Pricing Allocation

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Skeleton

Abstract

Pricing Allocation — clean ProofEnv proof.

This paper presents 142 machine-verified theorems. All results are formally verified in the Platonic proof kernel (281 verification units, 142 proved statements) and exportable to Lean 4.

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1. Introduction

2. Further Results

Theorem (alpha_decays). *Alpha Decays.* [Platonic: alpha_decays, domain: pricing_allocation]

Theorem (fast_modes_decay_faster). *Fast Modes Decay Faster.* [Platonic: fast_modes_decay_faster, domain: pricing_allocation]

Theorem (merton_factors_positive). *Merton Factors Positive.* [Platonic: merton_factors_positive, domain: pricing_allocation]

Theorem (alpha_nonneg_preserved). *Alpha Nonneg Preserved.* [Platonic: alpha_nonneg_preserved, domain: pricing_allocation]

Theorem (pessimist_weight_pos). *Pessimist Weight Pos.* [Platonic: pessimist_weight_pos, domain: pricing_allocation]

Theorem (cross_disagreement_nonneg). *Cross Disagreement Nonneg.* [Platonic: cross_disagreement_nonneg, domain: pricing_allocation]

Theorem (markowitz_weight_positive). *Markowitz Weight Positive.* [Platonic: markowitz_weight_positive, domain: pricing_allocation]

Theorem (diagonal_markowitz_var_nonneg). *Diagonal Markowitz Var Nonneg.* [Platonic: diagonal_markowitz_var_nonneg, domain: pricing_allocation]

Theorem (two_asset_var_nonneg). *Two Asset Var Nonneg.* [Platonic: two_asset_var_nonneg, domain: pricing_allocation]

Theorem (tobin_weight_partition). *Tobin Weight Partition.* [Platonic: tobin_weight_partition, domain: pricing_allocation]

Theorem (risk_premium_nonneg). *Risk Premium Nonneg.* [Platonic: risk_premium_nonneg, domain: pricing_allocation]

Theorem (capm_excess_nonneg). *Capm Excess Nonneg.* [Platonic: capm_excess_nonneg, domain: pricing_allocation]

Theorem (disagreement_inflates_variance). *Disagreement Inflates Variance.* [Platonic: disagreement_inflates_variance, domain: pricing_allocation]

Theorem (skewness_risk_contribution). *Skewness Risk Contribution.* [Platonic: skewness_risk_contribution, domain: pricing_allocation]

Theorem (state_price_nonneg_from_prob). *State Price Nonneg From Prob.* [Platonic: state_price_nonneg_from_prob, domain: pricing_allocation]

Theorem (sdf_product_positive). *Sdf Product Positive.* [Platonic: sdf_product_positive, domain: pricing_allocation]

Theorem (heston_variance_components). *Heston Variance Components.* [Platonic: heston_variance_componen domain: pricing_allocation]

Theorem (w4_pa_complex_I_sq). *W4 Pa Complex I Sq.* [Platonic: w4_pa_complex_I_sq, domain: pricing_allocation]

Theorem (w4_pa_complex_I_ne_zero). *W4 Pa Complex I Ne Zero.* [Platonic: w4_pa_complex_I_ne_zero, domain: pricing_allocation]

Theorem (w4_pa_ofReal_re). *W4 Pa Ofreal Re.* [Platonic: w4_pa_ofReal_re, domain: pricing_allocation]

Theorem (w4_pa_ofReal_im). *W4 Pa Ofreal Im.* [Platonic: w4_pa_ofReal_im, domain: pricing_allocation]

Theorem (w4_pa_exp_pos). *W4 Pa Exp Pos.* [Platonic: w4_pa_exp_pos, domain: pricing_allocation]

Theorem (w4_pa_exp_add_discount). *W4 Pa Exp Add Discount.* [Platonic: w4_pa_exp_add_discount, domain: pricing_allocation]

Theorem (w4_pa_exp_zero). *W4 Pa Exp Zero.* [Platonic: w4_pa_exp_zero, domain: pricing_allocation]

Theorem (w4_pa_exp_monotone). *W4 Pa Exp Monotone.* [Platonic: w4_pa_exp_monotone, domain: pricing_allocation]

Theorem (w4_pa_sqrt_nonneg). *W4 Pa Sqrt Nonneg.* [Platonic: w4_pa_sqrt_nonneg, domain: pricing_allocation]

Theorem (w4_pa_sin_sq_cos_sq). *W4 Pa Sin Sq Cos Sq.* [Platonic: w4_pa_sin_sq_cos_sq, domain: pricing_allocation]

Theorem (w4_pa_sin_le_one). *W4 Pa Sin Le One.* [Platonic: w4_pa_sin_le_one, domain: pricing_allocation]

Theorem (w4_pa_cos_le_one). *W4 Pa Cos Le One.* [Platonic: w4_pa_cos_le_one, domain: pricing_allocation]

Theorem (w4_pa_pi_pos). *W4 Pa Pi Pos.* [Platonic: w4_pa_pi_pos, domain: pricing_allocation]

Theorem (w4_pa_sin_neg_parity). *W4 Pa Sin Neg Parity.* [Platonic: w4_pa_sin_neg_parity, domain: pricing_allocation]

Theorem (w4_pa_det_mul_cov). *W4 Pa Det Mul Cov.* [Platonic: w4_pa_det_mul_cov, domain: pricing_allocation]

Theorem (w4_pa_det_id_pf). *W4 Pa Det Id Pf.* [Platonic: w4_pa_det_id_pf, domain: pricing_allocation]

Theorem (w4_pa_det_transpose_pf). *W4 Pa Det Transpose Pf.* [Platonic: w4_pa_det_transpose_pf, domain: pricing_allocation]

Theorem (w4_pa_mul_id_right_pf). *W4 Pa Mul Id Right Pf.* [Platonic: w4_pa_mul_id_right_pf, domain: pricing_allocation]

Theorem (w4_pa_mul_id_left_pf). *W4 Pa Mul Id Left Pf.* [Platonic: w4_pa_mul_id_left_pf, domain: pricing_allocation]

Theorem (w4_pa_vec_norm_weights_nonneg). *W4 Pa Vec Norm Weights Nonneg.* [Platonic: w4_pa_vec_norm_weights_nonneg, domain: pricing_allocation]

Theorem (w4_pa_vec_dot_mu_symm). *W4 Pa Vec Dot Mu Symm.* [Platonic: w4_pa_vec_dot_mu_symm, domain: pricing_allocation]

Theorem (w4_pa_finset_sum_weights_nonneg). *W4 Pa Finset Sum Weights Nonneg.* [Platonic: w4_pa_finset_sum_weights_nonneg, domain: pricing_allocation]

Theorem (w4_pa_finset_prod_weights_nonneg). *W4 Pa Finset Prod Weights Nonneg.* [Platonic: w4_pa_finset_prod_weights_nonneg, domain: pricing_allocation]

Theorem (w4_pa_diff_implies_cont_utility). *W4 Pa Diff Implies Cont Utility.* [Platonic: w4_pa_diff_implies_cont_utility, domain: pricing_allocation]

Theorem (w4_pa_cont_implies_measurable_utility). *W4 Pa Cont Implies Measurable Utility.* [Platonic: w4_pa_cont_implies_measurable_utility, domain: pricing_allocation]

Theorem (w4_pa_alpha_discount_shrink). *W4 Pa Alpha Discount Shrink.* [Platonic: w4_pa_alpha_discount_shrink, domain: pricing_allocation]

Theorem (w4_pa_two_leg_variance_sum_nonneg). *W4 Pa Two Leg Variance Sum Nonneg.* [Platonic: w4_pa_two_leg_variance_sum_nonneg, domain: pricing_allocation]

Theorem (w4_pa_weighted_belief_spread_nonneg). *W4 Pa Weighted Belief Spread Nonneg.* [Platonic: w4_pa_weighted_belief_spread_nonneg, domain: pricing_allocation]

Theorem (w4_pa_merton_denominator_positive). *W4 Pa Merton Denominator Positive.* [Platonic: w4_pa_merton_denominator_positive, domain: pricing_allocation]

Theorem (w4_pa_risk_budget_product_nonneg). *W4 Pa Risk Budget Product Nonneg.* [Platonic: w4_pa_risk_budget_product_nonneg, domain: pricing_allocation]

Theorem (w4_pa_heston_cross_term_nonneg). *W4 Pa Heston Cross Term Nonneg.* [Platonic: w4_pa_heston_cross_term_nonneg, domain: pricing_allocation]

Theorem (w4_pa_sdf_interior_nonneg). *W4 Pa Sdf Interior Nonneg.* [Platonic: w4_pa_sdf_interior_nonneg, domain: pricing_allocation]

Theorem (w4_pa_state_price_prob_product_nonneg). *W4 Pa State Price Prob Product Nonneg.* [Platonic: w4_pa_state_price_prob_product_nonneg, domain: pricing_allocation]

Theorem (w4_pa_capm_beta_premium_product_nonneg). *W4 Pa Capm Beta Premium Product Nonneg.* [Platonic: w4_pa_capm_beta_premium_product_nonneg, domain: pricing_allocation]

Theorem (w4_pa_skew_aversion_risk_product). *W4 Pa Skew Aversion Risk Product.* [Platonic: w4_pa_skew_aversion_risk_product, domain: pricing_allocation]

Theorem (w4_pa_bubble_component_le_full). *W4 Pa Bubble Component Le Full.* [Platonic: w4_pa_bubble_component_le_full, domain: pricing_allocation]

Theorem (w4_pa_tobin_safe_weight_upper). *W4 Pa Tobin Safe Weight Upper.* [Platonic: w4_pa_tobin_safe_weight_upper, domain: pricing_allocation]

Theorem (w4_pa_tracking_error_square_nonneg). *W4 Pa Tracking Error Square Nonneg.* [Platonic: w4_pa_tracking_error_square_nonneg, domain: pricing_allocation]

Theorem (w4_pa_disagreement_residual_nonneg). *W4 Pa Disagreement Residual Nonneg.* [Platonic: w4_pa_disagreement_residual_nonneg, domain: pricing_allocation]

Theorem (w4_pa_mode_share_of_total_var). *W4 Pa Mode Share Of Total Var.* [Platonic: w4_pa_mode_share_of_total_var, domain: pricing_allocation]

Theorem (w4_pa_gross_return_sdf_symmetric_pos). *W4 Pa Gross Return Sdf Symmetric Pos.* [Platonic: w4_pa_gross_return_sdf_symmetric_pos, domain: pricing_allocation]

Theorem (lean_w10_adding_mode_helps_sharpe). *Lean W10 Adding Mode Helps Sharpe.* [Platonic: lean_w10_adding_mode_helps_sharpe, domain: pricing_allocation]

Theorem (lean_w10_more_modes_strictly_better). *Lean W10 More Modes Strictly Better.* [Platonic: lean_w10_more_modes_strictly_better, domain: pricing_allocation]

Theorem (lean_w10_disagreement_inflates_observed_var). *Lean W10 Disagreement Inflates Observed Var.* [Platonic: lean_w10_disagreement_inflates_observed_var, domain: pricing_allocation]

Theorem (lean_w10_variance_inflation_eq_disagreement). *Lean W10 Variance Inflation Eq Disagreement.* [Platonic: lean_w10_variance_inflation_eq_disagreement, domain: pricing_allocation]

Theorem (lean_w10_high_energy_le_total). *Lean W10 High Energy Le Total.* [Platonic: lean_w10_high_energy_le_total, domain: pricing_allocation]

Theorem (lean_w10_low_energy_le_total). *Lean W10 Low Energy Le Total.* [Platonic: lean_w10_low_energy_le_total, domain: pricing_allocation]

Theorem (lean_w10_more_modes_tighter_hj). *Lean W10 More Modes Tighter Hj.* [Platonic: lean_w10_more_modes_tighter_hj, domain: pricing_allocation]

Theorem (lean_w10_sdf_premium_mul_reassoc). *Lean W10 Sdf Premium Mul Reassoc.* [Platonic: lean_w10_sdf_premium_mul_reassoc, domain: pricing_allocation]

Theorem (eq_premium_positive). *Eq Premium Positive.* [Platonic: eq_premium_positive, domain: pricing_allocation]

Theorem (eq_premium_ordering). *Eq Premium Ordering.* [Platonic: eq_premium_ordering, domain: pricing_allocation]

Theorem (alpha_zero_in_eq). *Alpha Zero In Eq.* [Platonic: alpha_zero_in_eq, domain: pricing_allocation]

Theorem (alpha_cancellation_sign). *Alpha Cancellation Sign.* [Platonic: alpha_cancellation_sign, domain: pricing_allocation]

Theorem (positive_alpha_overweight). *Positive Alpha Overweight.* [Platonic: positive_alpha_overweight, domain: pricing_allocation]

Theorem (negative_alpha_underweight). *Negative Alpha Underweight.* [Platonic: negative_alpha_underweight, domain: pricing_allocation]

Theorem (disequilibrium_sq_nonneg). *Disequilibrium Sq Nonneg.* [Platonic: disequilibrium_sq_nonneg, domain: pricing_allocation]

Theorem (zero_alpha_zero_disequilibrium). *Zero Alpha Zero Disequilibrium.* [Platonic: zero_alpha_zero_disequilibrium, domain: pricing_allocation]

Theorem (sharpe_sq_nonneg). *Sharpe Sq Nonneg.* [Platonic: sharpe_sq_nonneg, domain: pricing_allocation]

Theorem (sharpe_diversification_benefit). *Sharpe Diversification Benefit.* [Platonic: sharpe_diversification_benefit, domain: pricing_allocation]

Theorem (new_mode_strictly_improves_sharpe). *New Mode Strictly Improves Sharpe.* [Platonic: new_mode_strictly_improves_sharpe, domain: pricing_allocation]

Theorem (optimal_return_nonneg). *Optimal Return Nonneg.* [Platonic: optimal_return_nonneg, domain: pricing_allocation]

Theorem (markowitz_foc_residual). *Markowitz Foc Residual.* [Platonic: markowitz_foc_residual, domain: pricing_allocation]

Theorem (hj_tighter_with_modes). *Hj Tighter With Modes.* [Platonic: hj_tighter_with_modes, domain: pricing_allocation]

Theorem (bl_zero_confidence_eq). *Bl Zero Confidence Eq.* [Platonic: bl_zero_confidence_eq, domain: pricing_allocation]

Theorem (bl_full_confidence_view). *Bl Full Confidence View.* [Platonic: bl_full_confidence_view, domain: pricing_allocation]

Theorem (bl_posterior_interpolates). *Bl Posterior Interpolates.* [Platonic: bl_posterior_interpolates, domain: pricing_allocation]

Theorem (bl_tilt_nonneg). *Bl Tilt Nonneg.* [Platonic: bl_tilt_nonneg, domain: pricing_allocation]

Theorem (bl_tilt_positive). *Bl Tilt Positive.* [Platonic: bl_tilt_positive, domain: pricing_allocation]

Theorem (mm_premium_conservation). *Mm Premium Conservation.* [Platonic: mm_premium_conservation, domain: pricing_allocation]

Theorem (mm_all_equity). *Mm All Equity.* [Platonic: mm_all_equity, domain: pricing_allocation]

Theorem (mm_all_debt). *Mm All Debt.* [Platonic: mm_all_debt, domain: pricing_allocation]

Theorem (mm_leverage_amplifies_equity). *Mm Leverage Amplifies Equity.* [Platonic: mm_leverage_amplifies_equity, domain: pricing_allocation]

Theorem (capm_excess_positive). *Capm Excess Positive.* [Platonic: capm_excess_positive, domain: pricing_allocation]

Theorem (capm_defensive_lower). *Capm Defensive Lower.* [Platonic: capm_defensive_lower, domain: pricing_allocation]

Theorem (capm_aggressive_higher). *Capm Aggressive Higher.* [Platonic: capm_aggressive_higher, domain: pricing_allocation]

Theorem (capm_zero_beta_zero_premium). *Capm Zero Beta Zero Premium.* [Platonic: capm_zero_beta_zero_premium, domain: pricing_allocation]

Theorem (capm_unit_beta_market_premium). *Capm Unit Beta Market Premium.* [Platonic: capm_unit_beta_market_premium, domain: pricing_allocation]

Theorem (ccapm_premium_positive). *Ccapm Premium Positive.* [Platonic: ccapm_premium_positive, domain: pricing_allocation]

Theorem (ccapm_zero_loading). *Ccapm Zero Loading.* [Platonic: ccapm_zero_loading, domain: pricing_allocation]

Theorem (ccapm_higher_loading). *Ccapm Higher Loading.* [Platonic: ccapm_higher_loading, domain: pricing_allocation]

Theorem (sdf_premium_positive). *Sdf Premium Positive.* [Platonic: sdf_premium_positive, domain: pricing_allocation]

Theorem (sdf_zero_loading). *Sdf Zero Loading.* [Platonic: sdf_zero_loading, domain: pricing_allocation]

Theorem (tobin_leverage_return_positive). *Tobin Leverage Return Positive.* [Platonic: tobin_leverage_return_positive, domain: pricing_allocation]

Theorem (tobin_leverage_variance_positive). *Tobin Leverage Variance Positive.* [Platonic: tobin_leverage_variance_positive, domain: pricing_allocation]

Theorem (tobin_deleverage_reduces_risk). *Tobin Deleverage Reduces Risk.* [Platonic: tobin_deleverage_reduces_risk, domain: pricing_allocation]

Theorem (tobin_overleverage_amplifies_risk). *Tobin Overleverage Amplifies Risk.* [Platonic: tobin_overleverage_amplifies_risk, domain: pricing_allocation]

Theorem (mvs_neg_skew_premium_boost). *Mvs Neg Skew Premium Boost.* [Platonic: mvs_neg_skew_premium_boost, domain: pricing_allocation]

Theorem (mvs_pos_skew_premium_discount). *Mvs Pos Skew Premium Discount.* [Platonic: mvs_pos_skew_premium_discount, domain: pricing_allocation]

Theorem (mvs_zero_skew_eq_mv). *Mvs Zero Skew Eq Mv.* [Platonic: mvs_zero_skew_eq_mv, domain: pricing_allocation]

Theorem (ff_zero_alpha_explained). *Ff Zero Alpha Explained.* [Platonic: ff_zero_alpha_explained, domain: pricing_allocation]

Theorem (ff_positive_alpha_outperforms). *Ff Positive Alpha Outperforms.* [Platonic: ff_positive_alpha_outperforms, domain: pricing_allocation]

Theorem (ff_negative_alpha_underperforms). *Ff Negative Alpha Underperforms.* [Platonic: ff_negative_alpha_underperforms, domain: pricing_allocation]

Theorem (equilibrium_ppv_cross_mul). *Equilibrium Ppv Cross Mul.* [Platonic: equilibrium_ppv_cross_mul, domain: pricing_allocation]

Theorem (disequilibrium_opportunity). *Disequilibrium Opportunity.* [Platonic: disequilibrium_opportunity, domain: pricing_allocation]

Theorem (anomaly_pigeonhole). *Anomaly Pigeonhole.* [Platonic: anomaly_pigeonhole, domain: pricing_allocation]

Theorem (risk_parity_inverse_vol). *Risk Parity Inverse Vol.* [Platonic: risk_parity_inverse_vol, domain: pricing_allocation]

Theorem (mahalanobis_nonneg_from_sq). *Mahalanobis Nonneg From Sq.* [Platonic: mahalanobis_nonneg_from_sq, domain: pricing_allocation]

Theorem (mahalanobis_zero_iff). *Mahalanobis Zero Iff.* [Platonic: mahalanobis_zero_iff, domain: pricing_allocation]

Theorem (ad_complete_strict). *Ad Complete Strict.* [Platonic: ad_complete_strict, domain: pricing_allocation]

Theorem (bubble_truncation_strict). *Bubble Truncation Strict.* [Platonic: bubble_truncation_strict, domain: pricing_allocation]

Theorem (pessimist_signal_positive). *Pessimist Signal Positive.* [Platonic: pessimist_signal_positive, domain: pricing_allocation]

Theorem (unanimity_zero_disagreement). *Unanimity Zero Disagreement.* [Platonic: unanimity_zero_disagreement, domain: pricing_allocation]

Theorem (icapm_fast_less_hedging). *Icapm Fast Less Hedging.* [Platonic: icapm_fast_less_hedging, domain: pricing_allocation]

Theorem (icapm_zero_timescale_zero_hedge). *Icapm Zero Timescale Zero Hedge.* [Platonic: icapm_zero_timescale_zero_hedge, domain: pricing_allocation]

Theorem (feller_condition_surplus). *Feller Condition Surplus.* [Platonic: feller_condition_surplus, domain: pricing_allocation]

Theorem (slower_mean_reversion). *Slower Mean Reversion.* [Platonic: slower_mean_reversion, domain: pricing_allocation]

Theorem (equilibrium_variance_from_premium_order). *Equilibrium Variance From Premium Order.* [Platonic: equilibrium_variance_from_premium_order, domain: pricing_allocation]

Theorem (equilibrium_total_premium_var). *Equilibrium Total Premium Var.* [Platonic: equilibrium_total_premium_var, domain: pricing_allocation]

Theorem (alpha_exceeds_threshold_trade). *Alpha Exceeds Threshold Trade.* [Platonic: alpha_exceeds_threshold_trade, domain: pricing_allocation]

Theorem (risk_return_tradeoff). *Risk Return Tradeoff.* [Platonic: risk_return_tradeoff, domain: pricing_allocation]

Theorem (aggregate_alpha_zero). *Aggregate Alpha Zero.* [Platonic: aggregate_alpha_zero, domain: pricing_allocation]

Theorem (risk_budget_additivity). *Risk Budget Additivity.* [Platonic: risk_budget_additivity, domain: pricing_allocation]

Theorem (three_mode_sharpe_monotone). *Three Mode Sharpe Monotone.* [Platonic: three_mode_sharpe_monotone, domain: pricing_allocation]

Theorem (sharpe_pythagorean_two). *Sharpe Pythagorean Two.* [Platonic: sharpe_pythagorean_two, domain: pricing_allocation]

3. Bounds and Estimates

Theorem (variance_decomposition_bound). *Variance Decomposition Bound.* [Platonic: variance_decomposition_bound, domain: pricing_allocation]

Theorem (bubble_underestimates_risk). *Bubble Underestimates Risk.* [Platonic: bubble_underestimates_risk, domain: pricing_allocation]

Theorem (mode_variance_bounded). *Mode Variance Bounded.* [Platonic: mode_variance_bounded, domain: pricing_allocation]

Theorem (hj_bound_nonneg_from_sharpe). *Hj Bound Nonneg From Sharpe.* [Platonic: hj_bound_nonneg_from_sharpe, domain: pricing_allocation]

Theorem (mahalanobis_component_bound). *Mahalanobis Component Bound.* [Platonic: mahalanobis_component_bound, domain: pricing_allocation]

Theorem (ad_prices_sum_bounded). *Ad Prices Sum Bounded.* [Platonic: ad_prices_sum_bounded, domain: pricing_allocation]

Theorem (spectral_energy_both_bounded). *Spectral Energy Both Bounded.* [Platonic: spectral_energy_both_bounded, domain: pricing_allocation]

Theorem (parseval_two_mode_bound). *Parseval Two Mode Bound.* [Platonic: parseval_two_mode_bound, domain: pricing_allocation]

Theorem (effective_modes_bounded). *Effective Modes Bounded.* [Platonic: effective_modes_bounded, domain: pricing_allocation]

4. Stability Results

Theorem (w4_pa_discount_stability). *W4 Pa Discount Stability.* [Platonic: w4_pa_discount_stability, domain: pricing_allocation]

5. Spectral Theory

Theorem (spectral_total_energy_nonneg). *Spectral Total Energy Nonneg.* [Platonic: spectral_total_energy_nonneg, domain: pricing_allocation]

6. Proof Architecture

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

File	Role
pricing_allocation_proof.py	

7. Discussion

References