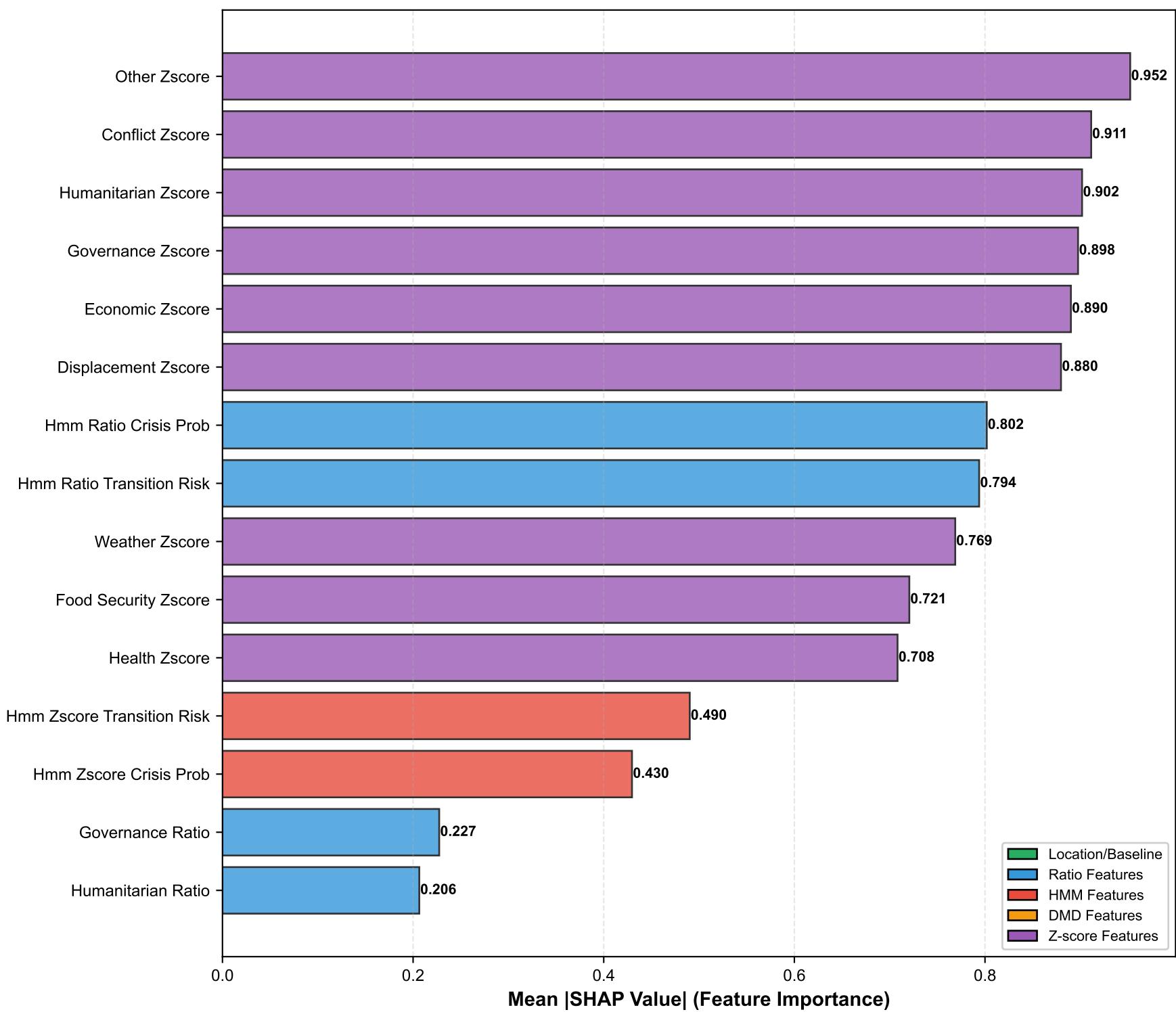
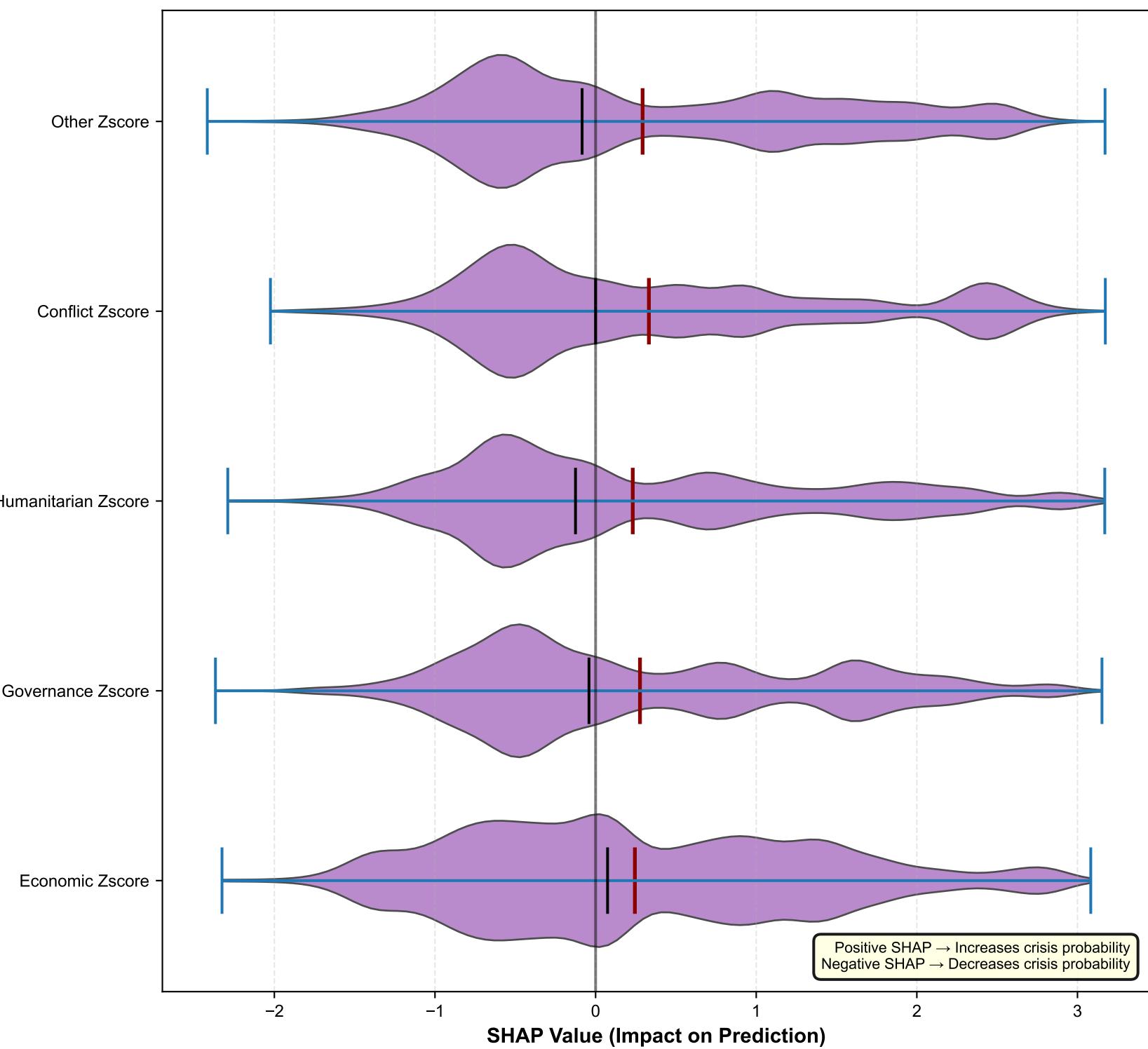


SHAP Feature Attribution: What Drives Cascade Predictions?

A) Global Feature Importance
Top 15 Features by Mean Absolute SHAP



B) SHAP Value Distribution
Top 5 Features Showing Impact Range



SHAP (SHapley Additive exPlanations) analysis showing feature importance and impact distribution for cascade XGBoost model. Panel A: Global importance ranked by mean absolute SHAP value across all 23,039 predictions. Top features dominated by location context (`country_data_density`, `country_baseline_conflict`) and compositional ratios (`other_ratio`, `health_ratio`), confirming ablation study findings that location + ratio features provide strongest signals. Panel B: SHAP value distributions for top 5 features show impact range—positive values increase crisis probability, negative values decrease. Violin width indicates frequency of SHAP values at each magnitude. Red line = mean, black line = median. `Country_data_density` shows wide distribution (high variance in impact), while `country_baseline_conflict` more concentrated (consistent impact direction). Validates feature engineering strategy: location context + news compositional ratios outperform raw counts or z-scores alone. 5-fold stratified spatial CV, h=8 months, XGBoost Advanced model (35 features).