# Internet Appendix
# "Industrial Concentration, Property Values, and Municipal Bond Spreads"
**Kenneth R. Ahern**

## Appendix A. Cross-Sector Employment Growth Correlations

This appendix reports summary statistics for the distribution of pairwise cross-sector correlations in annual national employment growth across the 20 NAICS supersectors, discussed in Section III.C. The sample covers the LODES panel from 2003 to 2022. The left column reports statistics for the unconditional (raw) correlations; the right column reports the same statistics after residualizing each sector's growth rate on year fixed effects (the cross-section demean within each year). The average off-diagonal correlation in the raw data is 0.261, reflecting the shared influence of aggregate business-cycle shocks on sector employment growth. After projecting out year fixed effects, the average residual correlation collapses to −0.007, essentially zero. This pattern establishes that the common time factor captures nearly all of the cross-sector co-movement in the data and supports the portfolio-variance result underlying the use of HHI as a scaling factor for idiosyncratic revenue volatility.

Table IA.1
Cross-Sector Employment Growth Correlations

| | Unconditional | After year FE |
|---|---|---|
| Mean off-diagonal correlation | 0.261 | −0.007 |
| Median off-diagonal correlation | 0.273 | −0.029 |
| Standard deviation of off-diagonal | 0.318 | 0.355 |
| Fraction positive | 0.763 | 0.458 |
| Fraction exceeding 0.5 | 0.258 | 0.100 |
| Number of sectors | 20 | |
| Number of off-diagonal pairs | 190 | |
| Sample period | 2003–2022 | |

*Notes:* Each entry summarizes the distribution of 190 pairwise correlations of annual employment growth rates across the 20 NAICS 2-digit supersectors. Employment data are from the LODES Workplace Area Characteristics (WAC) files aggregated to the national level, 2003–2022. "After year FE" residualizes each sector's growth rate on year fixed effects before computing correlations.

## Appendix B. Fiscal Primitives by Property Value Tercile

This appendix documents the empirical stability of the leverage ratio and the intergovernmental revenue share across property-value terciles, supporting the decision in Section VII.B to treat $d_c$ and the fiscal structure as exogenous inputs to the quantitative model. Table IA.2 reports mean values within each tercile of the annual ACS median home value distribution. Leverage ranges between 1.01 and 1.24 across terciles—a modest dispersion that is absorbed in the model by a single leverage parameter—and the intergovernmental revenue share varies by less than six percent around a mean of 0.178. Figure IA.1 plots the same two quantities. The stability of these fiscal primitives contrasts with the substantial variation in bond spreads across terciles documented in Section IV, where the HHI–spread gradient differs by an order of magnitude between the lowest and highest property-value cities. Ahern (2024) independently documents that the non-debt expenditure-to-revenue ratio in the Census of Governments is approximately 0.94 and is stable across property-value terciles, a stability that the model section treats as a fixed fiscal primitive.

Table IA.2
Fiscal Primitives by Property Value Tercile

| | Low PV | Mid PV | High PV | All |
|---|---|---|---|---|
| Leverage (debt / revenue) | 1.154 | 1.243 | 1.009 | 1.146 |
| Intergovernmental revenue share | 0.181 | 0.180 | 0.171 | 0.178 |

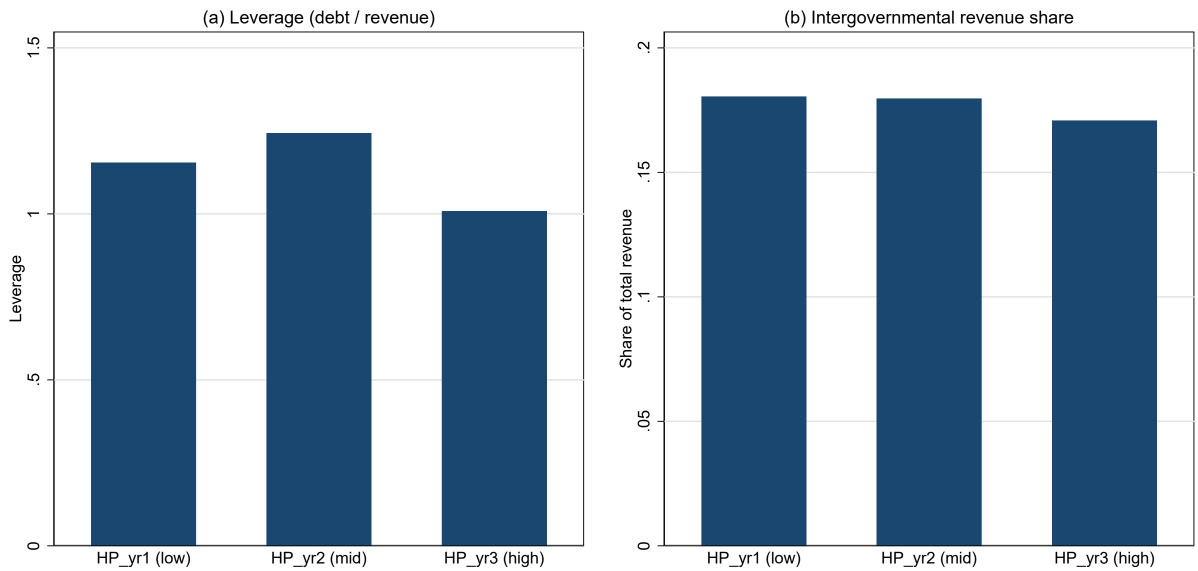
## Appendix C. Robustness: Additional Liquidity Controls

A potential concern is that employment concentration proxies for secondary-market illiquidity rather than credit risk: concentrated cities tend to be smaller, with fewer outstanding bonds and thinner trading, which could inflate spreads through a liquidity premium rather than a default premium. The baseline specifications control for log number of trades and log par value traded, but these are coarse measures of market liquidity.

To address this concern more rigorously, I construct four additional liquidity measures from the trade-level MSRB data:

(1) *Bid-ask proxy* (Harris and Piwowar, 2006): for each bond on each trading day where both dealer-to-customer sales and dealer purchases from customers occur, I compute the mean yield differential. The city-year measure is the median across all qualifying bond-days.

Figure IA.1
Fiscal Primitives by Property Value Tercile




(2) *Yield dispersion* (Jankowitsch, Nashikkar, and Subrahmanyam, 2011): the standard deviation of yields across all trades of the same bond within a year, averaged across bonds within each city-year. Higher dispersion indicates greater price uncertainty and information asymmetry.

(3) *Zero-trading-day fraction* (Chen, Lesmond, and Wei, 2007): for each bond, the fraction of trading days in a year with no recorded trades, averaged across bonds within each city-year. Higher values indicate more infrequent trading.

(4) *Turnover ratio*: total par value traded divided by total par amount outstanding (from EMMA security characteristics), aggregated to the city-year level. Higher turnover indicates more active secondary markets.

Table IA.3 reports the results in two panels. Panel A reproduces the baseline specification (corresponding to Column 1 of Table III) and sequentially adds each liquidity measure. Panel B reproduces the property value interaction specification (corresponding to Column 2 of Table III) and adds the same liquidity controls. In each panel, Columns (2)–(5) add one liquidity measure at a time and Column (6) includes all four simultaneously.

The HHI coefficient is remarkably stable across all specifications in both panels. In Panel A, the unconditional HHI coefficient is essentially unchanged when liquidity controls are added: it ranges from 54.8 to 57.9 basis points across the six columns, with the kitchen-sink specification (column 6) at 57.9 and the baseline (column 1) at 55.0. Panel B confirms that the property value interaction pattern is equally robust: the cross-tercile wedge between low- and high-property-value cities (HHI × Low PV) is stable at approximately 118 to 123 basis points across all six columns, and the high-property-value HHI gradient (the base HHI coefficient) is consistently small and statistically zero. The concentration premium remains concentrated in low-property-value cities regardless of which liquidity controls are included.

Among the liquidity measures, yield dispersion and the bid-ask proxy are the strongest predictors of spreads, and the within-$R^2$ rises modestly when all four liquidity controls are included. Crucially, this additional explanatory power does not come at the expense of the HHI coefficient: the concentration–spread relationship is not a liquidity artifact.

Table IA.3
Liquidity Robustness: HHI Coefficient with Additional Liquidity Controls

| | (1) Baseline | (2) +Bid-ask | (3) +Yield disp | (4) +Zero-trade | (5) +Turnover | (6) All liq |
|---|---|---|---|---|---|---|
| *Panel A: Baseline* | | | | | | |
| Industrial Concentration | 55.0* | 55.3* | 55.4* | 57.1* | 54.8* | 57.9* |
| | ( 32.4) | ( 32.4) | ( 32.3) | ( 32.4) | ( 32.3) | ( 32.0) |
| Observations | 16,318 | 16,318 | 16,318 | 16,318 | 16,318 | 16,318 |
| Within $R^2$ | 0.083 | 0.084 | 0.083 | 0.086 | 0.083 | 0.087 |
| *Panel B: Property Value Interaction (high tercile omitted)* | | | | | | |
| Industrial Concentration (High PV) | -11.7 | -10.8 | -11.9 | -11.3 | -11.8 | -10.2 |
| | ( 46.3) | ( 45.8) | ( 46.6) | ( 47.6) | ( 46.4) | ( 47.0) |
| Ind. Conc. × Low PV | 119.7* | 118.4* | 121.0* | 123.0* | 119.7* | 122.2* |
| | ( 71.2) | ( 70.7) | ( 71.1) | ( 73.8) | ( 71.2) | ( 72.4) |
| Ind. Conc. × Mid PV | 42.0 | 41.4 | 43.6 | 43.9 | 42.0 | 44.9 |
| | ( 51.5) | ( 51.1) | ( 51.4) | ( 52.8) | ( 51.6) | ( 51.8) |
| Observations | 16,318 | 16,318 | 16,318 | 16,318 | 16,318 | 16,318 |
| Within $R^2$ | 0.079 | 0.079 | 0.080 | 0.082 | 0.079 | 0.084 |

Notes: The dependent variable is the AAA-cities-benchmark municipal bond yield spread in basis points. All specifications include city and year fixed effects and the full v17 control set (macro, issued, traded). Standard errors (in parentheses) are two-way clustered by city and year. Panel A reports the baseline HHI coefficient. Panel B reports the HHI–tercile interactions with the high tercile as the omitted reference category, so the HHI base coefficient is the HHI gradient for high-property-value cities and the Low/Mid PV interactions report deviations from that benchmark. Columns (2)–(5) each add one liquidity measure; column (6) includes all four simultaneously. Sample is fixed across columns by requiring all four liquidity measures to be non-missing. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

## Appendix D. Cross-Sectional Evidence

Because employment concentration is primarily a cross-sectional characteristic, a natural first test examines whether the HHI–spread relationship holds in a pure between-city regression. I collapse the panel to a single cross-section by averaging all variables to city-level means over the sample period (2005–2022), then estimate OLS regressions of mean spreads on mean HHI with the same control variables used in the panel regressions: log median property value, general obligation bond share, callable share, average years to maturity, state income tax rate, unemployment rate, log trades, log population, and log par value traded. State fixed effects absorb time-invariant state-level tax and institutional differences. Standard errors are clustered by state (41 clusters).

Table IA.4 reports the results for 1,175 cities. Column (1) confirms that cities with higher average employment concentration have higher average bond spreads, even after controlling for observable city characteristics and state fixed effects. Columns (2)–(3) interact HHI with property value terciles formed from city-mean median property value; to avoid collinearity, log median property value is excluded from the controls in these specifications. The cross-sectional gradient is monotonically decreasing: the HHI coefficient for low-property-value cities is approximately 130 basis points with state fixed effects, declining to 83 for the middle tercile and 57 for high-property-value cities.

These cross-sectional results confirm that the between-city variation in HHI is associated with meaningful spread differences, particularly among fiscally vulnerable cities. The panel regressions in the main text add city fixed effects that exploit only within-city variation over time, providing a more demanding identification strategy that controls for all time-invariant city characteristics.

## Appendix E. Complete OLS Results

This appendix reports the full set of coefficients and standard errors for the OLS specifications discussed in connection with Table III. Each table reports the property-value tercile dummies, their interactions with HHI, and the full set of macro and bond-trait controls omitted from the main table for brevity. All specifications include city and year fixed effects and report two-way clustered standard errors by city and year. The four tables differ only in the dependent variable.

Table IA.5 reports the headline specification using the AAA-cities-benchmark spread as the dependent variable. Tables IA.6, IA.7, and IA.8 replicate the same three columns using,

Table IA.4
Cross-Sectional OLS: City-Mean Spreads on City-Mean HHI

| | (1) Baseline | (2) HP × HHI | (3) HP × HHI |
|---|---|---|---|
| HHI | 79.7** | | |
| | (38.6) | | |
| HHI × Low Property Value | | 160.4*** | 130.0*** |
| | | (39.2) | (47.6) |
| HHI × Medium Property Value | | 102.9*** | 83.2** |
| | | (39.5) | (39.0) |
| HHI × High Property Value | | 73.3* | 57.1* |
| | | (38.4) | (28.3) |
| Log median home value | -11.2*** | | |
| | (2.0) | | |
| GO bond share | -16.2*** | -7.1 | -16.4*** |
| | (5.5) | (13.5) | (5.9) |
| Callable share | 65.4*** | 68.1*** | 66.0*** |
| | (10.8) | (11.2) | (11.7) |
| Avg years to maturity | -2.7*** | -3.0*** | -2.6*** |
| | (0.7) | (0.9) | (0.7) |
| State income tax rate | -8.5*** | 0.2 | -8.0*** |
| | (1.8) | (0.2) | (2.0) |
| Unemployment rate | 2.8*** | 4.4*** | 3.7*** |
| | (0.5) | (0.9) | (0.8) |
| Log trades | 4.3 | 4.7 | 4.2 |
| | (3.9) | (3.4) | (3.8) |
| Log population | 3.4** | 4.9*** | 4.0** |
| | (1.4) | (1.8) | (1.5) |
| Log par value | -8.2*** | -9.4*** | -8.4*** |
| | (3.0) | (3.3) | (3.0) |
| GO bond share (outstanding) | 4.5 | 2.2 | 3.1 |
| | (6.0) | (14.1) | (5.8) |
| Callable share (outstanding) | -22.9* | -20.1* | -23.8* |
| | (12.1) | (10.5) | (13.1) |
| Avg YTM (outstanding) | 2.6*** | 2.9*** | 2.6*** |
| | (0.6) | (0.9) | (0.6) |
| State FE | Yes | No | Yes |
| SE clustering | State | Robust | State |
| Cities | 1,175 | 1,177 | 1,175 |
| $R^2$ | 0.497 | 0.401 | 0.491 |

Notes: Dependent variable: city-mean AAA-cities-benchmark municipal bond yield spread (bps). Each observation is a city, with variables averaged over all panel years (2005–2022). Columns (2)–(3) interact HHI with property value terciles formed from city-mean median home value; log median home value is excluded from controls in those columns to avoid collinearity. The three HHI–tercile interaction coefficients are the per-tercile gradients themselves (with no omitted base), providing the same information as the HP3-base parameterization in Table III in a form that shows each tercile's gradient as a separate coefficient. State fixed effects absorb state-level tax and institutional differences. Standard errors clustered by state in columns with state FE; heteroskedasticity-robust otherwise. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

respectively, the raw par-weighted yield, the AAA spread restricted to actively traded city-years (at least ten trades), and the AAA spread under a loosened maturity filter (years to maturity in $[2, 25]$).

Table IA.5
OLS Estimates on Bond Spreads: Complete Results

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| HHI | 13.45 | | −80.83* | −45.41 | −39.25 |
| | (29.00) | | (41.11) | (37.51) | (37.41) |
| ln(Property value) | | −23.92*** | | | |
| | | (6.44) | | | |
| Low Property Value | | | −18.01 | −12.75 | −10.88 |
| | | | (10.40) | (8.48) | (8.51) |
| Mid Property Value | | | −3.68 | −1.67 | −0.68 |
| | | | (7.06) | (5.81) | (5.76) |
| Low Property Value × HHI | | | 189.44*** | 144.85** | 126.10** |
| | | | (58.20) | (56.56) | (57.35) |
| Mid Property Value × HHI | | | 79.99* | 56.44 | 42.81 |
| | | | (44.89) | (40.64) | (39.83) |
| State income tax rate | | | | −5.10*** | −4.67** |
| | | | | (1.69) | (1.67) |
| Unemployment rate | | | | 5.86*** | 5.84*** |
| | | | | (1.29) | (1.24) |
| ln(Population) | | | | −20.75** | −21.48*** |
| | | | | (7.85) | (7.37) |
| GO bond share (outstanding) | | | | | 16.21*** |
| | | | | | (4.63) |
| Callable share (outstanding) | | | | | 17.94** |
| | | | | | (6.53) |
| Avg. years to maturity (outstanding) | | | | | −0.01 |
| | | | | | (0.36) |
| GO bond share (traded) | | | | | −23.75*** |
| | | | | | (3.25) |
| Callable share (traded) | | | | | 28.25*** |
| | | | | | (5.85) |
| Avg. years to maturity (traded) | | | | | −0.23 |
| | | | | | (0.39) |

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Table IA.5
OLS Estimates on Bond Spreads: Complete Results (continued)

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| ln(Number of trades) | | | | | 0.24 |
| | | | | | (1.90) |
| ln(Par value traded) | | | | | −3.36** |
| | | | | | (1.31) |
| City, Year FE | Yes | Yes | Yes | Yes | Yes |
| Cluster (city, year) | Yes | Yes | Yes | Yes | Yes |
| Observations | 18,745 | 21,701 | 18,741 | 18,427 | 18,427 |
| Adjusted $R^2$ | 0.365 | 0.369 | 0.366 | 0.386 | 0.415 |

Notes: The dependent variable is the AAA-cities-benchmark municipal bond yield spread (each trade's yield minus the par-weighted yield of AAA-rated cities' GO trades in the same year and maturity bucket, then par-weighted to the city-year level), in basis points. HHI is the Herfindahl index of city-level employment shares across 20 industry sectors. Property-value terciles are formed within each year from ACS median home value; the high tercile is the omitted reference category, so the HHI base coefficient in Columns (3)–(5) is the HHI gradient for high-property-value cities, and the "Low × HHI" and "Mid × HHI" rows report how the gradient differs in lower terciles relative to high. All specifications include city and year fixed effects. Standard errors in parentheses, two-way clustered by city and year. Column (1) reports the unconditional HHI coefficient with no other regressors. Column (2) reports the unconditional log median property value coefficient. Column (3) reports HHI, the property-value tercile dummies, and their interactions with HHI. Column (4) adds macro controls (state income tax rate, unemployment rate, log population). Column (5) adds issuance characteristics (GO share, callable share, average years to maturity of outstanding bonds) and trade characteristics (GO share, callable share, average YTM, log number of trades, log par value traded) for each city-year. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table IA.6
OLS Estimates on Raw Bond Yields: Complete Results

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| HHI | 88.97** | | 11.24 | 58.52 | −2.42 |
| | (36.48) | | (64.64) | (52.99) | (40.67) |
| ln(Property value) | | −36.68 | | | |
| | | (0.00) | | | |
| Low Property Value | | | −12.22 | −5.53 | −4.46 |
| | | | (13.00) | (10.51) | (9.78) |
| Mid Property Value | | | 1.08 | 4.20 | 7.57 |
| | | | (9.74) | (8.26) | (6.55) |
| Low Property Value × HHI | | | 173.58** | 113.50 | 128.29* |
| | | | (76.71) | (66.97) | (65.83) |
| Mid Property Value × HHI | | | 48.04 | 15.49 | 14.51 |
| | | | (65.73) | (57.59) | (41.83) |
| State income tax rate | | | | −6.82*** | −4.25* |
| | | | | (2.34) | (2.36) |
| Unemployment rate | | | | 7.61*** | 7.51*** |
| | | | | (1.71) | (1.72) |
| ln(Population) | | | | −23.93** | −22.89** |
| | | | | (10.23) | (9.16) |
| GO bond share (outstanding) | | | | | 12.92** |
| | | | | | (5.44) |
| Callable share (outstanding) | | | | | 9.72 |
| | | | | | (7.19) |
| Avg. years to maturity (outstanding) | | | | | −0.71 |
| | | | | | (0.47) |
| GO bond share (traded) | | | | | −19.60*** |
| | | | | | (3.20) |
| Callable share (traded) | | | | | 27.76*** |
| | | | | | (4.65) |
| Avg. years to maturity (traded) | | | | | 8.48*** |
| | | | | | (0.84) |

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Table IA.6
OLS Estimates on Raw Bond Yields: Complete Results (continued)

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| ln(Number of trades) | | | | | 9.84*** |
| | | | | | (2.50) |
| ln(Par value traded) | | | | | −8.75*** |
| | | | | | (1.82) |
| City, Year FE | Yes | Yes | Yes | Yes | Yes |
| Cluster (city, year) | Yes | Yes | Yes | Yes | Yes |
| Observations | 18,778 | 21,746 | 18,774 | 18,460 | 18,460 |
| Adjusted $R^2$ | 0.737 | 0.743 | 0.737 | 0.744 | 0.833 |

Notes: The dependent variable is the par-weighted municipal bond yield (raw, not benchmarked) at the city-year level, in basis points. HHI is the Herfindahl index of city-level employment shares across 20 industry sectors. Property-value terciles are formed within each year from ACS median home value; the high tercile is the omitted reference category, so the HHI base coefficient in Columns (3)–(5) is the HHI gradient for high-property-value cities, and the "Low × HHI" and "Mid × HHI" rows report how the gradient differs in lower terciles relative to high. All specifications include city and year fixed effects. Standard errors in parentheses, two-way clustered by city and year. Column (1) reports the unconditional HHI coefficient with no other regressors. Column (2) reports the unconditional log median property value coefficient. Column (3) reports HHI, the property-value tercile dummies, and their interactions with HHI. Column (4) adds macro controls (state income tax rate, unemployment rate, log population). Column (5) adds issuance characteristics (GO share, callable share, average years to maturity of outstanding bonds) and trade characteristics (GO share, callable share, average YTM, log number of trades, log par value traded) for each city-year. $^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$.

Table IA.7
OLS Estimates on Bond Spreads — Active-Trading Subsample: Complete Results

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| HHI | 17.46 | | −83.03* | −47.51 | −37.96 |
| | (0.00) | | (41.48) | (38.26) | (37.61) |
| ln(Property value) | | −23.38*** | | | |
| | | (6.35) | | | |
| Low Property Value | | | −20.11* | −15.19* | −12.33 |
| | | | (9.88) | (8.16) | (8.28) |
| Mid Property Value | | | −7.45 | −5.19 | −3.46 |
| | | | (7.20) | (6.03) | (6.01) |
| Low Property Value × HHI | | | 195.59*** | 150.19** | 128.63** |
| | | | (56.86) | (55.48) | (57.06) |
| Mid Property Value × HHI | | | 98.93** | 72.33 | 55.54 |
| | | | (46.88) | (42.53) | (41.45) |
| State income tax rate | | | | −5.17*** | −4.65*** |
| | | | | (1.58) | (1.59) |
| Unemployment rate | | | | 5.50*** | 5.46*** |
| | | | | (1.26) | (1.22) |
| ln(Population) | | | | −23.67** | −25.82*** |
| | | | | (8.36) | (8.12) |
| GO bond share (outstanding) | | | | | 10.90** |
| | | | | | (4.47) |
| Callable share (outstanding) | | | | | 17.89** |
| | | | | | (6.83) |
| Avg. years to maturity (outstanding) | | | | | −0.05 |
| | | | | | (0.34) |
| GO bond share (traded) | | | | | −19.91*** |
| | | | | | (3.06) |
| Callable share (traded) | | | | | 28.06*** |
| | | | | | (5.69) |
| Avg. years to maturity (traded) | | | | | −0.19 |
| | | | | | (0.38) |

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Table IA.7
OLS Estimates on Bond Spreads — Active-Trading Subsample: Complete Results
(continued)

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| ln(Number of trades) | | | | | 0.95 |
| | | | | | (1.92) |
| ln(Par value traded) | | | | | −2.36* |
| | | | | | (1.36) |
| City, Year FE | Yes | Yes | Yes | Yes | Yes |
| Cluster (city, year) | Yes | Yes | Yes | Yes | Yes |
| Observations | 17,878 | 20,518 | 17,874 | 17,562 | 17,562 |
| Adjusted $R^2$ | 0.359 | 0.363 | 0.360 | 0.380 | 0.405 |

Notes: The dependent variable is the AAA-cities-benchmark municipal bond yield spread, in basis points, restricted to city-years with at least 10 trades. HHI is the Herfindahl index of city-level employment shares across 20 industry sectors. Property-value terciles are formed within each year from ACS median home value; the high tercile is the omitted reference category, so the HHI base coefficient in Columns (3)–(5) is the HHI gradient for high-property-value cities, and the "Low × HHI" and "Mid × HHI" rows report how the gradient differs in lower terciles relative to high. All specifications include city and year fixed effects. Standard errors in parentheses, two-way clustered by city and year. Column (1) reports the unconditional HHI coefficient with no other regressors. Column (2) reports the unconditional log median property value coefficient. Column (3) reports HHI, the property-value tercile dummies, and their interactions with HHI. Column (4) adds macro controls (state income tax rate, unemployment rate, log population). Column (5) adds issuance characteristics (GO share, callable share, average years to maturity of outstanding bonds) and trade characteristics (GO share, callable share, average YTM, log number of trades, log par value traded) for each city-year. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table IA.8
OLS Estimates on Bond Spreads — Loose Maturity Filter: Complete Results

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| HHI | 5.58 | | −75.27* | −43.32 | −27.99 |
| | (0.00) | | (43.00) | (40.56) | (40.55) |
| ln(Property value) | | −25.13*** | | | |
| | | (6.46) | | | |
| Low Property Value | | | −17.27 | −12.44 | −8.70 |
| | | | (10.80) | (9.08) | (9.10) |
| Mid Property Value | | | −1.27 | 0.37 | 2.23 |
| | | | (7.00) | (5.91) | (5.81) |
| Low Property Value × HHI | | | 178.01** | 133.75** | 101.02 |
| | | | (62.19) | (60.25) | (60.31) |
| Mid Property Value × HHI | | | 61.48 | 39.50 | 18.81 |
| | | | (45.16) | (41.65) | (40.72) |
| State income tax rate | | | | −4.99** | −4.31** |
| | | | | (1.79) | (1.72) |
| Unemployment rate | | | | 5.97*** | 5.87*** |
| | | | | (1.34) | (1.29) |
| ln(Population) | | | | −22.74*** | −24.20*** |
| | | | | (7.77) | (7.44) |
| GO bond share (outstanding) | | | | | 15.18*** |
| | | | | | (4.69) |
| Callable share (outstanding) | | | | | 18.20** |
| | | | | | (6.42) |
| Avg. years to maturity (outstanding) | | | | | 0.35 |
| | | | | | (0.34) |
| GO bond share (traded) | | | | | −22.10*** |
| | | | | | (2.97) |
| Callable share (traded) | | | | | 29.38*** |
| | | | | | (5.24) |
| Avg. years to maturity (traded) | | | | | −1.00** |
| | | | | | (0.37) |

*Continued on next page*

Table IA.8
OLS Estimates on Bond Spreads — Loose Maturity Filter: Complete Results
(continued)

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| ln(Number of trades) | | | | | 2.50 |
| | | | | | (1.89) |
| ln(Par value traded) | | | | | $-3.90^{**}$ |
| | | | | | (1.43) |
| City, Year FE | Yes | Yes | Yes | Yes | Yes |
| Cluster (city, year) | Yes | Yes | Yes | Yes | Yes |
| Observations | 18,511 | 21,373 | 18,507 | 18,196 | 18,196 |
| Adjusted $R^2$ | 0.356 | 0.360 | 0.357 | 0.377 | 0.407 |

Notes: The dependent variable is the AAA-cities-benchmark municipal bond yield spread, in basis points, with the maturity filter loosened to include all bonds with years to maturity in [2, 25]. HHI is the Herfindahl index of city-level employment shares across 20 industry sectors. Property-value terciles are formed within each year from ACS median home value; the high tercile is the omitted reference category, so the HHI base coefficient in Columns (3)–(5) is the HHI gradient for high-property-value cities, and the "Low × HHI" and "Mid × HHI" rows report how the gradient differs in lower terciles relative to high. All specifications include city and year fixed effects. Standard errors in parentheses, two-way clustered by city and year. Column (1) reports the unconditional HHI coefficient with no other regressors. Column (2) reports the unconditional log median property value coefficient. Column (3) reports HHI, the property-value tercile dummies, and their interactions with HHI. Column (4) adds macro controls (state income tax rate, unemployment rate, log population). Column (5) adds issuance characteristics (GO share, callable share, average years to maturity of outstanding bonds) and trade characteristics (GO share, callable share, average YTM, log number of trades, log par value traded) for each city-year. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

## Appendix F. Variance Decomposition of Economic Spread Determinants

This appendix reports a Shapley decomposition of the R-squared of a spread regression on four economically meaningful regressor groups, after partialing out city and year fixed effects and bond-mix composition characteristics (GO share, callable share, average years to maturity, ln(number of trades), and ln(par value traded)). The residualization isolates spread variation that reflects city-level economic determinants rather than mechanical trade-composition effects, mirroring the bond-maturity and mix controls that Schwert (2017) partials out in his cross-sectional default–liquidity–tax decomposition. Credit ratings are excluded from the decomposition because they are downstream outcomes of the same fundamentals that drive spreads—conditioning on them would induce a bad-control bias.

The four groups are: (i) the paper's concentration channel (HHI, ln(property value), and their interaction); (ii) local macro and demographic controls (unemployment rate and ln(population)); (iii) state income taxation, the classic muni-tax channel studied by Poterba (1989) and Wang, Wu, and Zhang (2008); and (iv) liquidity, measured by the bid-ask proxy, within-cusip yield dispersion, zero-trade-day fraction, and turnover—the components of the microstructure literature.

Table IA.9 reports the results. The concentration channel contributes approximately fourteen percent of the economic spread variation—a nontrivial share of comparable magnitude to the canonical drivers identified in the prior literature. Local macro and demographic conditions account for the largest share at roughly forty percent, the state-tax channel accounts for a further third, and liquidity accounts for the remaining thirteen percent. The relatively muted role of liquidity in this decomposition—compared with the larger liquidity component in Treasury-benchmarked decompositions such as Schwert (2017), Harris and Piwowar (2006), and Green, Hollifield, and Schürhoff (2007)—reflects that the AAA-cities benchmark already differences out much of the liquidity-driven AAA-versus-Treasury wedge that loaded onto the level of Treasury-benchmarked spreads. The decomposition indicates that industrial concentration is a quantitatively meaningful determinant of spreads alongside the well-established channels, not a marginal residual that is dwarfed by them.

## Appendix G. Robustness: State × Year Fixed Effects

A potential concern is that time-varying state-level factors—such as changes in state fiscal policy, state bond market conditions, or state-level exposure to national economic trends—could confound the HHI–spread relationship. The baseline specifications include separate city and year fixed effects, which absorb time-invariant city characteristics and common annual shocks, but do not control for state-level factors that vary over time. State × year fixed effects absorb all such time-varying state-level factors, providing a more demanding test that identifies the HHI–spread relationship solely from within-state, within-year variation across cities.

Table IA.10 reports OLS estimates with city and state × year fixed effects (replacing the separate city and year fixed effects used in the main tables). This more demanding specification identifies the HHI–spread relationship solely from within-state, within-year variation

Table IA.9
Shapley Decomposition of the Economic Spread Variance

| Regressor group | Shapley $R^2$ | Share of $R^2$ (%) |
|---|---|---|
| HHI, ln(Property value), and their interaction | 0.0058 | 13.8 |
| Local macroeconomic/demographic controls (unemployment, ln pop.) | 0.0166 | 39.6 |
| Tax (state top income tax rate) | 0.0140 | 33.5 |
| Liquidity (bid-ask, dispersion, zeros, turnover) | 0.0055 | 13.1 |
| Residualized model $R^2$ | 0.0418 | 100.0 |
| Observations | 16,318 | |

Notes: The dependent variable is the AAA-cities-benchmark municipal bond yield spread. The dependent variable and each regressor group are first residualized against city fixed effects, year fixed effects, and bond-mix characteristics (outstanding GO share, callable share, average years to maturity; traded GO share, callable share, average years to maturity, ln(number of trades), ln(par value traded)). This removes mechanical spread variation attributable to which bonds happened to trade or be outstanding in each city-year, mirroring the bond-maturity and mix controls used by Schwert (2017) in his cross-sectional decomposition of municipal spreads. Shapley values on the residualized regression average the incremental $R^2$ each group contributes across all orderings of the four groups; by construction, they sum to the full-model $R^2$ of the residualized regression. Credit ratings are excluded because they are downstream outcomes of the same fundamentals that drive spreads (a bad control). Liquidity variables are the bid-ask proxy, within-cusip yield dispersion, zero-trade-day fraction, and turnover, merged from `msrb_liquidity_measures.csv`. The sample is restricted to city-years with all four groups non-missing and all bond-trait controls observed.

across cities. Column (1) reports the baseline HHI coefficient. Column (2) interacts Industrial Concentration with annual property value terciles, paralleling the main specification in Table III.

Table IA.10
Robustness: State × Year Fixed Effects

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| HHI | 50.02 | | −9.29 | −12.44 | −11.88 |
| | (28.84) | | (39.87) | (39.55) | (38.72) |
| ln(Property value) | | −12.37* | | | |
| | | (6.13) | | | |
| Low Property Value | | | −14.42* | −15.21* | −13.81* |
| | | | (7.33) | (7.26) | (7.32) |
| Mid Property Value | | | −1.83 | −2.74 | −2.57 |
| | | | (5.61) | (5.61) | (5.67) |
| Low Property Value × HHI | | | 134.28** | 139.19** | 125.50** |

*Continued on next page*

Table IA.10
Robustness: State × Year Fixed Effects (continued)

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | | | (55.36) | (54.76) | (54.94) |
| Mid Property Value × HHI | | | 36.14 | 41.75 | 32.55 |
| | | | (40.35) | (40.12) | (39.72) |
| State income tax rate | | | | 0.00 | 0.00 |
| | | | | (0.00) | (0.00) |
| Unemployment rate | | | | 2.76*** | 2.68*** |
| | | | | (0.88) | (0.84) |
| ln(Population) | | | | −6.60 | −5.20 |
| | | | | (7.01) | (6.82) |
| GO bond share (outstanding) | | | | | 6.10 |
| | | | | | (4.33) |
| Callable share (outstanding) | | | | | 7.20 |
| | | | | | (5.61) |
| Avg. years to maturity (outstanding) | | | | | 0.33 |
| | | | | | (0.31) |
| GO bond share (traded) | | | | | −22.54*** |
| | | | | | (2.94) |
| Callable share (traded) | | | | | 28.75*** |
| | | | | | (5.66) |
| Avg. years to maturity (traded) | | | | | −0.13 |
| | | | | | (0.37) |
| ln(Number of trades) | | | | | −0.61 |
| | | | | | (1.85) |
| ln(Par value traded) | | | | | −3.31** |
| | | | | | (1.29) |
| City FE | Yes | Yes | Yes | Yes | Yes |
| State × Year FE | Yes | Yes | Yes | Yes | Yes |
| Observations | 18,709 | 21,660 | 18,705 | 18,391 | 18,391 |
| Adjusted $R^2$ | 0.438 | 0.436 | 0.439 | 0.439 | 0.467 |

*Continued on next page*

Table IA.10
Robustness: State × Year Fixed Effects (continued)

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|

Notes: The dependent variable is the AAA-cities-benchmark municipal bond yield spread, in basis points. All specifications include city fixed effects and state × year fixed effects, replacing the separate city and year fixed effects used in the main OLS table (Table III). The high tercile is the omitted reference category, matching Table III. Standard errors (in parentheses) are two-way clustered by city and year. Column (1) reports the unconditional HHI coefficient. Column (2) reports the unconditional log median property value coefficient. Columns (3)–(5) interact HHI with the property-value terciles. "Macro" controls are the state income tax rate, county unemployment rate, and log population. "Bond" controls are the GO share, callable share, and average years to maturity of outstanding and traded bonds, plus log number of trades and log par value traded. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

## Appendix H. Complete IV Results

This appendix reports the complete results for the two-channel IV design in Section V.

### *VIII.A. Complete Second-Stage Results*

Table IA.11 reports the full set of coefficients, standard errors, $p$-values, and wild cluster bootstrap $p$-values for the three IV specifications discussed in Section V.E, using the AAA-cities-benchmark spread as the dependent variable. Tables IA.12, IA.13, and IA.14 replicate the same three columns using, respectively, the raw par-weighted yield, the AAA spread restricted to actively traded city-years (at least ten trades), and the AAA spread under a loosened maturity filter (years to maturity in $[2, 25]$).

Table IA.11
2SLS Estimates on Bond Spreads: Complete Results

| | (1) | (2) | (3) |
|---|---|---|---|
| HHI | 121.855** | 74.307** | 66.486** |
| Standard error | (50.900) | (31.551) | (29.735) |
| *p*-value | 0.017 | 0.019 | 0.025 |
| Bootstrap *p* | 0.020 | 0.014 | 0.022 |
| ln(Property value) | −2.038*** | −1.155*** | −1.180*** |
| Standard error | (0.624) | (0.374) | (0.354) |
| *p*-value | 0.001 | 0.002 | <0.001 |
| Bootstrap *p* | 0.006 | 0.003 | 0.001 |
| HHI × ln(Property value) | −9.524** | −5.692** | −5.035** |
| Standard error | (4.264) | (2.618) | (2.472) |
| *p*-value | 0.026 | 0.030 | 0.042 |
| Bootstrap *p* | 0.033 | 0.031 | 0.042 |
| State income tax rate | | −0.066*** | −0.063*** |
| | | (0.010) | (0.010) |
| Unemployment rate | | 0.061*** | 0.060*** |
| | | (0.007) | (0.006) |
| ln(Population) | | 0.935*** | 0.894*** |
| | | (0.216) | (0.208) |
| GO bond share (outstanding) | | | 0.151** |
| | | | (0.070) |
| Callable share (outstanding) | | | 0.104 |
| | | | (0.083) |
| Avg. years to maturity (outstanding) | | | −0.002 |
| | | | (0.004) |
| GO bond share (traded) | | | −0.221*** |
| | | | (0.039) |
| Callable share (traded) | | | 0.268*** |
| | | | (0.034) |
| Avg. years to maturity (traded) | | | −0.002 |
| | | | (0.002) |

*Continued on next page*

Table IA.11
2SLS Estimates on Bond Spreads: Complete Results (continued)

| | (1) | (2) | (3) |
|---|---|---|---|
| ln(Number of trades) | | | 0.009 |
| | | | (0.015) |
| ln(Par value traded) | | | $-0.024^{**}$ |
| | | | (0.009) |
| City, Year FE | Yes | Yes | Yes |
| Kleibergen-Paap $F$ | 10.541 | 11.243 | 11.361 |
| Hansen $J$ $p$ | 0.237 | 0.143 | 0.110 |
| Observations | 15,981 | 15,981 | 15,981 |

Notes: The dependent variable is the AAA-cities-benchmark municipal bond yield spread. All coefficients are scaled by $10^{-2}$ (i.e., units are percentage points; multiply by 100 for basis points). HHI is the Herfindahl index of city-level employment shares across 20 industry sectors. "ln(Property value)" is the log of ACS median home value. All three endogenous variables (HHI, ln(Property value), and their interaction) are instrumented by the seven instruments $B$, $G$, $B^2$, $G^2$, $BG$, $B^2G$, $BG^2$, where $B$ is the predicted HHI from a Bartik shift-share design and $G$ is the Guren et al. (2021) cumulative housing supply instrument. All specifications include city and year fixed effects (absorbed by pre-demeaning) and cluster standard errors by city. Column (1) reports the interaction-only specification with no exogenous controls. Column (2) adds macroeconomic controls (state income tax rate, unemployment rate, log population). Column (3) adds issuance characteristics (GO share, callable share, average years to maturity of outstanding bonds) and trade characteristics (GO share, callable share, average YTM, log number of trades, log par value traded). $p$-values are asymptotic. Bootstrap $p$-values use the wild cluster bootstrap (999 replications, clustered by year). Hansen $J$ tests the overidentifying restrictions. $^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$.

Table IA.12
2SLS Estimates on Raw Bond Yields: Complete Results

| | (1) | (2) | (3) |
|---|---|---|---|
| HHI | 143.828** | 79.888** | 62.713** |
| Standard error | (59.244) | (36.532) | (30.988) |
| *p*-value | 0.015 | 0.029 | 0.043 |
| Bootstrap *p* | 0.019 | 0.027 | 0.038 |
| ln(Property value) | −2.465*** | −1.279*** | −1.684*** |
| Standard error | (0.757) | (0.457) | (0.379) |
| *p*-value | 0.001 | 0.005 | <0.001 |
| Bootstrap *p* | 0.001 | 0.005 | <0.001 |
| HHI × ln(Property value) | −11.077** | −5.956** | −4.596* |
| Standard error | (4.905) | (2.984) | (2.563) |
| *p*-value | 0.024 | 0.046 | 0.073 |
| Bootstrap *p* | 0.033 | 0.041 | 0.071 |
| State income tax rate | | −0.086*** | −0.066*** |
| | | (0.012) | (0.011) |
| Unemployment rate | | 0.079*** | 0.077*** |
| | | (0.009) | (0.007) |
| ln(Population) | | 0.933*** | 1.114*** |
| | | (0.280) | (0.246) |
| GO bond share (outstanding) | | | 0.136* |
| | | | (0.081) |
| Callable share (outstanding) | | | −0.005 |
| | | | (0.098) |
| Avg. years to maturity (outstanding) | | | −0.009* |
| | | | (0.005) |
| GO bond share (traded) | | | −0.177*** |
| | | | (0.042) |
| Callable share (traded) | | | 0.263*** |
| | | | (0.037) |
| Avg. years to maturity (traded) | | | 0.085*** |
| | | | (0.003) |

*Continued on next page*

Table IA.12
2SLS Estimates on Raw Bond Yields: Complete Results (continued)

| | (1) | (2) | (3) |
|---|---|---|---|
| ln(Number of trades) | | | 0.110*** |
| | | | (0.018) |
| ln(Par value traded) | | | −0.078*** |
| | | | (0.012) |
| City, Year FE | Yes | Yes | Yes |
| Kleibergen-Paap $F$ | 10.522 | 11.231 | 11.367 |
| Hansen $J$ $p$ | 0.491 | 0.440 | 0.387 |
| Observations | 16,009 | 16,009 | 16,009 |

Notes: The dependent variable is the par-weighted municipal bond yield (raw, not benchmarked) at the city-year level. All coefficients are scaled by $10^{-2}$ (i.e., units are percentage points; multiply by 100 for basis points). HHI is the Herfindahl index of city-level employment shares across 20 industry sectors. "ln(Property value)" is the log of ACS median home value. All three endogenous variables (HHI, ln(Property value), and their interaction) are instrumented by the seven instruments $B$, $G$, $B^2$, $G^2$, $BG$, $B^2G$, $BG^2$, where $B$ is the predicted HHI from a Bartik shift-share design and $G$ is the Guren et al. (2021) cumulative housing supply instrument. All specifications include city and year fixed effects (absorbed by pre-demeaning) and cluster standard errors by city. Column (1) reports the interaction-only specification with no exogenous controls. Column (2) adds macroeconomic controls (state income tax rate, unemployment rate, log population). Column (3) adds issuance characteristics (GO share, callable share, average years to maturity of outstanding bonds) and trade characteristics (GO share, callable share, average YTM, log number of trades, log par value traded). $p$-values are asymptotic. Bootstrap $p$-values use the wild cluster bootstrap (999 replications, clustered by year). Hansen $J$ tests the overidentifying restrictions. $^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$.

Table IA.13
2SLS Estimates on Bond Spreads (Active-Trading Subsample): Complete Results

| | (1) | (2) | (3) |
|---|---|---|---|
| HHI | 98.584** | 62.609** | 56.165** |
| Standard error | (42.848) | (27.804) | (26.544) |
| *p*-value | 0.021 | 0.024 | 0.034 |
| Bootstrap *p* | 0.019 | 0.016 | 0.023 |
| ln(Property value) | −1.900*** | −1.068*** | −1.116*** |
| Standard error | (0.571) | (0.354) | (0.338) |
| *p*-value | <0.001 | 0.003 | <0.001 |
| Bootstrap *p* | <0.001 | 0.002 | 0.001 |
| HHI × ln(Property value) | −7.662** | −4.794** | −4.245* |
| Standard error | (3.590) | (2.307) | (2.207) |
| *p*-value | 0.033 | 0.038 | 0.054 |
| Bootstrap *p* | 0.032 | 0.029 | 0.055 |
| State income tax rate | | −0.064*** | −0.061*** |
| | | (0.010) | (0.010) |
| Unemployment rate | | 0.056*** | 0.055*** |
| | | (0.006) | (0.006) |
| ln(Population) | | 0.772*** | 0.743*** |
| | | (0.203) | (0.197) |
| GO bond share (outstanding) | | | 0.075 |
| | | | (0.067) |
| Callable share (outstanding) | | | 0.089 |
| | | | (0.080) |
| Avg. years to maturity (outstanding) | | | −0.001 |
| | | | (0.004) |
| GO bond share (traded) | | | −0.173*** |
| | | | (0.036) |
| Callable share (traded) | | | 0.271*** |
| | | | (0.034) |
| Avg. years to maturity (traded) | | | −0.002 |
| | | | (0.002) |

*Continued on next page*

Table IA.13
2SLS Estimates on Bond Spreads (Active-Trading Subsample): Complete Results (continued)

| | (1) | (2) | (3) |
|---|---|---|---|
| ln(Number of trades) | | | 0.014 |
| | | | (0.015) |
| ln(Par value traded) | | | −0.012 |
| | | | (0.010) |
| City, Year FE | Yes | Yes | Yes |
| Kleibergen-Paap $F$ | 11.162 | 12.649 | 12.909 |
| Hansen $J$ $p$ | 0.121 | 0.075 | 0.070 |
| Observations | 15,221 | 15,221 | 15,221 |

Notes: The dependent variable is the AAA-cities-benchmark municipal bond yield spread, restricted to city-years with at least 10 trades. All coefficients are scaled by $10^{-2}$ (i.e., units are percentage points; multiply by 100 for basis points). HHI is the Herfindahl index of city-level employment shares across 20 industry sectors. "ln(Property value)" is the log of ACS median home value. All three endogenous variables (HHI, ln(Property value), and their interaction) are instrumented by the seven instruments $B$, $G$, $B^2$, $G^2$, $BG$, $B^2G$, $BG^2$, where $B$ is the predicted HHI from a Bartik shift-share design and $G$ is the Guren et al. (2021) cumulative housing supply instrument. All specifications include city and year fixed effects (absorbed by pre-demeaning) and cluster standard errors by city. Column (1) reports the interaction-only specification with no exogenous controls. Column (2) adds macroeconomic controls (state income tax rate, unemployment rate, log population). Column (3) adds issuance characteristics (GO share, callable share, average years to maturity of outstanding bonds) and trade characteristics (GO share, callable share, average YTM, log number of trades, log par value traded). $p$-values are asymptotic. Bootstrap $p$-values use the wild cluster bootstrap (999 replications, clustered by year). Hansen $J$ tests the overidentifying restrictions. $^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$.

Table IA.14
2SLS Estimates on Bond Spreads (Loose Maturity Filter): Complete Results

| | (1) | (2) | (3) |
|---|---|---|---|
| HHI | 118.301** | 68.840** | 64.540** |
| Standard error | (51.506) | (32.394) | (31.149) |
| *p*-value | 0.022 | 0.034 | 0.038 |
| Bootstrap *p* | 0.025 | 0.030 | 0.035 |
| ln(Property value) | −2.213*** | −1.306*** | −1.311*** |
| Standard error | (0.630) | (0.376) | (0.360) |
| *p*-value | <0.001 | <0.001 | <0.001 |
| Bootstrap *p* | 0.001 | 0.001 | <0.001 |
| HHI × ln(Property value) | −9.192** | −5.229* | −4.854* |
| Standard error | (4.309) | (2.679) | (2.579) |
| *p*-value | 0.033 | 0.051 | 0.060 |
| Bootstrap *p* | 0.034 | 0.048 | 0.057 |
| State income tax rate | | −0.067*** | −0.061*** |
| | | (0.010) | (0.010) |
| Unemployment rate | | 0.062*** | 0.061*** |
| | | (0.007) | (0.007) |
| ln(Population) | | 0.932*** | 0.897*** |
| | | (0.217) | (0.212) |
| GO bond share (outstanding) | | | 0.149** |
| | | | (0.071) |
| Callable share (outstanding) | | | 0.105 |
| | | | (0.083) |
| Avg. years to maturity (outstanding) | | | 0.003 |
| | | | (0.005) |
| GO bond share (traded) | | | −0.214*** |
| | | | (0.038) |
| Callable share (traded) | | | 0.272*** |
| | | | (0.033) |
| Avg. years to maturity (traded) | | | −0.011*** |
| | | | (0.003) |

*Continued on next page*

Table IA.14
2SLS Estimates on Bond Spreads (Loose Maturity Filter): Complete Results (continued)

| | (1) | (2) | (3) |
|---|---|---|---|
| ln(Number of trades) | | | $0.029^{**}$ |
| | | | (0.015) |
| ln(Par value traded) | | | $-0.028^{***}$ |
| | | | (0.010) |
| City, Year FE | Yes | Yes | Yes |
| Kleibergen-Paap $F$ | 10.818 | 12.062 | 12.103 |
| Hansen $J$ $p$ | 0.192 | 0.099 | 0.098 |
| Observations | 15,772 | 15,772 | 15,772 |

Notes: The dependent variable is the AAA-cities-benchmark municipal bond yield spread, with the maturity filter loosened to include all bonds with years to maturity in $[2, 25]$. All coefficients are scaled by $10^{-2}$ (i.e., units are percentage points; multiply by 100 for basis points). HHI is the Herfindahl index of city-level employment shares across 20 industry sectors. "ln(Property value)" is the log of ACS median home value. All three endogenous variables (HHI, ln(Property value), and their interaction) are instrumented by the seven instruments $B$, $G$, $B^2$, $G^2$, $BG$, $B^2G$, $BG^2$, where $B$ is the predicted HHI from a Bartik shift-share design and $G$ is the Guren et al. (2021) cumulative housing supply instrument. All specifications include city and year fixed effects (absorbed by pre-demeaning) and cluster standard errors by city. Column (1) reports the interaction-only specification with no exogenous controls. Column (2) adds macroeconomic controls (state income tax rate, unemployment rate, log population). Column (3) adds issuance characteristics (GO share, callable share, average years to maturity of outstanding bonds) and trade characteristics (GO share, callable share, average YTM, log number of trades, log par value traded). $p$-values are asymptotic. Bootstrap $p$-values use the wild cluster bootstrap (999 replications, clustered by year). Hansen $J$ tests the overidentifying restrictions. $^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$.

### *VIII.B. First-Stage Regressions*

Table IA.15 reports the first-stage regressions for the preferred specification (Column (3) of Table IA.11), which includes all macroeconomic and bond-level controls with city clustering. Each column reports the regression of one endogenous variable on the seven excluded instruments and eleven included controls, with city and year fixed effects.

Table IA.15
First-Stage IV Regressions

| | (1) HHI | (2) ln(PV) | (3) HHI × ln(PV) |
|---|---|---|---|
| *Excluded Instruments* | | | |
| Bartik Predicted HHI ($B$) | 0.837*** | 2.022 | 10.616*** |
| | (0.309) | (1.448) | (3.617) |
| Guren et al. Predicted Housing Shock ($G$) | −0.026* | 0.550*** | −0.319* |
| | (0.013) | (0.105) | (0.178) |
| $B^2$ | −0.580 | −2.029 | −7.815 |
| | (0.991) | (3.918) | (11.577) |
| $G^2$ | 0.005 | −0.281*** | 0.016 |
| | (0.012) | (0.062) | (0.149) |
| $BG$ | 0.308** | −3.039** | 4.241** |
| | (0.142) | (1.366) | (1.941) |
| $B^2G$ | −1.095*** | 2.983 | −14.620*** |
| | (0.258) | (4.224) | (3.827) |
| $BG^2$ | −0.016 | 1.349*** | 0.051 |
| | (0.102) | (0.491) | (1.299) |
| *Included Controls (×100)* | | | |
| State income tax rate | 0.113*** | −1.699*** | 1.359*** |
| | (0.029) | (0.315) | (0.392) |
| Unemployment rate | 0.008 | 0.199 | 0.150 |
| | (0.025) | (0.182) | (0.310) |
| ln(Population) | −1.290*** | 52.826*** | −8.011 |
| | (0.461) | (4.995) | (5.779) |
| GO bond share (outstanding) | 0.227 | −1.006 | 2.510 |
| | (0.292) | (2.444) | (3.663) |

*Continued on next page*

Table IA.15
First-Stage IV Regressions (continued)

| | (1) HHI | (2) ln(PV) | (3) HHI × ln(PV) |
|---|---|---|---|
| Callable share (outstanding) | −0.404 | −4.855* | −6.104* |
| | (0.282) | (2.834) | (3.628) |
| Avg. years to maturity (outstanding) | 0.003 | 0.004 | 0.039 |
| | (0.016) | (0.140) | (0.206) |
| GO bond share (traded) | −0.013 | 0.856 | 0.285 |
| | (0.110) | (0.995) | (1.473) |
| Callable share (traded) | 0.076 | 0.061 | 1.100 |
| | (0.102) | (0.878) | (1.352) |
| Avg. years to maturity (traded) | 0.013* | −0.050 | 0.170* |
| | (0.007) | (0.059) | (0.089) |
| ln(Number of trades) | −0.003 | 0.690* | 0.009 |
| | (0.045) | (0.376) | (0.574) |
| ln(Par value traded) | −0.040 | 0.353 | −0.439 |
| | (0.025) | (0.230) | (0.313) |
| City, Year FE | Yes | Yes | Yes |
| $R^2$ | 0.886 | 0.964 | 0.883 |
| Within $R^2$ | 0.069 | 0.098 | 0.065 |
| $F$-statistic | 8.16 | 16.35 | 6.77 |
| Observations | 15,981 | 15,981 | 15,981 |
| Kleibergen–Paap $F$ | | 11.349 | |

Notes: First-stage regressions corresponding to Column (3) of the IV table on M2 (the AAA-cities-benchmark spread), which includes all macroeconomic and bond-level controls. Each column reports the OLS regression of the indicated endogenous variable on the seven excluded instruments and eleven included controls. All specifications include city and year fixed effects. $R^2$ is for the full model including fixed effects; Within $R^2$ is the share of within-city, within-year variation explained by the regressors. Included control coefficients are scaled by 100 for readability. $B$ is predicted HHI from a Bartik shift-share design using leave-one-out national industry employment growth and base-period city employment shares; $G$ is the Guren et al. (2021) cumulative housing supply instrument. The $F$-statistic tests joint significance of all regressors in each first-stage equation; the Kleibergen–Paap $F$ tests the joint rank condition across all three first stages. Standard errors (in parentheses) are clustered by city, consistent with the second-stage clustering. $^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$.

## Appendix I. Placebo Bartik Tests of the Exclusion Restriction

This appendix reports placebo versions of the Bartik instrument that retain the structure of the shift-share design but destroy the sector-specific information used for identification. Each placebo re-estimates Column (3) of Table IV with a modified Bartik; the remaining instruments, sample, and controls are unchanged.

**Permuted-shock placebo.** Within each year, the 20 national sector shocks are randomly permuted across the 20 NAICS supersectors (seed 20260420). The permutation preserves the mean and variance of shocks within each year but destroys the match between a given sector's growth rate and each city's exposure to that sector. If the real Bartik identified variation through a generic sector-shock exposure channel rather than through city-specific concentration dynamics, the permuted version would produce similar results.

**Future-shock placebo.** For year $t$, the national sector growth shocks from year $t+5$ are substituted for the contemporaneous shocks. If the real Bartik identified variation through a long-run sector-trend channel correlated with current fiscal conditions, future shocks would also predict current spreads. The future-shock sample loses the final five years (2018–2022) because the required 2023–2027 growth is unobserved.

Column (1) of Table IA.16 reproduces the baseline real-Bartik result exactly, so the placebo comparison is on the same footing. In the permuted-shock placebo (Column 2), the HHI coefficient attenuates by roughly 45%, the interaction weakens, and the Kleibergen–Paap $F$-statistic falls from 11.4 to 3.7, well below the Stock–Yogo 10% relative-bias critical value. In the future-shock placebo (Column 3), the HHI coefficient flips sign entirely, standard errors explode, and the Kleibergen–Paap $F$-statistic drops to 1.3. Both placebos therefore fail to replicate the main identification. These tests directly answer the concern that the nonlinear Bartik identifies generic sector-shock exposure rather than concentration-specific variation: when the sector-specific information is destroyed, the IV loses its explanatory power.

## Appendix J. Systematic Risk: City Beta

This appendix reports the city-beta robustness analysis discussed in Section VI.A. City betas are constructed following Tuzel and Zhang (2017) in two steps. In the first step, I estimate an industry-level beta for each of the 20 NAICS supersectors by regressing annual national sector employment growth on aggregate national employment growth.[13] In the

[13]Tuzel and Zhang (2017) use BEA sector value-added regressed on GDP growth; I use LODES sector employment regressed on national employment for internal consistency with the HHI measure, which is also constructed from LODES employment data. The qualitative interpretation is the same: $\hat{\lambda}_k$ measures the cyclical exposure of sector $k$'s output to the common business-cycle factor.

Table IA.16
Placebo Bartik Robustness

| | Real Bartik (1) | Permuted shocks (2) | Future shocks (+5y) (3) |
|---|---|---|---|
| HHI | 66.486 | 37.543 | -62.561 |
| | (29.735) | (28.278) | (189.492) |
| ln(Property value) | -1.180 | -1.397 | -2.849 |
| | (0.354) | (0.348) | (1.684) |
| HHI × ln(Property value) | -5.035 | -2.697 | 6.105 |
| | (2.472) | (2.426) | (15.537) |
| Kleibergen-Paap $F$ | 11.36 | 3.67 | 1.31 |
| Observations | 15,981 | 15,981 | 11,698 |

Notes: Column (1) reproduces Column (3) of Table IV using the paper's baseline Bartik instrument. Column (2) replaces the national sector shocks with a random permutation of the 20 NAICS supersector shocks within each year (seed 20260420), preserving their mean and variance but destroying the industry-specific signal. Column (3) replaces the national sector shocks with shocks from five years in the future (year $t$ uses year $t+5$ growth); the future-shock sample loses years 2018–2022. All coefficients are scaled by $10^{-2}$ (i.e., percentage points; multiply by 100 for basis points), matching Table IV. All specifications include city and year fixed effects, are estimated on the AAA-cities-benchmark spread sample, and cluster standard errors by city. Each column uses the seven-instrument polynomial set $(B, G, B^2, G^2, BG, B^2G, BG^2)$. Standard errors in parentheses.

second step, I aggregate to a city-year beta as an employment-weighted average of the sector betas, $\hat{\beta}_{it} = \sum_k p_{kit}\,\hat{\lambda}_k$, which is exactly the local-beta construction of Tuzel and Zhang (2017). Table IA.17 reports the results. Column (1) is the OLS baseline augmented with $\hat{\beta}_{it}$ as an exogenous control. Column (2) is the IV from Section V augmented with $\hat{\beta}_{it}$ as an exogenous control. In both specifications the HHI coefficient and its interaction with ln(PV) are essentially unchanged, confirming that the main results are not driven by unobserved heterogeneous exposure to aggregate risk.

## Appendix K. Robustness: Predetermined Property Value Terciles

A potential concern with the contemporaneous property value tercile interaction is reverse causality: a negative employment shock could simultaneously raise HHI, depress property values, and increase spreads, mechanically sorting cities into lower terciles. To address this concern, Table IA.18 replicates the main OLS and IV specifications using property value terciles formed from the *prior year's* median property value. Because the lagged tercile assignment is predetermined relative to the current year's outcomes, it is unaffected by

Table IA.17
Robustness to City Beta as a Control

| | (1) OLS | (2) IV (2SLS) |
|---|---|---|
| HHI | 5.806 | 68.121** |
| | (7.771) | (30.032) |
| ln(Property value) | -0.187** | -1.171*** |
| | (0.082) | (0.357) |
| HHI × ln(Property value) | -0.446 | -5.168** |
| | (0.623) | (2.492) |
| City beta | 0.006 | 0.294 |
| | (0.107) | (0.219) |
| City and year fixed effects | Yes | Yes |
| Macro + issued + traded controls | Yes | Yes |
| Kleibergen-Paap $F$ | — | 11.55 |
| Hansen $J$ $p$ | — | 0.131 |
| Observations | 15,981 | 15,981 |

contemporaneous shocks. The results are qualitatively similar to the main estimates: the HHI–spread gradient is concentrated among low-property-value cities, with attenuated effects for high-property-value cities. The lagged Low PV × HHI interaction is +122 basis points ($p < 0.10$), compared to +189 in the contemporaneous Column (3) specification (Table III)—a roughly one-third attenuation that suggests a portion of the contemporaneous heterogeneity reflects endogenous sorting of shocked cities into lower terciles. The qualitative pattern—a steep gradient for low-property-value cities and a moderated gradient for high-property-value cities—is preserved.[14]

## Appendix L. Robustness: Structural HHI

A natural concern with the contemporaneous specification is that year-to-year HHI variation may reflect transitory shocks rather than the deep industrial structure that lenders price. Table IA.19 addresses this concern by re-estimating the main interaction specification

[14] A fully time-invariant tercile (fixed at the earliest available year) is absorbed by city fixed effects, eliminating the identifying variation in the interaction term. The lagged tercile provides the appropriate middle ground: predetermined relative to contemporaneous shocks while retaining sufficient time variation for identification. The OLS and IV sample sizes (16,942 and 15,755) are slightly smaller than the main OLS (18,427) and IV (15,981) samples because the lagged tercile assignment requires non-missing prior-year median home value, dropping observations in the first sample year and any with a one-year ACS gap.

TABLE IA.18
Robustness: Predetermined (Lagged) Property Value Terciles

| | OLS | 2SLS |
|---|---|---|
| HHI (high-PV gradient, lagged) | -38.1 | 103.0 |
| | (42.9) | (149.3) |
| Low PV (lagged) × HHI | 121.9* | 177.6 |
| | (63.3) | (105.9) |
| Mid PV (lagged) × HHI | 59.1 | 81.0 |
| | (48.0) | (96.6) |
| Observations | 16942 | 15755 |
| Fixed effects | City, Year | City, Year |
| First-stage F | | 8.79 |

Notes: Dependent variable: AAA-cities-benchmark yield spread (bps). All specifications include city and year fixed effects. Property value terciles are formed within each year's cross-section using the PRIOR YEAR's median home value, addressing potential endogeneity of contemporaneous tercile assignment. The high tercile is the omitted reference category, matching Table III, so the HHI base coefficient is the HHI gradient for high-property-value cities, and the Low/Mid interaction rows report deviations from that benchmark. Column (2) instruments HHI and HHI×tercile interactions with Bartik predicted values. Standard errors two-way clustered by city and year. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

with both the dependent variable (spread) and the regressor of interest (HHI) replaced by their five-year backward moving averages. Treating both objects as structural rather than year-by-year realizations removes the high-frequency noise in spreads (driven, e.g., by single-trade outliers and short-run secondary-market fluctuations) and in HHI (driven by transitory employment shifts), and isolates the slow-moving cross-tercile structure that the framework predicts lenders should price.

Column (1) reproduces the main OLS specification (Table III, Column 5) for reference. Column (2) reports the smoothed specification. The cross-tercile wedge—the HHI × Low PV coefficient—grows from 126 basis points in the contemporaneous specification to 266 basis points in the structural specification ($p = 0.022$), and the adjusted $R^2$ rises from 0.42 to 0.67, confirming that the structural reading produces a substantially better-fitting model. The high-property-value HHI gradient (the HHI base coefficient) also strengthens, from $-39$ to $-149$ basis points ($p < 0.10$). The structural specification supports the same qualitative story as the baseline—low-property-value cities pay a concentration premium while high-property-value cities exhibit a concentration discount—but with magnitudes roughly twice as large, consistent with the view that the year-by-year specification understates the structural relationship by attenuating the long-run signal with high-frequency noise.

The instrumental-variables design in Section V cannot be analogously re-estimated on a moving-average regressor: the Bartik shift-share instrument is constructed to capture predicted HHI *movements* induced by national sector shocks, and smoothing it to a multi-year moving average mechanically removes most of its identifying variation (the Kleibergen–Paap statistic falls to under five in unreported tests). The IV identification therefore relies on year-to-year Bartik variation by construction; the OLS robustness above provides the structural-interpretation evidence.

Table IA.19
Robustness: Structural HHI Interpretation

| | (1) Baseline | (2) 5-year MA, both sides |
|---|---|---|
| HHI (high-PV gradient) | $-39.25$ | $-149.47^{*}$ |
| | (37.41) | (73.12) |
| Low PV × HHI | $126.10^{**}$ | $265.96^{**}$ |
| | (57.35) | (102.63) |
| Mid PV × HHI | 42.81 | 108.95 |
| | (39.83) | (80.02) |
| Dependent variable | Spread (bps) | 5-yr MA Spread (bps) |
| HHI regressor | Contemporaneous | 5-yr MA |
| Macro + issued + traded controls | Yes | Yes |
| City and year fixed effects | Yes | Yes |
| Observations | 18,427 | 13,122 |
| Adjusted $R^2$ | 0.415 | 0.668 |

Notes: Column (1) reproduces the main OLS specification (Table III, Column 5). Column (2) re-estimates the same specification with both the dependent variable (AAA-cities-benchmark spread) and the regressor of interest (HHI) replaced by their 5-year backward moving averages, treating both objects as structural rather than year-by-year realizations. The high tercile is the omitted reference category, so the HHI base coefficient is the HHI gradient for high-property-value cities and the Low/Mid interaction rows report deviations from that benchmark. Both specifications include city and year fixed effects, the full macro + issued + traded control set, and two-way clustering by city and year. The smoothed column has a smaller sample because the lagged-HHI requirement drops observations in the first sample years and any with a missing intermediate value. $^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$.