Rent, Risk, and Recovery: Strategic Leasing Insights from Macroeconomic Models

Datafest 2025

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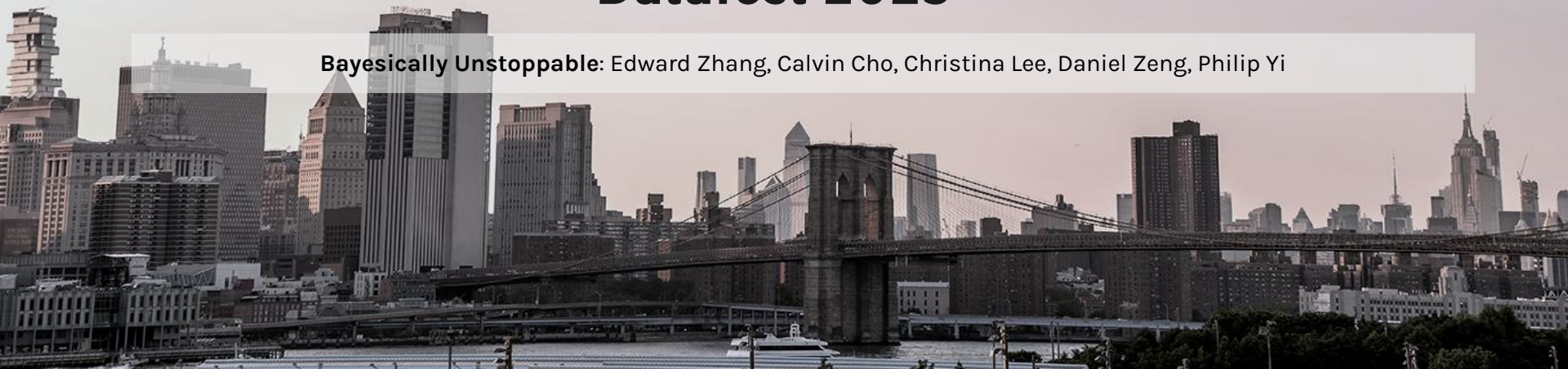
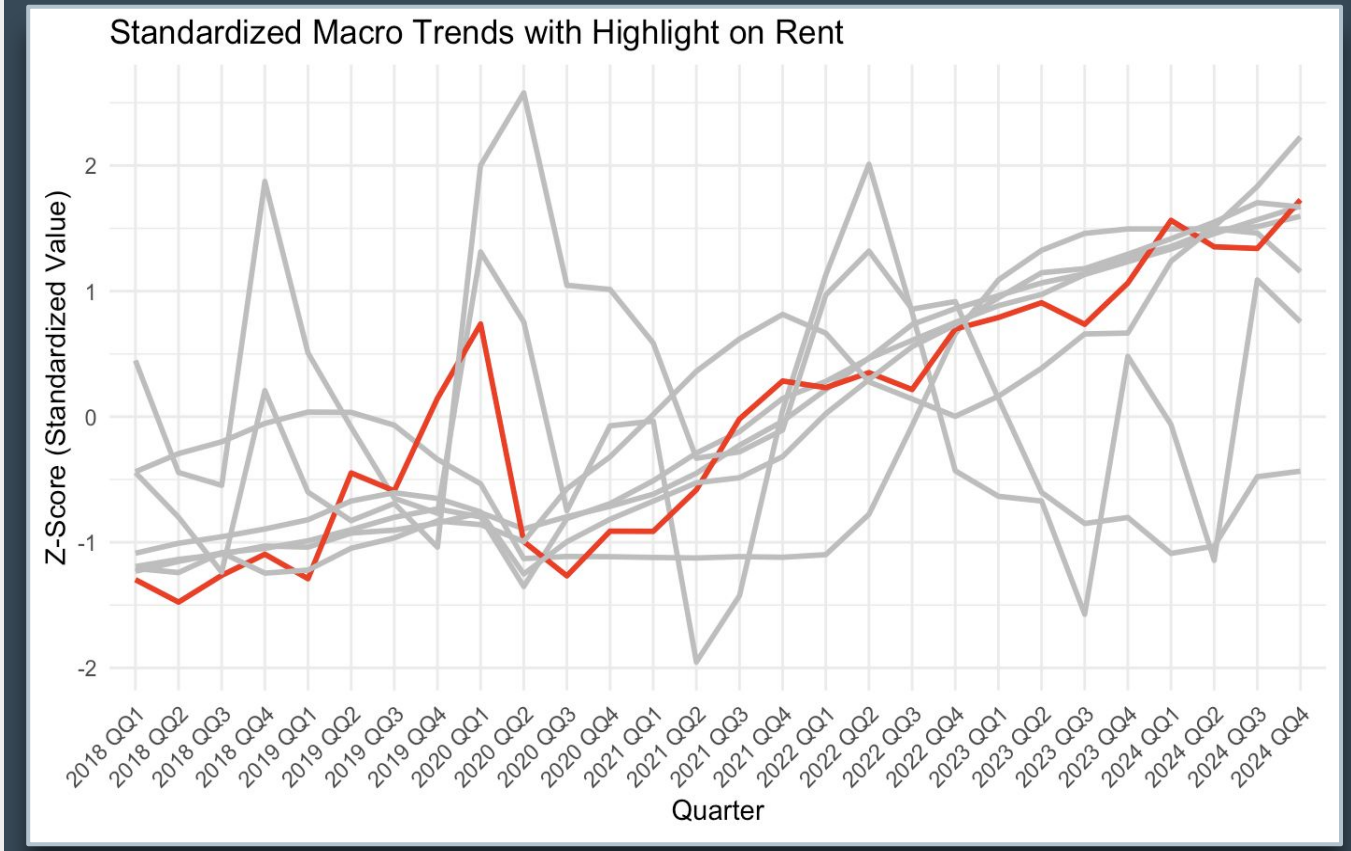


Predicting National Average Rent with Macro Factors



Avg National Rent (standardized)

Macro Data (GDP, S&P 500, CPI, Federal Funds, VIX, PNFI)

Panel Regression for City-Specific Sensitivities - Fixed-Effects Model (Common Slopes)

$$price_{i,t} = \alpha_i + \beta_1\, GDP\_pct\_change_t + \beta_2\, SP\_pctchange_t + \beta_3\, fed\_rate_t + \beta_4\, vix\_pctchange_t + \beta_5\, CPI\_pct\_change_t + \beta_6\, PNFI\_pct\_change_t + \varepsilon_{i,t}$$

OLS Regression Results

Dep. Variable:	price	R-squared:	0.973
Model:	OLS	Adj. R-squared:	0.971
Method:	Least Squares	F-statistic:	607.7
Date:	Sun, 06 Apr 2025	Prob (F-statistic):	2.59e-189
Time:	06:48:25	Log-Likelihood:	-670.03
No. Observations:	270	AIC:	1372.
Df Residuals:	254	BIC:	1430.
Df Model:	15		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
C(city)[Atlanta]	26.5549	0.801	33.161	0.000	24.978	28.132
C(city)[Austin]	39.0612	0.801	48.778	0.000	37.484	40.638
C(city)[Boston]	37.2109	0.801	46.468	0.000	35.634	38.788
C(city)[Manhattan]	74.5817	0.801	93.135	0.000	73.005	76.159
C(city)[Northern New Jersey]	26.6540	0.801	33.285	0.000	25.077	28.231
C(city)[Northern Virginia]	31.5887	0.801	39.447	0.000	30.012	33.166
C(city)[Philadelphia]	26.6458	0.801	33.274	0.000	25.069	28.223
C(city)[Salt Lake City]	22.3190	0.801	27.871	0.000	20.742	23.896
C(city)[San Francisco]	69.4495	0.801	86.726	0.000	67.873	71.027
C(city)[Seattle]	38.0139	0.801	47.471	0.000	36.437	39.591
GDP_pct_change	-0.0278	0.133	-0.209	0.834	-0.289	0.233
SP_pctchange	0.0920	0.042	2.205	0.028	0.010	0.174
fed_rate	0.6175	0.098	6.280	0.000	0.424	0.811
vix_pctchange	0.0084	0.005	1.654	0.099	-0.002	0.018
CPI_pct_change	1.9914	0.432	4.608	0.000	1.140	2.842
PNFI_pct_change	-0.2668	0.184	-1.451	0.148	-0.629	0.095

Omnibus:	11.882	Durbin-Watson:	0.366
Prob(Omnibus):	0.003	Jarque-Bera (JB):	23.420
Skew:	0.163	Prob(JB):	8.21e-06
Kurtosis:	4.405	Cond. No.	749.

- City fixed effects α capture large rent level differences (e.g., Manhattan ≈ $75/SF vs. Phoenix ≈ $25/SF)
- Common slope estimates:
  - **Positive** for GDP and S&P 500 (though not all are statistically significant)
  - **Negative** for VIX
  - **Slightly negative** for the federal funds rate (suggesting higher rates may suppress rents)
- The model's R^2 is **relevant** → macro variables explain some rent variation
- **City-specific dynamics are crucial**

Bayesian Hierarchical Model (Partial Pooling)

Let θ represent all unknown parameters:

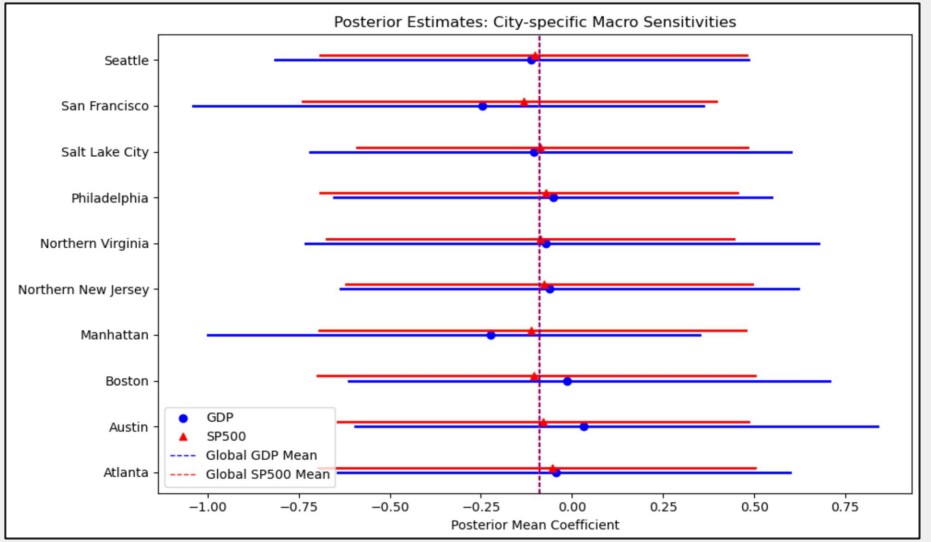
$$\theta = \{\alpha_j, \beta_j^{GDP}, \beta_j^{SP}, \mu_\alpha, \mu_{\beta,GDP}, \mu_{\beta,SP}, \tau_\alpha, \tau_{\beta,GDP}, \tau_{\beta,SP}, \sigma\}$$

Given the data $D = \{y_i, x_i\}$, the posterior is:

$$p(\theta \mid D) \propto \underbrace{\prod_{i=1}^{N} \mathcal{N}\left(y_i \mid \alpha_{j[i]} + \beta_{j[i]}^{GDP} x_i^{GDP} + \beta_{j[i]}^{SP} x_i^{SP}, \sigma^2\right)}_{\text{Likelihood}} \times$$

$$\underbrace{\prod_{j=1}^{J} \mathcal{N}(\alpha_j \mid \mu_\alpha, \tau_\alpha^2) \cdot \mathcal{N}(\beta_j^{GDP} \mid \mu_{\beta,GDP}, \tau_{\beta,GDP}^2) \cdot \mathcal{N}(\beta_j^{SP} \mid \mu_{\beta,SP}, \tau_{\beta,SP}^2)}_{\text{City-level priors}} \times$$

$$\underbrace{\mathcal{N}(\mu_\alpha \mid 0, 10^2) \cdot \mathcal{N}(\mu_{\beta,GDP} \mid 0, 5^2) \cdot \mathcal{N}(\mu_{\beta,SP} \mid 0, 5^2)}_{\text{Hyperpriors on means}} \cdot \underbrace{\text{HalfNormal}(\tau_\alpha \mid 5) \cdot \text{HalfNormal}(\tau_{\beta,GDP} \mid 2) \cdot \text{HalfNormal}(\tau_{\beta,SP} \mid 2)}_{\text{Hyperpriors on std devs}} \cdot \underbrace{\text{HalfNormal}(\sigma \mid 1)}_{\text{Likelihood noise prior}}$$



- **Modeling Insight – Shrinkage:**
  - Extreme values (ex: **Manhattan's GDP effect**) are pulled toward the average
  - **Partial pooling** reduces overconfidence and better reflects uncertainty
- **Macroeconomic Impacts:**
  - **GDP** has a weak but positive effect on rents
  - **Stock market** gains have a positive influence

- **City-Specific Dynamics:**
  - **San Francisco and Manhattan:** Rent trends are less tied to GDP (possibly inverse)
  - **Phoenix, Atlanta, Houston:** More responsive to economic growth
  - **Stock market effects** are broadly positive and more consistent across cities