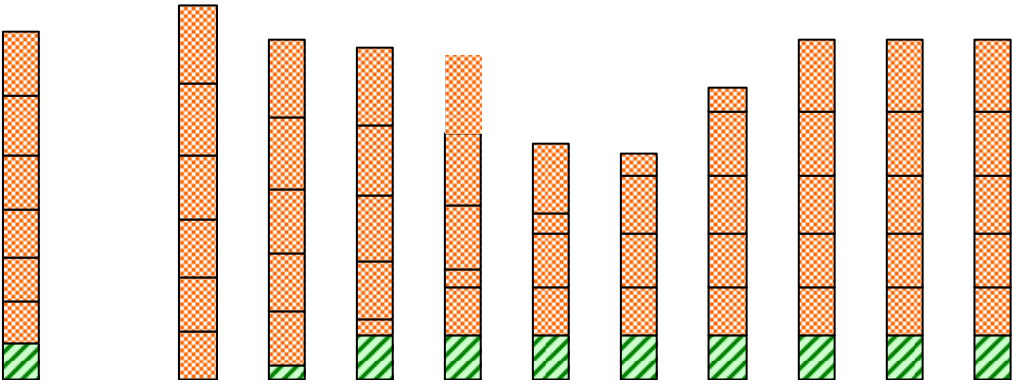


Figure 1. $\rho = \alpha - \beta$, $\gamma = \eta$, $\psi = \pi$





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