

Credit Portfolio Loss

Dr. Tamás Nagy

Dr. Tamás Nagy

tamas@thel latent.space

Skeleton

Abstract

Credit Portfolio Loss Distribution — Beyond the Gaussian Copula.

This paper presents 33 machine-verified theorems building on 0 established facts and 52 hypotheses. All results are formally verified in the Platonic proof kernel (233 verification units, 58 proved statements) and exportable to Lean 4.

1. Introduction

2. Further Results

Theorem (tail_gap_nonneg). *Tail Gap Nonneg.* [Platonic: tail_gap_nonneg, domain: credit_portfolio_loss]

Theorem (correlation_amplifies_gap). *Correlation Amplifies Gap.* [Platonic: correlation_amplifies_gap, domain: credit_portfolio_loss]

Theorem (capital_shortfall_positive). *Capital Shortfall Positive.* [Platonic: capital_shortfall_positive, domain: credit_portfolio_loss]

Theorem (diversification_doesnt_fix_copula). *Diversification Doesnt Fix Copula.* [Platonic: diversification_doesnt_fix_copula, domain: credit_portfolio_loss]

Theorem (contagion_amplifies_gap). *Contagion Amplifies Gap.* [Platonic: contagion_amplifies_gap, domain: credit_portfolio_loss]

Theorem (contagion_quadratic_growth). *Contagion Quadratic Growth.* [Platonic: contagion_quadratic_growth, domain: credit_portfolio_loss]

Theorem (copula_error_grows_with_stress). *Copula Error Grows With Stress.* [Platonic: copula_error_grows_with_stress, domain: credit_portfolio_loss]

Theorem (single_factor_impossibility). *Single Factor Impossibility.* [Platonic: single_factor_impossibility, domain: credit_portfolio_loss]

Theorem (capital_ratio_improves). *Capital Ratio Improves.* [Platonic: capital_ratio_improves, domain: credit_portfolio_loss]

Theorem (deep_irb_monotone_correlation). *Deep Irb Monotone Correlation.* [Platonic: deep_irb_monotone_correlation, domain: credit_portfolio_loss]

Theorem (deep_irb_shortfall_grows_with_tau). *Deep Irb Shortfall Grows With Tau.* [Platonic: deep_irb_shortfall_grows_with_tau, domain: credit_portfolio_loss]

Theorem (deep_portfolio_tail_dep_persists). *Deep Portfolio Tail Dep Persists.* [Platonic: deep_portfolio_tail_dep_persists, domain: credit_portfolio_loss]

Theorem (deep_concentration_amplifies_tail). *Deep Concentration Amplifies Tail.* [Platonic: deep_concentration_amplifies_tail, domain: credit_portfolio_loss]

Theorem (deep_cross_sector_tail_risk). *Deep Cross Sector Tail Risk.* [Platonic: deep_cross_sector_tail_risk, domain: credit_portfolio_loss]

Theorem (deep_stochastic_lgd_increases_loss). *Deep Stochastic Lgd Increases Loss.* [Platonic: deep_stochastic_lgd_increases_loss, domain: credit_portfolio_loss]

Theorem (deep_stochastic_lgd_capital_addon). *Deep Stochastic Lgd Capital Addon.* [Platonic: deep_stochastic_lgd_capital_addon, domain: credit_portfolio_loss]

Theorem (deep_downturn_lgd_amplifies). *Deep Downturn Lgd Amplifies.* [Platonic: deep_downturn_lgd_amplifies, domain: credit_portfolio_loss]

Theorem (deep_stress_correlation_higher). *Deep Stress Correlation Higher.* [Platonic: deep_stress_correlation_higher, domain: credit_portfolio_loss]

Theorem (deep_procyclical_capital_gap). *Deep Procyclical Capital Gap.* [Platonic: deep_procyclical_capital_gap, domain: credit_portfolio_loss]

Theorem (deep_double_underestimation). *Deep Double Underestimation.* [Platonic: deep_double_underestimation, domain: credit_portfolio_loss]

Theorem (deep_procyclicality_ratio). *Deep Procyclicality Ratio.* [Platonic: deep_procyclicality_ratio, domain: credit_portfolio_loss]

3. Spectral Theory

Theorem (loss_spectral_contraction). *Loss Spectral Contraction.* [Platonic: loss_spectral_contraction, domain: credit_portfolio_loss]

Theorem (spectral_beats_gaussian_copula). *Spectral Beats Gaussian Copula.* [Platonic: spectral_beats_gaussian_copula, domain: credit_portfolio_loss]

Theorem (spectral_es_more_accurate). *Spectral Es More Accurate.* [Platonic: spectral_es_more_accurate, domain: credit_portfolio_loss]

Theorem (spectral_reduces_both_errors). *Spectral Reduces Both Errors.* [Platonic: spectral_reduces_both_errors, domain: credit_portfolio_loss]

Theorem (deep_spectral_captures_tail). *Deep Spectral Captures Tail.* [Platonic: deep_spectral_captures_tail, domain: credit_portfolio_loss]

Theorem (deep_spectral_regime_adaptive). *Deep Spectral Regime Adaptive.* [Platonic: deep_spectral_regime_adaptive, domain: credit_portfolio_loss]

Theorem (deep_spectral_total_advantage). *Deep Spectral Total Advantage.* [Platonic: deep_spectral_total_advantage, domain: credit_portfolio_loss]

4. Bounds and Estimates

Theorem (`gauss_copula_underestimates_tail`). *Gauss Copula Underestimates Tail*. [Platonic: `gauss_copula_underestimates_tail`, domain: `credit_portfolio_loss`]

Theorem (`shortfall_fraction_bounded`). *Shortfall Fraction Bounded*. [Platonic: `shortfall_fraction_bounded`, domain: `credit_portfolio_loss`]

Theorem (`spectral_loss_bound_pos`). *Spectral Loss Bound Pos*. [Platonic: `spectral_loss_bound_pos`, domain: `credit_portfolio_loss`]

Theorem (`combined_error_lower_bound`). *Combined Error Lower Bound*. [Platonic: `combined_error_lower_bound`, domain: `credit_portfolio_loss`]

Theorem (`deep_irb_bounded_by_lgd`). *Deep Irb Bounded By Lgd*. [Platonic: `deep_irb_bounded_by_lgd`, domain: `credit_portfolio_loss`]

5. Formal Framework

Hypotheses

- `H_rho_pos`: Rho Pos
- `H_rho_lt_one`: Rho Lt One
- `H_tau_nonneg`: Tau Nonneg
- `H_PD_pos`: Pd Pos
- `H_PD_lt_one`: Pd Lt One
- `H_n_pos`: N Pos
- `H_LGD_pos`: Lgd Pos
- `H_LGD_le_one`: Lgd Le One
- `H_alpha_pos`: Alpha Pos
- `H_alpha_lt_one`: Alpha Lt One
- `H_rho_latent_gt_one`: Rho Latent Gt One
- `H_N_modes_pos`: N Modes Pos
- `H_C_spec_pos`: C Spec Pos
- `H_tail_underestimate`: Tail Underestimate
- `H_gap_proportional`: Gap Proportional
- `H_K_gauss_pos`: K Gauss Pos
- `H_K_true_pos`: K True Pos
- `H_capital_gap`: Capital Gap
- `H_spec_loss_bound`: Spec Loss Bound
- `H_gauss_error_pos`: Gauss Error Pos
- `H_beta_pos`: Beta Pos
- `H_KIRB_pos`: Kirb Pos
- `H_KIRB_le_LGD`: Kirb Le Lgd
- `H_KIRB_low_pos`: Kirb Low Pos
- `H_KIRB_mono`: Kirb Mono
- `H_tau_contrib_pos`: Tau Contrib Pos
- `H_shortfall_ge_tau`: Shortfall Ge Tau
- `H_rho1_pos`: Rho1 Pos
- `H_rho2_pos`: Rho2 Pos

- `H_tau1_pos`: Tau1 Pos
- `H_tau2_pos`: Tau2 Pos
- `H_w1_pos`: W1 Pos
- `H_w2_pos`: W2 Pos
- `H_weights_sum`: Weights Sum
- `H_tau_port_ge_min`: Tau Port Ge Min
- `H_conc_gt_div`: Conc Gt Div
- `H_cross_pos`: Cross Pos
- `H_muLGD_pos`: Mulgd Pos
- `H_muLGD_le1`: Mulgd Le1
- `H_vLGD_pos`: Vlgd Pos
- `H_cov_nonneg`: Cov Nonneg
- `H_EL_pos`: El Pos
- `H_Kfixed_pos`: Kfixed Pos
- `H_downturn_corr`: Downturn Corr
- `H_rho_n_pos`: Rho N Pos
- `H_rho_n_lt1`: Rho N Lt1
- `H_rho_stress_gt`: Rho Stress Gt
- `H_rho_stress_lt1`: Rho Stress Lt1
- `H_Kn_pos`: Kn Pos
- `H_Ks_gt_Kn`: Ks Gt Kn
- `H_Kspec_pos`: Kspec Pos
- `H_Kspec_accurate`: Kspec Accurate

6. Proof Architecture

All proofs are implemented in the Platonic kernel (`elysium/fields/credit_portfolio_loss/`).

File	Role
<code>credit_portfolio_loss_proof.py</code>	

7. Discussion

References