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The Assessment Gap in Quebec

Vertical and Horizontal Inequity in Municipal Property Valuation: Evidence from 522,769 Sales Matched to the Assessment Roll

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Abstract

Municipal property taxes are levied on assessed values, so any systematic relationship between assessment accuracy and market value silently redistributes the tax burden. Matching 522,769 residential transactions from 2021–2026 to the triennial assessment rolls of 625 Quebec municipalities at the parcel level, we provide the first province-wide evaluation of vertical and horizontal equity in Canadian property assessment. Assessment ratios decline steeply with price: within municipality $\times$ roll $\times$ sale-year markets, the elasticity of the assessment ratio with respect to the sale price is -0.34, and a rank-based instrumental-variable estimator in the spirit of Clapp (1990)—which purges the attenuation bias that pushes least-squares tests toward spurious regressivity—still yields -0.08 ($t \approx 4$). IAAO ratio-study diagnostics place 95% of municipalities below the acceptable price-related bias band and 99% above the COD uniformity ceiling; Montréal is the only large market whose assessments are progressive. Regressivity is strongest for single-family homes, older buildings, properties with a high assessed land share, and smaller municipalities, and it doubles in years when market prices decouple from the rolls' reference dates, pointing to infrequent revaluation as a first-order mechanism. The implied intra-municipal tax shift is large: the median dwelling in the bottom within-market price decile pays roughly 65% more property tax than it would under uniform assessment, while the top decile pays about 5% less.

Keywords: Property tax, Assessment, Vertical equity, Regressivity, Ratio study, Quebec

JEL Classification: H71, H22, R51, R31

1. Introduction

The property tax is the fiscal backbone of Canadian local government: it finances roughly two thirds of municipal budgets and is, by statute, an *ad valorem* tax — every dwelling in a municipality is meant to be taxed in strict proportion to its market value. That proportionality rests entirely on the quality of the assessment roll. If assessors systematically overvalue inexpensive homes relative to expensive ones, the legal tax rate becomes a fiction: the effective tax rate falls with wealth, and the resulting redistribution — from modest neighbourhoods toward affluent ones — occurs silently, without any legislative decision, embedded in a technical document that few taxpayers ever contest. A rapidly growing literature documents exactly this pattern in the United States, where assessment regressivity has been measured at national scale (Berry, 2021; Avenancio-León and Howard, 2022; Amornsiripanitch, 2022). Whether the same pathology afflicts Canadian assessment systems — centralized, professionally supervised, and widely presumed to be of high quality — is essentially unknown.

This paper provides the first province-wide answer for Quebec. We assemble 522,769 residential transactions recorded between January 2021 and July 2026 and match each sale, at the parcel level, to the triennial municipal assessment roll in force on the day of the sale. The match is performed on geographic coordinates and validated against the roll's recorded value; the median match distance is under one metre. The resulting file couples every sale price with the exact taxable value that generated the owner's property tax bill, together with the roll's decomposition of that value into land and building components, structural descriptors (lot area, floor area, year built, number of units), and the statutory market-condition reference date of the roll. The data span 625 municipalities — from Montréal (79,581 usable sales) to towns with barely a hundred — and a housing cycle of unusual amplitude: the post-pandemic boom, the 2022–2023 interest rate shock, and the subsequent recovery.

Quebec's institutional design makes it an unusually clean laboratory for equity measurement. Every municipality's roll is redone on a fixed three-year cycle, and by law (art. 46, *Loi sur la fiscalité municipale*) the values entered on a roll must reflect market conditions eighteen months before the roll takes effect — a single, known reference date shared by every property in the municipality (Gouvernement du Québec, 2026; Ministère des Affaires municipales et de l'Habitation, 2024). Within a municipality $\times$ roll $\times$ sale-year block, therefore, every assessment embodies the same market vintage, and any systematic relationship between assessment ratios and prices inside such a block is inequity, not timing. Our empirical design exploits exactly this structure: all regression estimates absorb 2,884 municipality $\times$ roll $\times$ year fixed effects, so that vertical inequity is identified purely from comparisons between cheap and expensive dwellings facing the same assessor, the same roll, and the same market moment.

Three findings emerge. First, assessment regressivity in Quebec is pervasive, large, and statistically unambiguous. The elasticity of the assessment ratio with respect to the sale price — zero under proportional assessment — is -0.34 (s.e. 0.03) in the fixed-effects log-log regression. Because sale prices measure market value with noise, part of that estimate reflects mechanical attenuation (Kochin and Parks, 1982; Clapp, 1990); a rank-based instrumental-variables estimator in the spirit of Clapp (1990) that purges this bias still yields -0.08 (s.e. 0.02). Under the IAAO ratio-study standards used by assessment authorities across North America (International Association of Assessing Officers, 2013), 95% of Quebec municipalities fall outside the acceptable band for price-related bias and 99% exceed the uniformity (COD) ceiling. Strikingly, Montréal — the province's largest and best-resourced assessment jurisdiction — is the *only* major market whose assessments are progressive.

Second, the inequity has a clear anatomy. Regressivity is roughly four times stronger for single-family homes and plexes than for condominiums, whose quasi-homogeneous units are easy to mass-appraise; it rises steeply with building age and with the assessed land share of the property, consistent with the difficulty of valuing land and depreciated structures (Bostic et al., 2007; Gloudemans and Almy, 2011); and it is worse in small municipalities, echoing the thin-market mechanism of McMillen and Weber (2008). The quantile profile is equally telling: the log-log slope falls from 0.87 at the first decile of the conditional value distribution to 0.49 at the ninth, so the failure of proportionality is concentrated at the top — expensive homes are not merely under-assessed, they are under-assessed at an accelerating rate.

Third, the stakes are material. Within a taxing jurisdiction the levy is proportional to assessed value, so a property assessed above the jurisdiction median ratio pays exactly that percentage more tax than uniform assessment would imply. The median dwelling in the bottom within-market price decile pays roughly 65% more property tax than under uniform assessment; the median dwelling in the top decile pays about 5% less. Put differently, the effective tax schedule that Quebec's assessment machinery delivers is regressive enough to undo, within each municipality, a substantial share of whatever progressivity the rest of the fiscal system achieves — a finding that complements Carbonnier (2024), who documents the regressivity of Quebec's property tax relative to income using survey data, but who could not observe the assessment channel isolated here.

We also show *when* the gap opens. Assessment ratios drift mechanically between reference dates, and the province-wide price-related bias doubles in 2021–2022, precisely when the post-pandemic boom pulled market prices away from rolls anchored in 2018–2020 conditions — direct evidence that infrequent revaluation is a first-order driver of measured inequity, as conjectured in the U.S. literature (Berry, 2021; Ross, 2012). Because the diagnosis singles out stale rolls, thin markets, and hard-to-value property types — rather than assessor discretion alone — it maps directly into policy: shorter revaluation cycles, pooled assessment services for small municipalities, and targeted review

of high-land-share and older properties.

Beyond the Canadian evidence gap, the paper makes two methodological contributions to the ratio-study literature. It is, to our knowledge, the first large-scale equity study to exploit a statutory single-date reference regime to separate timing drift from genuine vertical inequity by design rather than by econometric correction; and it implements the full modern test battery — IAAO diagnostics with bootstrap inference (International Association of Assessing Officers, 2013), the classical regression tests (Paglin and Fogarty, 1972; Cheng, 1974), measurement-error-robust IV (Clapp, 1990), and quantile profiles (McMillen and Singh, 2020) — on more than half a million sales, allowing precise subgroup estimates that smaller samples cannot support.

The remainder of the paper proceeds as follows. Section 2 positions the paper in the ratio-study and property-tax-equity literatures. Section 3 describes Quebec's assessment institutions. Section 4 presents the data and the matched sample. Section 5 lays out the diagnostics and econometric specifications. Section 6 reports the results, Section 7 the robustness battery, Section 8 discusses mechanisms and policy implications, and Section 9 concludes.

2. Related literature

2.1. Measuring vertical inequity: from ratio studies to modern tests

The empirical study of assessment equity is nearly as old as the modern property tax. Its workhorse is the *sales ratio study*: for each sale i, compute the ratio $r_i = AV_i/SP_i$ of assessed value to sale price and ask whether r_i is uniform across the value distribution. The practitioner's canon — codified in the IAAO *Standard on Ratio Studies* (International Association of Assessing Officers, 2013) and the mass-appraisal manuals of Eckert et al. (1990) and Gloudemans and Almy (2011) — summarizes a jurisdiction with the median ratio, the coefficient of dispersion (COD) for horizontal uniformity, and the price-related differential (PRD) or, since 2013, the coefficient of price-related bias (PRB) for vertical equity. These diagnostics discipline assessment practice across North America, and we report all of them, with bootstrap confidence intervals, for every Quebec municipality with sufficient sales.

The academic literature grew out of dissatisfaction with those summary measures. Paglin and Fogarty (1972) proposed regressing assessed value on sale price in levels and reading regressivity off a positive intercept; Cheng (1974) moved the test to logarithms, where the slope β has the clean interpretation of an elasticity and $\beta < 1$ signals regressivity. Subsequent work refined the specification menu — Bell (1984) and Sunderman et al. (1990) allowed splines and structural breaks, and Sirmans et al. (1995) surveyed the proliferating test battery. A decisive critique came from Kochin and Parks (1982) and Kennedy (1984): because the sale price is itself a noisy measure of market value, the log-log slope is attenuated toward zero even under perfectly proportional

assessment — ratio studies are biased *toward* finding regressivity. Clapp (1990) answered with a rank-based instrumental-variables estimator whose coarse instrument is nearly orthogonal to transitory price noise; Goolsby (1997) and McMillen and Singh (2020) document how severely the correction can matter, and Quintos (2020) extends the toolkit with machine-learning diagnostics. Our design follows this lesson to the letter: we report the naïve estimates, the Clapp IV, and quantile profiles (McMillen and Singh, 2020) side by side, and treat the IV as the lower bound on true regressivity.

2.2. Evidence: pervasive regressivity, mostly documented in the U.S.

Substantively, the modern consensus is that assessment regressivity is the rule rather than the exception. Berry (2021) computes ratio statistics for essentially every U.S. county and finds that the lowest-decile home within a jurisdiction faces an effective tax rate roughly double that of the top decile; Avenancio-León and Howard (2022) show in the *QJE* that the same machinery generates a 10–13% assessment gap against Black and Hispanic homeowners, driven partly by unpriced neighbourhood attributes and partly by differential appeals; Amornsiripanitch (2022) attributes much of the gradient to assessors' inability to capture unobserved quality that scales with price. Earlier strands documented the same pattern city by city — Engle (1975) in Boston, Baar (1981) across low-income neighbourhoods, McMillen (2011) and McMillen and Weber (2008) in Illinois, where thin markets and infrequent reassessment emerge as structural drivers, Hodge et al. (2017) in collapsing Detroit, and Plummer (2014) and Ihlanfeldt and Rodgers (2022) on the role of appeals and exemptions. Ross (2012) shows regressivity responds to the institutional incentives of assessors themselves. The mechanism menu that emerges — stale valuations, hard-to-value heterogeneous properties, thin markets, asymmetric appeals — guides our heterogeneity analysis directly.

2.3. Canada: a conspicuous gap

For Canada the cupboard is nearly bare. Ontario's assessment corporation publishes an internal vertical-equity review of its own values (Municipal Property Assessment Corporation, 2022), and Found and Tomlinson (2017) compare tax *rates* across cities, but neither measures sale-level equity. For Quebec, Carbonnier (2024) establishes with survey microdata that property tax payments are steeply regressive relative to *income*; the assessment channel — whether the tax base itself is mismeasured against *market value* — has never been examined at scale, for Quebec or for any Canadian province. This is the gap the present paper fills. The Canadian case is of independent interest precisely because its institutions differ from the fragmented U.S. county system on the dimensions the U.S. literature blames: Quebec assessment is governed by a uniform provincial statute and manual (Gouvernement du Québec, 2026; Ministère des Affaires municipales et de

l'Habitation, 2024), performed by certified professional evaluators, and synchronized to a statutory market-condition date. Finding large regressivity *despite* this apparatus sharpens the interpretation considerably: the problem is not lax governance but the intrinsic difficulty of mass appraisal, compounded by triennial staleness.

2.4. Hedonic foundations

Finally, the paper connects to the hedonic tradition. Mass appraisal is applied hedonics (Rosen, 1974; Malpezzi, 2003): the assessor's model prices a bundle of structural and locational attributes, and equity failures are hedonic specification failures — unpriced land-share gradients (Bostic et al., 2007), depreciation curvature, or neighbourhood effects that Quebec practitioners have long modelled in the Quebec City market (Des Rosiers et al., 2000). Reading our subgroup estimates through this lens turns an audit into a diagnosis: the assessment gap is largest exactly where the hedonic problem is hardest.

3. Institutional setting: property assessment in Quebec

Quebec's municipal fiscal regime is governed by the *Loi sur la fiscalité municipale* (LFM) and operationalized by the province's assessment manual, the *Manuel d'évaluation foncière du Québec* (Gouvernement du Québec, 2026; Ministère des Affaires municipales et de l'Habitation, 2024). Four features matter for the measurement design of this paper.

Triennial rolls. Every municipality's assessment roll is redrawn on a fixed three-year cycle by a municipal body or a contracted private firm under the responsibility of a chartered evaluator. The roll lists, for each assessment unit, the taxable value of the property and its decomposition into land and building components, along with the structural descriptors used in valuation (lot area, floor area, year of construction, number of dwelling units, physical configuration, and a standardized use code, the CUBF).

A statutory market-condition date. Article 46 of the LFM requires that the values entered on a roll reflect the state of the market *eighteen months before* the roll takes effect: a roll entering force on January 1 of year t must value every property as of July 1 of year $t-2$. This single reference date is printed on the roll itself and is common to every property in the municipality. Two implications follow. First, in a rising market the *level* of assessment ratios drifts mechanically below one as sales occur further from the reference date — between 18 and 54 months elapse between the reference date and a sale, 36 months at the median in our sample. This drift is a feature of the system, not an inequity, and our empirical design absorbs it entirely with municipality $\times$ roll $\times$ sale-year fixed

effects. Second, and crucially, *within* such a block every property shares the same market vintage, so cross-sectional patterns in ratios cannot be attributed to timing.

Uniform taxation of the rolled value. The municipal levy on a residential property is the rolled taxable value multiplied by the municipal rate (plus school taxes levied on the same base). There are no assessment-growth caps, homestead exemptions, or acquisition-value rules of the Californian or Floridian type: relative taxable values within a municipality equal relative assessed values. This makes the mapping from assessment error to tax-burden redistribution exact — a property assessed 10% above the jurisdiction's median ratio pays 10% more tax than uniform assessment would imply — and motivates the tax-shift calculation of Section 6.

Oversight and appeal. The Ministry of Municipal Affairs (MAMH) prescribes methods and audits rolls; owners may request an administrative review and appeal to the Tribunal administratif du Québec. Appeal rates for residential property are low. Unlike several U.S. jurisdictions studied in the literature (Plummer, 2014; Avenancio-León and Howard, 2022), Quebec's appeal system plays a minor quantitative role for the housing stock at large, which makes the valuation model itself — rather than post-assessment litigation — the natural locus of any inequity we measure.

Taken together, these institutions imply that Quebec should be a *best-case* environment for assessment equity: uniform provincial methodology, professional certification, statutory synchronization of market vintage, and a tax that consumes the rolled value without exemption-driven distortions. The magnitude of the inequity we document below should be read against this backdrop.

4. Data and sample construction

4.1. Sources and matching

We start from a compiled registry of 745,119 residential-market transactions recorded in Quebec between January 2021 and July 2026, each carrying the sale price, sale date, civic address, geographic coordinates, and a listing-derived property type. Each transaction has been matched at the parcel level to the municipal assessment roll in force on the sale date. The match keys on geographic proximity between the transaction's coordinates and the roll unit's coordinates and is validated against the roll's recorded value; a composite score (maximum 220) summarizes the quality of the address, distance and value agreement. Matches are extremely tight: the median distance between the transaction and the matched roll unit is 0.6 metres, and every observation retained in the estimation sample reproduces the roll's assessed value exactly.

From the roll we observe the taxable value of the property (AV, `valeur immeuble`), its land and building components, lot area, total floor area, year of construction, number of dwelling units,

Table 1. Summary statistics, estimation sample

Variable	n	Mean	SD	P10	Median	P90
Sale price ($)	522,769	462,131	331,669	175,000	400,000	787,500
Assessed value ($)	522,769	378,576	284,509	155,000	309,400	664,500
Assessment ratio AV/SP	522,769	0.878	0.429	0.579	0.784	1.138
Roll lag (months)	522,769	37.1	11.3	22.5	36.2	50.7
Assessed land share	519,330	0.310	0.149	0.126	0.296	0.511
Building age (years)	498,458	43.6	30.1	10.0	39.0	79.0
Lot area (m^2)	522,475	1,406	10,906	112	556	2,258
Floor area (m^2)	515,958	137.6	84.9	75.9	112.0	225.9

Notes: 522,769 residential sales, January 2021 – July 2026, matched at the parcel level to the assessment roll in force at the sale date. The assessment ratio is assessed value divided by sale price. Roll lag is the number of months between the roll's statutory market-condition reference date (July 1) and the sale date. The assessed land share is the roll's land value divided by total assessed value.

the standardized use code (CUBF), the roll vintage, and the statutory market-condition reference date discussed in Section 3.

4.2. Sample restrictions

Table 1 describes the estimation sample; the selection cascade is as follows. We keep sales of residential use codes — dwellings (CUBF 1000), cottages (1100), mobile homes (1211) and other residential (1990) — which removes vacant land, commercial property and construction-in-progress (672,276 sales remain). We require a high-confidence roll match (distance ≤ 50 m and score ≥ 150; 568,711 sales), a positive assessed value and a price of at least $50,000 — the floor of the source registry, which also screens out most non-arm's-length transfers. Assessment ratios $r_i = AV_i/SP_i$ are trimmed at the 1st and 99th percentiles *within each roll vintage*, so that the mechanical drift of ratio levels across vintages is not trimmed asymmetrically (557,325 sales). Finally, since all estimates compare sales within a municipality $\times$ roll $\times$ sale-year block ("cell"), we require at least 20 sales per cell. The estimation sample contains **522,769 sales** in 625 municipalities and 2,884 cells: 345,053 single-family homes, 81,693 plexes (2–5 units), 81,461 condominiums, 9,287 cottages and 4,701 mobile homes.

4.3. The raw pattern

The median assessment ratio is 0.78: the typical dwelling sells for about 28% more than its rolled value, the expected imprint of a rising market on back-dated rolls. Figure 1 shows the distribution and its decomposition by roll lag: sales occurring within two years of the reference date centre near 0.87, while sales more than four years out centre near 0.64 — the mechanical staleness gradient that our fixed effects absorb. Figure 2 traces the same mechanics in calendar time: each roll vintage

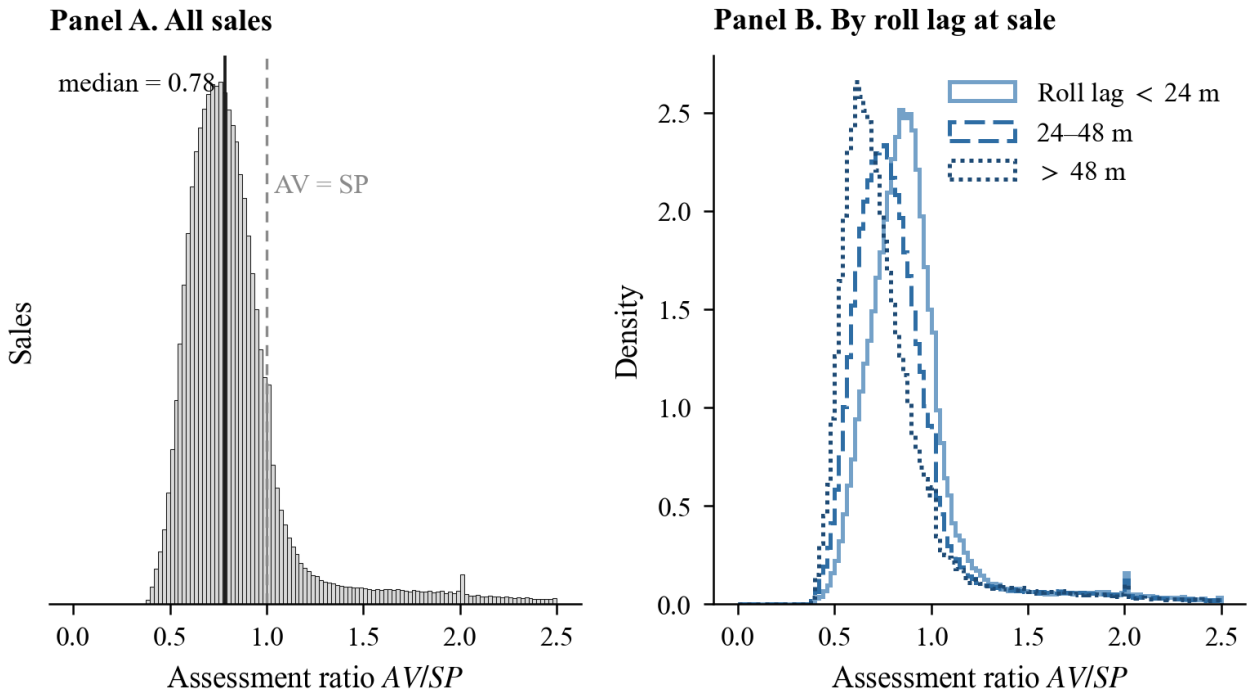

Figure 1. Assessment ratios. Panel A: distribution of AV/SP across the estimation sample; the median is 0.78 and the dashed line marks parity. Panel B: kernel of the same distribution split by the number of months between the roll's market-condition reference date and the sale; older rolls sit systematically further below parity.

enters near parity with the market it was referenced on, then drifts down as prices rise, and the 2022–2023 rate shock is visible as a flattening of the drift. Everything that follows nets out this timing structure and asks a sharper question: *within* a given municipality, roll, and year, do cheap and expensive homes face the same ratio?

5. Methodology

Let AV_i denote the assessed value of property i on the roll in force at its sale, SP_i its sale price, and $r_i = AV_i/SP_i$ the assessment ratio. Under perfectly proportional (vertically equitable) assessment, $\mathbb{E}[r_i \mid SP_i]$ is constant. All tests below ask, in different ways, whether r_i instead declines with value.

5.1. IAAO ratio-study diagnostics

For any group of sales we report the four statistics of the IAAO *Standard on Ratio Studies* (International Association of Assessing Officers, 2013). The *median ratio* measures the assessment level. The *coefficient of dispersion*, $\mathrm{COD} = 100 \cdot \mathrm{mean}(|r_i - \tilde{r}|)/\tilde{r}$ with $\tilde{r}$ the median ratio, measures horizontal uniformity; the standard deems residential CODs above 15 unacceptable. The *price-related differential*, $\mathrm{PRD} = \bar{r} / (\sum_i AV_i / \sum_i SP_i)$, compares the unweighted and value-weighted mean ratios;

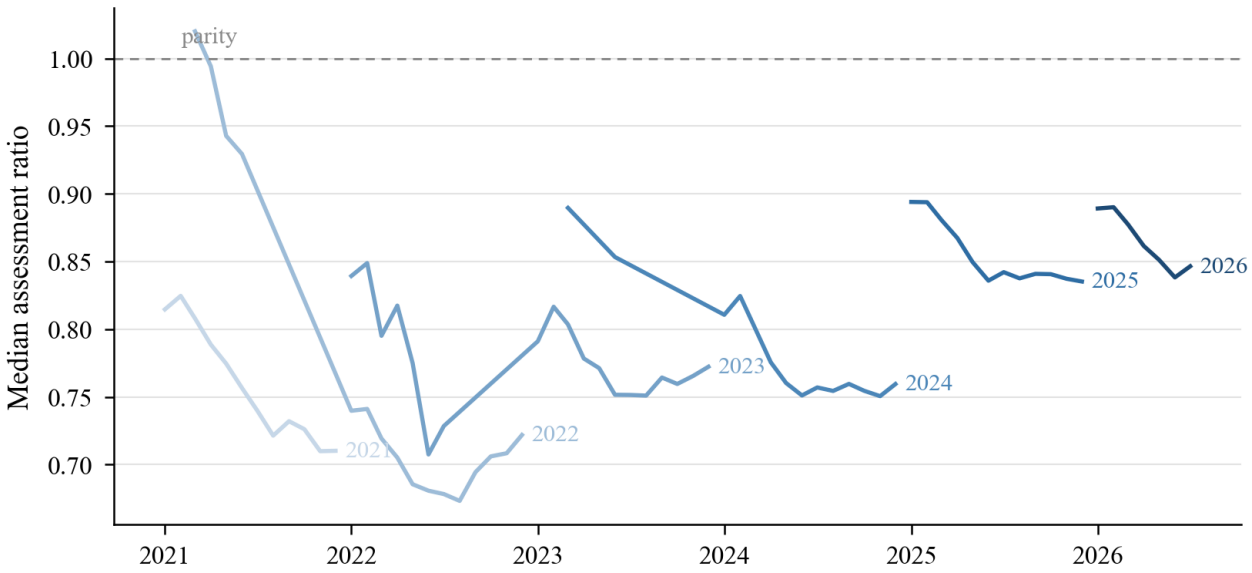

Figure 2. Median assessment ratio by sale month and roll vintage. Each line follows sales assessed under one triennial vintage (labelled by entry year); monthly medians with fewer than 100 sales are suppressed. Vintages enter near their reference-date market level and drift down as prices rise; the flattening after 2022 reflects the interest-rate correction.

PRD > 1.03 indicates regressivity. Because the PRD is sensitive to outliers, the standard's preferred vertical measure is the *coefficient of price-related bias* (PRB), the slope b in

$$\frac{r_i - \tilde{r}}{\tilde{r}} \;=\; a + b \cdot \log_2\!\left(\tfrac{1}{2}SP_i + \tfrac{1}{2}AV_i/\tilde{r}\right) + u_i, \tag{1}$$

which measures the proportional change in the ratio per doubling of value; the acceptable band is $[-0.05, 0.05]$. We compute percentile-bootstrap confidence intervals for all four statistics. Because ratio levels drift with roll staleness, municipality-level diagnostics are computed within municipality $\times$ sale-year blocks — inside which a single roll is in force — and aggregated across years by the median.

5.2. Regression tests with market-timing fixed effects

Our workhorse is the log-log specification of Cheng (1974),

$$\ln AV_i \;=\; \alpha_{c(i)} + \beta \, \ln SP_i + \varepsilon_i, \tag{2}$$

where $c(i)$ indexes the municipality $\times$ roll $\times$ sale-year cell of sale i and the α_c are 2,884 absorbed fixed effects. Proportionality implies $\beta = 1$; we report $\gamma \equiv \beta - 1$, the elasticity of the assessment *ratio* with respect to price ($\gamma < 0$: regressive). The fixed effects guarantee that γ is identified only from comparisons of dwellings assessed by the same authority, on the same roll vintage, and

sold in the same year — purging the staleness drift, municipal composition, and aggregate market movements in one stroke. For completeness we also report the pooled regression without fixed effects and the levels test of Paglin and Fogarty (1972). Inference is clustered at the municipality level throughout (625 clusters).

5.3. Measurement error and the Clapp instrument

Sale prices measure market value with idiosyncratic noise — bilateral bargaining, unobserved conditions of sale — so OLS on equation (2) suffers attenuation bias: $\hat{\beta} < 1$ even under proportional assessment (Kochin and Parks, 1982; Kennedy, 1984). Following Clapp (1990), we instrument $\ln SP_i$ with a coarse rank variable $Z_i \in \{-1, 0, +1\}$ that flags sales in the bottom or top third of *both* the within-cell $\ln AV$ and $\ln SP$ distributions. Because Z_i retains only ordinal information agreed on by both measures of value, it is (nearly) orthogonal to the transitory component of either, and the resulting two-stage least-squares estimate of β is consistent under classical measurement error. The demeaned-within-cell implementation preserves the fixed-effects structure. Throughout the paper we treat γ_{IV} as a conservative lower bound on regressivity and γ_{FE} as the descriptive upper bound; the truth lies between.

5.4. Quantile profile and heterogeneity

Averaging can hide where proportionality fails. We estimate equation (2) by quantile regression on within-cell demeaned variables at $\tau \in \{0.10, 0.25, 0.50, 0.75, 0.90\}$ (McMillen and Singh, 2020), tracing $\beta(\tau)$ across the conditional distribution of assessed values. We then re-estimate the fixed-effects model on subsamples — property class, building-age bands, assessed-land-share bands, roll-lag bands, municipality size, and sale year — keeping only cells that retain at least 20 sales, to locate the inequity where the mass-appraisal problem is hardest.

5.5. Horizontal inequity

Vertical tests concern the *mean* of r_i given value; horizontal equity concerns its *dispersion* among comparable properties (Allen and Dare, 2002; Sirmans et al., 2008). Beyond the COD, we ask who receives noisy assessments: we regress the absolute deviation of a sale's log ratio from its cell median, $|\ln r_i - \mathrm{med}_{c(i)} \ln r|$, on property characteristics (age, land share, property-class indicators) with cell fixed effects.

5.6. The implied tax shift

Because Quebec taxes the rolled value without exemptions or caps (Section 3), a property whose ratio exceeds its jurisdiction's median by $x\%$ pays exactly $x\%$ more tax than uniform assessment

Table 2. IAAO ratio-study diagnostics, province-wide

Sample	n	Median ratio	COD	PRD	PRB
All sales 2021–2026	522,769	0.784	28.5	1.072	-0.0292
		[0.784, 0.785]	[28.3, 28.6]	[1.071, 1.073]	[-0.0312, -0.0272]
2021	115,221	0.759	26.6	1.098	-0.1044
		[0.757, 0.760]	[26.4, 26.8]	[1.096, 1.100]	[-0.1078, -0.1013]
2022	90,627	0.700	30.2	1.114	-0.1165
		[0.699, 0.701]	[29.9, 30.5]	[1.112, 1.117]	[-0.1209, -0.1107]
2023	74,110	0.768	30.2	1.067	-0.0146
		[0.767, 0.769]	[29.8, 30.4]	[1.064, 1.069]	[-0.0198, -0.0085]
2024	89,204	0.765	29.5	1.061	-0.0022
		[0.764, 0.767]	[29.2, 29.8]	[1.059, 1.063]	[-0.0071, 0.0031]
2025	102,026	0.851	25.5	1.070	-0.0389
		[0.850, 0.851]	[25.2, 25.7]	[1.068, 1.072]	[-0.0440, -0.0344]
2026	51,581	0.857	25.5	1.068	-0.0305
		[0.855, 0.858]	[25.1, 25.9]	[1.065, 1.071]	[-0.0383, -0.0240]

Notes: Median assessment ratio, coefficient of dispersion (COD), price-related differential (PRD) and coefficient of price-related bias (PRB), computed on the estimation sample; 95% percentile-bootstrap confidence intervals (200 replications) in brackets. IAAO acceptable ranges: COD ≤ 15 (single-family residential), PRD $\in [0.98, 1.03]$, PRB $\in [-0.05, 0.05]$.

would imply. For each sale we compute the relative assessment error $e_i = r_i / \operatorname{med}_{c(i)}(r) - 1$ and average it by within-cell sale-price decile. This translates the econometrics into the policy-relevant object: the percentage over- or under-payment of property tax by position in the local price distribution.

6. Results

6.1. Province-wide diagnostics

Table 2 reports the IAAO statistics for the full sample and by sale year. Three facts stand out. First, uniformity is poor everywhere: the province-wide COD is 28.5, and even within municipality-year blocks the median municipality posts a COD of 26 — nearly twice the IAAO ceiling of 15 for residential property; 99% of municipalities exceed it (Figure 3). Second, every vertical measure points the same way: the PRD is 1.072 (acceptable range 0.98–1.03) and the PRB is -0.029 with a bootstrap confidence interval far from zero — ratios fall by about 3% of the median with every doubling of value. Third, the time pattern is diagnostic: the PRB collapses to -0.104 and -0.117 in 2021 and 2022 — when the boom pulled prices away from rolls referenced on 2018–2020 markets — and shrinks to -0.002 in 2024 before widening again. Vertical inequity is not a fixed institutional constant; it breathes with the gap between the market and the roll's vintage.

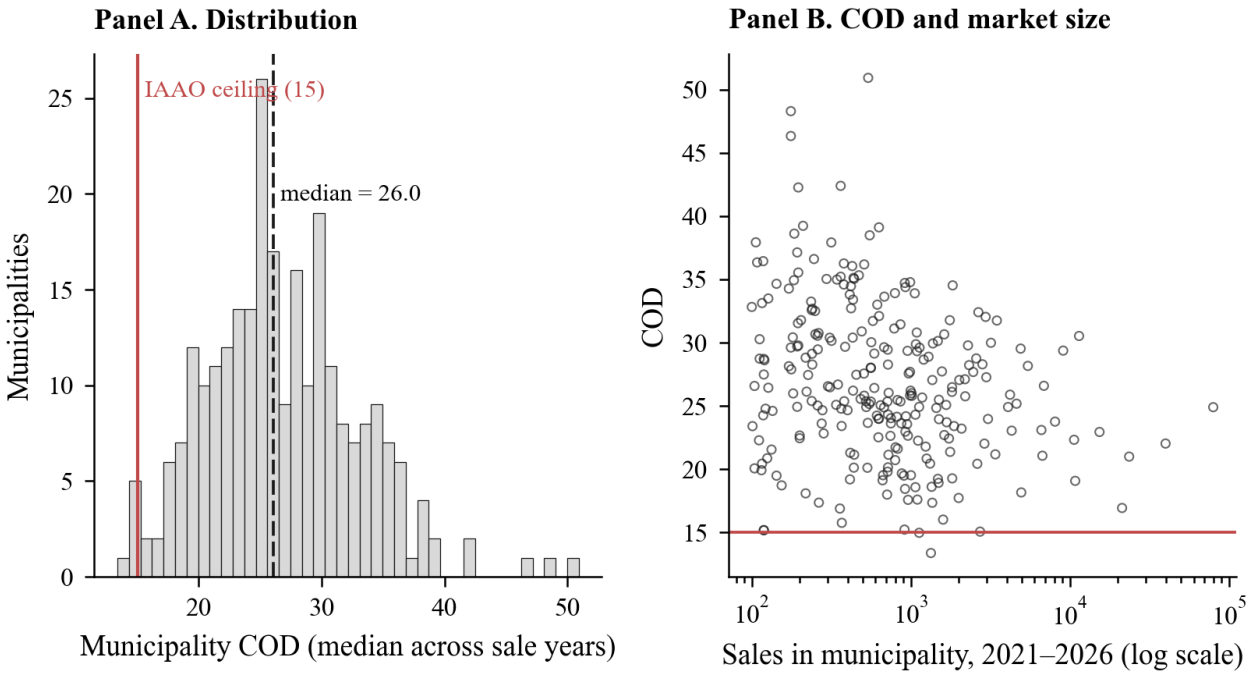

Figure 3. Horizontal uniformity. Panel A: distribution of municipality-level CODs (median across sale-year blocks); the IAAO ceiling for residential property is 15. Panel B: COD against the number of sales in the municipality; dispersion is worst in the thinnest markets.

Table 3 disaggregates the ten largest markets. Regressivity is significant in nine of them — Sherbrooke (-0.39), Trois-Rivières (-0.32) and Terrebonne (-0.29) are the worst — in every single sale year. The exception is Montréal, whose PRB of $+0.07$ makes it the lone *progressive* large jurisdiction in the province, in all six years. We return to this contrast in Section 8. Figure 5 maps the municipal estimates: regressive (red) municipalities carpet the province, with the Montréal agglomeration a solitary blue island, and Figure 4 shows the distribution: 99% of the 261 municipalities with at least 100 usable sales have a negative PRB, and 95% fall below the IAAO band.

6.2. Regression estimates

Table 4 presents the econometric core. Figure 6 shows the raw material: within municipality $\times$ roll $\times$ year cells, mean log assessment ratios fall monotonically — and remarkably linearly through the central 90% of the distribution — as log prices rise. The pooled Cheng (1974) elasticity is $\beta = 0.812$ (s.e. 0.029); absorbing the 2,884 cell fixed effects *steepens* it to $\beta = 0.656$, i.e. $\gamma_{\text{FE}} = -0.344$: within the same market and vintage, a home priced 10% above its neighbours is assessed only about 6.6% higher, so its ratio is 3.4% lower. The levels test of Paglin and Fogarty (1972) agrees: the intercept is \$31,729 (s.e. \$5,378) — inexpensive properties carry a fixed assessment premium.

Table 3. Assessment equity in the ten largest markets

Municipality	n	Median ratio	COD	PRD	PRB	Share of years PRB < 0
Montréal	79,581	0.892	24.9	1.057	0.0697	0.00
Québec	39,927	0.809	22.0	1.071	-0.0480	1.00
Laval	23,569	0.729	21.0	1.076	-0.1677	1.00
Gatineau	21,270	0.798	16.9	1.050	-0.1366	1.00
Longueuil	15,343	0.699	22.9	1.074	-0.1276	1.00
Sherbrooke	11,413	0.744	30.5	1.137	-0.3872	1.00
Saguenay	10,794	0.787	19.1	1.064	-0.1885	1.00
Lévis	10,622	0.827	22.3	1.089	-0.2369	1.00
Trois-Rivières	9,070	0.729	29.4	1.123	-0.3167	1.00
Terrebonne	8,061	0.795	23.8	1.096	-0.2896	1.00

Notes: Statistics computed within municipality $\times$ sale-year blocks (a single roll in force per block) and aggregated across years by the median; n is the total number of sales. The last column is the share of the six sale years in which the municipality's PRB is negative.

How much of this is measurement-error artefact? The Clapp (1990) instrument delivers $\beta_{\text{IV}} = 0.917$ (s.e. 0.021): attenuation indeed accounts for the majority of the naïve gap, exactly as the critique of Kochin and Parks (1982) predicts — but the corrected elasticity remains four standard errors below one. Genuine regressivity of roughly -0.08 survives the harshest correction in the literature. An 8% ratio penalty per log-point of value is economically large: across the interquartile price range within a typical market (roughly 0.8 log points), it generates a 6–7% differential in effective tax rates from vertical inequity alone, before adding the much larger dispersion documented below.

6.3. Where proportionality fails: the quantile profile

Figure 7 plots $\beta(\tau)$. The profile is strikingly asymmetric: β is 0.87 at $\tau = 0.10$ and 0.86 at $\tau = 0.25$, then falls to 0.70 at $\tau = 0.75$ and 0.49 at $\tau = 0.90$ (Table 9 in the robustness section reports the coefficients). Assessment tracks the market tolerably well through the middle of the distribution and loses contact at the top: the most expensive homes within each market are under-assessed at an accelerating rate. This is the signature of hedonic truncation — mass-appraisal models built on mid-market comparables extrapolate poorly into thin luxury segments (Amornsiripanitch, 2022; Gloudemans and Almy, 2011).

6.4. The anatomy of regressivity

Figure 8 and Table 5 dissect γ_{FE} by subsample, and the pattern reads like a map of mass-appraisal difficulty:

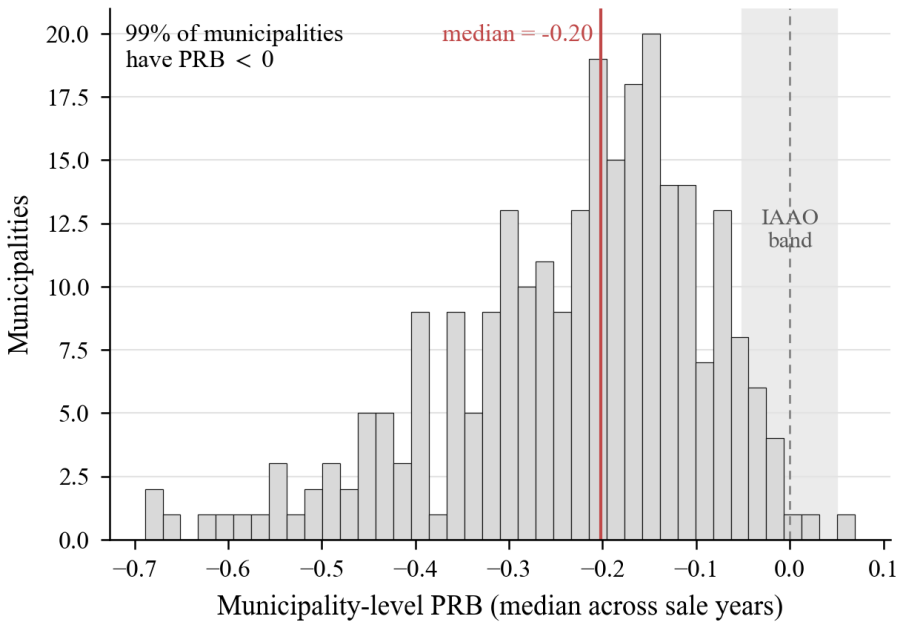

Figure 4. Distribution of municipality-level PRB across the 261 municipalities with at least 100 usable sales. The shaded band is the IAAO acceptable range $[-0.05, 0.05]$.

- **Property class.** Condominiums — homogeneous units with abundant comparables — show $\gamma = -0.12$, single-family homes -0.45 and plexes -0.49. The assessor's problem, not the assessor's jurisdiction, drives the gradient.
- **Building age.** Regressivity deepens from -0.30 (under 20 years) to -0.43 (over 60): depreciation and renovation heterogeneity are hard to observe from the roll.
- **Land share.** The starkest gradient: -0.26 where land is under 20% of assessed value versus -0.50 where it exceeds 40%. Land is the component without construction-cost anchoring (Bostic et al., 2007), and properties whose value is mostly land are assessed worst.
- **Municipality size.** Large markets (>10k sales) do better (-0.27) than mid-sized ones (-0.41), consistent with McMillen and Weber (2008).
- **Stability.** Estimates are remarkably stable across sale years (-0.32 to -0.38) and roll lags — unlike the *level* statistics, the within-market elasticity is a structural feature of the valuation technology, not of the cycle.

6.5. Horizontal inequity

Table 6 reports the dispersion regression. The mean absolute deviation of a sale's log ratio from its cell median is 0.188 — the typical Quebec dwelling is assessed 19% away from its market's norm, an enormous horizontal lottery consistent with the COD evidence. The deviation rises by 0.75 log points per decade of building age and by 5.2 points for cottages, and falls by 5.5 points for condominiums. Old, idiosyncratic, land-heavy properties receive not only biased but *noisy*

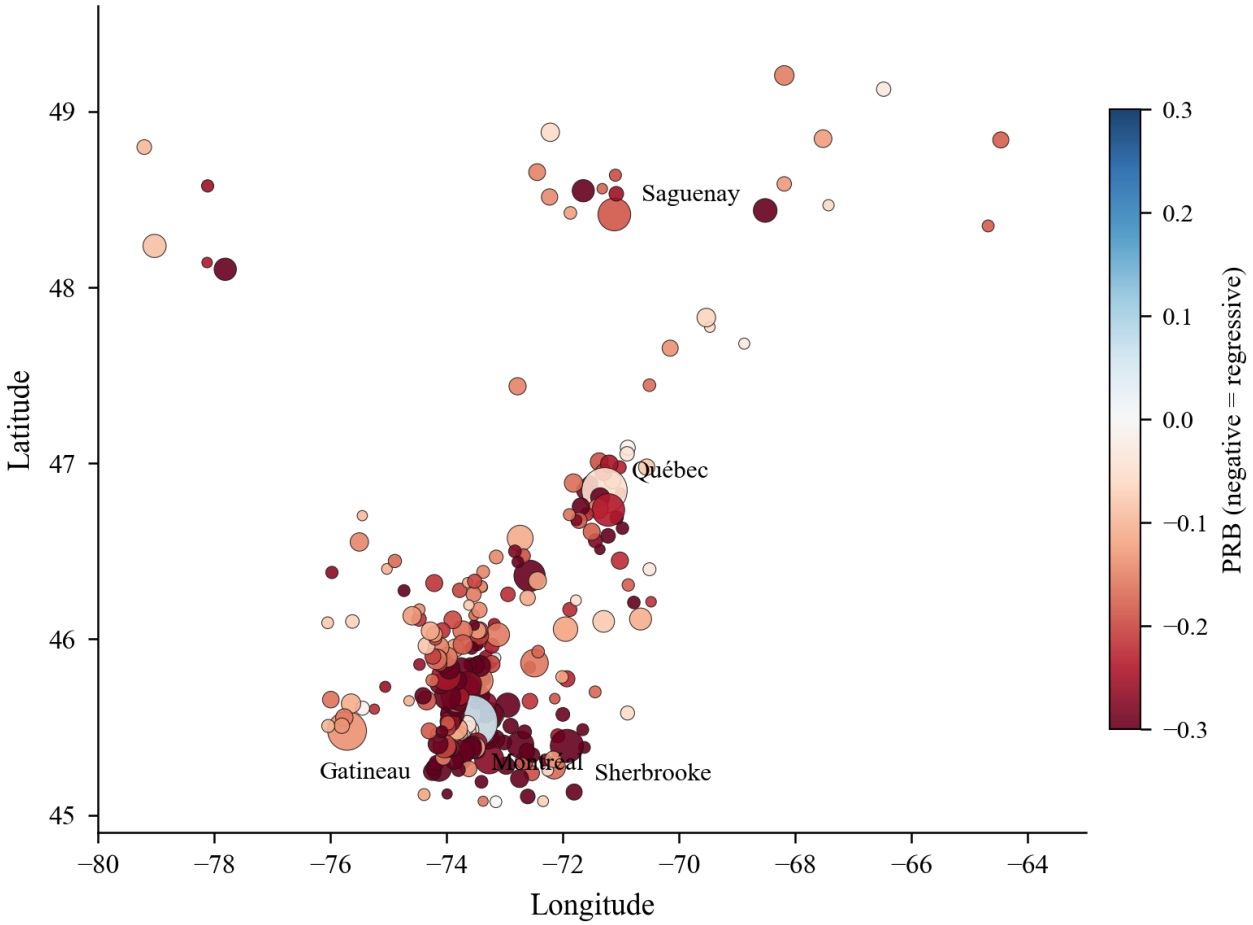

Figure 5. The geography of vertical inequity. Municipality-level PRB (median across sale-year blocks); bubble area is proportional to the square root of the number of sales. Montréal is the only large progressive jurisdiction.

valuations.

6.6. The implied tax shift

Figure 9 and Table 7 translate the estimates into tax dollars. Within the median market, the median dwelling in the bottom price decile is assessed 65% above the local norm — and therefore pays 65% more property tax than uniform assessment would imply. The overpayment falls to +7% in the second decile and crosses zero at the median; the top decile underpays by about 5%. The redistribution is strongly convex: the burden of assessment error is overwhelmingly concentrated on the cheapest tenth of the housing stock — precisely the segment where owners have the least capacity to appeal and the highest housing-cost burdens. The magnitudes rival those documented for the U.S. by Berry (2021), in a system with none of the U.S.'s institutional fragmentation.

Table 4. Vertical-inequity regressions

	(1) Cheng OLS	(2) Cheng FE	(3) Clapp IV
β (ln sale price)	0.812***	0.656***	0.917***
	(0.029)	(0.029)	(0.021)
$\gamma = \beta - 1$	-0.188	-0.344	-0.083
Cell fixed effects	No	Yes	Yes
Error-in-price robust	No	No	Yes
Observations	522,769	522,769	522,769
R^2	0.705	0.796	0.486

Notes: Dependent variable: $\ln AV$. Column (1): pooled OLS. Column (2): absorbing least squares with 2,884 municipality $\times$ roll $\times$ sale-year fixed effects. Column (3): within-cell 2SLS using the Clapp (1990) rank instrument $Z \in \{-1, 0, +1\}$. Standard errors clustered by municipality (625 clusters) in parentheses. Stars test $H_0 : \beta = 1$ (proportional assessment); *** $p < 0.01$.

7. Robustness

Table 8 and Figure 10 re-estimate the two headline elasticities — γ_{FE} and the Clapp γ_{IV} — across ten sample and measurement variants; Table 9 reports the quantile coefficients underlying Figure 7.

Match quality. Requiring the maximum matcher score of 220 (210,820 sales) or a match distance under 10 metres changes γ_{FE} to -0.41 and -0.36 respectively, and γ_{IV} to -0.10 and -0.09: if anything, the cleanest matches show *more* regressivity, ruling out mismatch noise as the source.

Extreme sales. Dropping all sales under \$100,000 — the segment most likely to harbour residual non-arm's-length transfers — attenuates the FE estimate modestly (-0.30) and the IV to -0.05, both still overwhelmingly significant. Tightening the ratio trim to the 5th–95th percentiles, which mechanically compresses dispersion, cuts γ_{FE} to -0.15 and γ_{IV} to -0.04; the qualitative conclusion is unchanged, and the ordering $|\gamma_{\text{IV}}| < |\gamma_{\text{FE}}|$ is preserved in every variant, as the measurement-error logic requires.

Composition. Single-family homes alone give $\gamma_{\text{FE}} = -0.45$; condominiums alone -0.12 (with an IV estimate indistinguishable from zero), confirming that the aggregate result is not an artefact of pooling heterogeneous property classes — each class is regressive or neutral on its own, none is progressive.

Table 5. Heterogeneity of vertical inequity

Subsample	γ	Std. error	n
Property class			
Single-family	-0.454***	(0.018)	337,855
Condominium	-0.125***	(0.015)	77,976
Plex (2–5 units)	-0.487***	(0.054)	69,745
Cottage	-0.288***	(0.026)	2,114
Building age			
Age $<$ 20 y	-0.297***	(0.041)	117,898
Age 20–60 y	-0.384***	(0.034)	227,857
Age $>$ 60 y	-0.435***	(0.028)	108,049
Assessed land share			
Land share $<$ 0.2	-0.262***	(0.042)	119,718
Land share 0.2–0.4	-0.372***	(0.032)	236,923
Land share $>$ 0.4	-0.503***	(0.030)	125,714
Roll lag at sale			
Roll lag $<$ 24 m	-0.335***	(0.028)	86,001
Roll lag 24–48 m	-0.338***	(0.033)	327,031
Roll lag $>$ 48 m	-0.361***	(0.026)	91,367
Municipality size			
Muni $<$ 1k sales	-0.379***	(0.007)	125,139
Muni 1k–10k sales	-0.406***	(0.014)	185,111
Muni $>$ 10k sales	-0.267***	(0.043)	212,519
Sale year			
Sales 2021	-0.316***	(0.027)	115,221
Sales 2022	-0.380***	(0.030)	90,627
Sales 2023	-0.365***	(0.034)	74,110
Sales 2024	-0.333***	(0.032)	89,204
Sales 2025	-0.335***	(0.026)	102,026
Sales 2026	-0.349***	(0.030)	51,581

Notes: Cheng fixed-effects estimates of $\gamma = \beta - 1$ by subsample; cells with fewer than 20 sales after masking are dropped. Municipality-clustered standard errors in parentheses. *, **, *** denote significance at 10%, 5%, 1%.

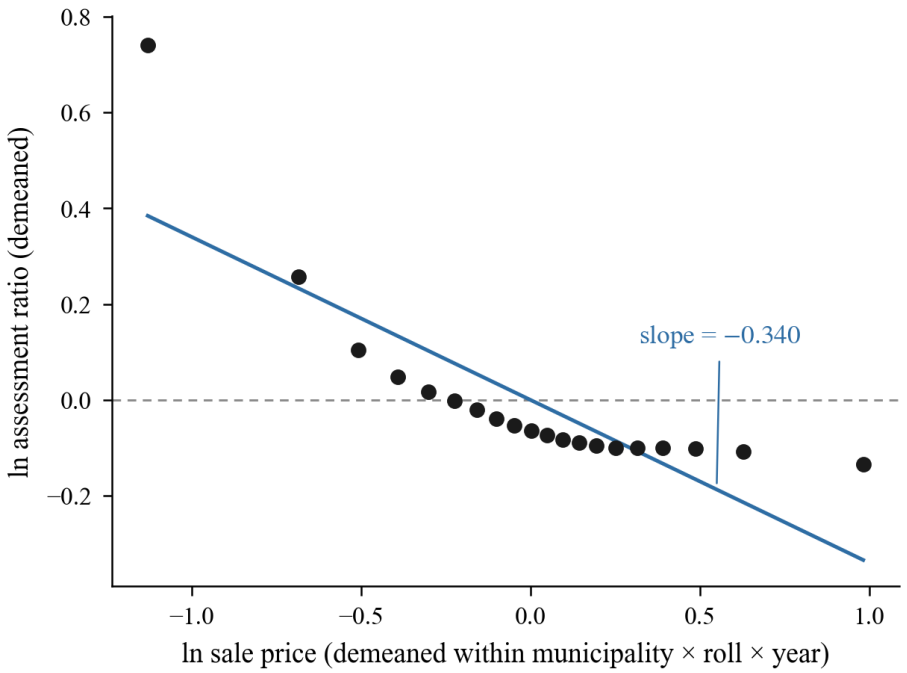

Figure 6. Vertical inequity within markets. Mean of the within-cell demeaned log assessment ratio by vigintile of the within-cell demeaned log sale price; whiskers are 95% confidence intervals (they are smaller than the markers). The fitted line is the sale-weighted least-squares slope.

Time and market depth. Splitting the window into 2021–2023 and 2024–2026 yields -0.35 and -0.34 (FE); restricting to municipalities with at least 300 sales, or to cells with at least 50, moves the estimates by less than 0.005. The phenomenon is stable across the largest housing-cycle swing in recent Canadian history.

Inference. With 625 municipality clusters, the cluster-robust t-statistics on γ_{FE} exceed 11 in every variant; the IV first stage is enormous (the rank instrument correlates with within-cell log price at F far above conventional thresholds), so weak-instrument concerns do not arise.

8. Discussion

8.1. Mechanisms

The evidence assembles into a coherent mechanism story with three layers.

1. Hedonic difficulty, not assessor idiosyncrasy. The heterogeneity profile tracks the difficulty of the valuation problem with almost embarrassing fidelity: condominiums (homogeneous, comparable-rich) are nearly equitable; old houses, plexes, cottages and high-land-share properties (heterogeneous, comparable-poor, unanchored by construction costs) are severely regressive. This

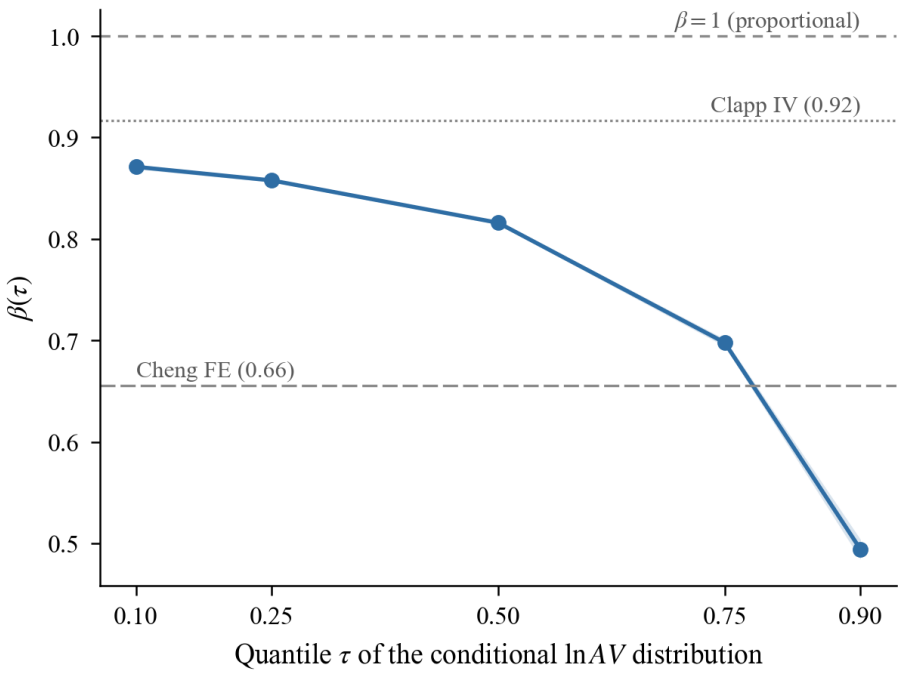

Figure 7. Quantile profile of the Cheng elasticity. Quantile regressions of within-cell demeaned $\ln AV$ on demeaned $\ln SP$; the shaded band is the pointwise 95% confidence interval. Reference lines mark proportionality ($\beta = 1$) and the FE and IV point estimates.

is the pattern predicted if assessors run reasonable hedonic models whose unexplained component is largest — and most value-correlated — where the housing bundle is hardest to price (Amornsiripanitch, 2022; Gloudemans and Almy, 2011; Bostic et al., 2007). Regression toward the mean in any imperfect valuation model over-values the cheap tail and under-values the expensive tail; our quantile profile, with proportionality holding at the bottom and collapsing at the top ($\beta(0.90) = 0.49$), shows Quebec's failure is concentrated where comparables are thinnest.

2. Staleness amplifies the gap. The doubling of the province-wide PRB in 2021–2022 shows that triennial rolls interact perversely with fast markets: when prices move 30–40% between reference dates, the cross-sectional dispersion of appreciation — which is itself correlated with price segment — loads directly into measured inequity. Jurisdictions cannot control housing cycles, but they control revaluation frequency; annual-cycle systems mechanically cap this channel (Berry, 2021; Ross, 2012).

3. Scale helps: the Montréal exception. Montréal — the largest sales sample, a dedicated in-house assessment service, dense comparable markets in every segment — is the only large jurisdiction with progressive assessments, in all six years. Mid-sized and small municipalities, many relying on contracted regional evaluators with limited modelling capacity, are uniformly regressive.

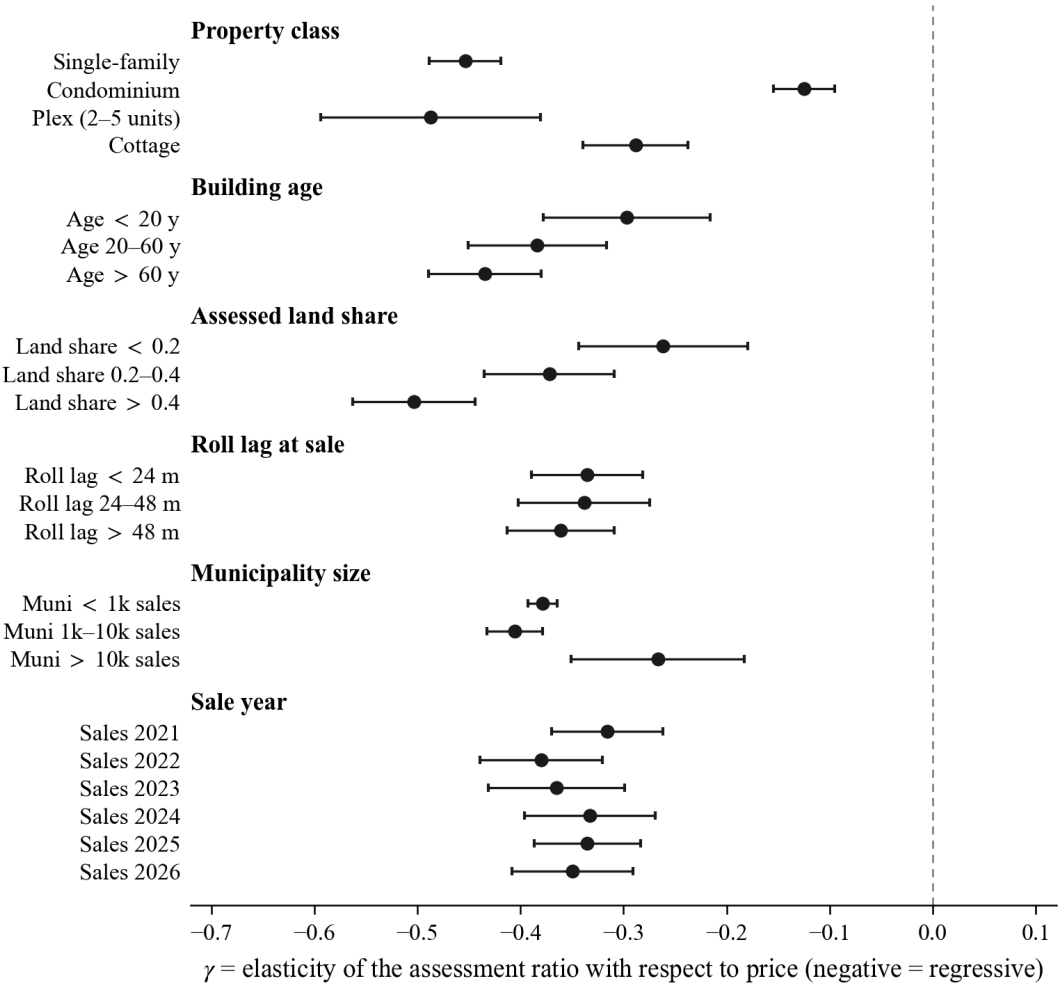

Figure 8. Heterogeneity of the within-market elasticity γ. Each point is a separate fixed-effects estimate of equation (2) on the indicated subsample; whiskers are 95% confidence intervals with municipality-clustered standard errors.

Table 6. Horizontal inequity: who receives noisy assessments?

	Coefficient	Std. error
Building age (decades)	+0.0075***	(0.0012)
Assessed land share	+0.0031	(0.0298)
Condominium	-0.0551***	(0.0074)
Plex (2–5 units)	+0.0247	(0.0151)
Cottage	+0.0520***	(0.0073)
Mean of dependent variable	0.188	
Observations	495,092	

Notes: Dependent variable: $|\ln r_i - \text{med}_{c(i)} \ln r|$. Absorbing least squares with cell fixed effects; municipality-clustered standard errors. Omitted class: single-family. *, **, *** denote significance at 10%, 5%, 1%.

The thin-market mechanism of McMillen and Weber (2008) operates within a single provincial rulebook: identical statutes, divergent outcomes, sorted by market depth and assessment resources. We note one caveat: Montréal's measured progressivity may partly reflect within-city composition (its cell is the whole city, pooling boroughs), and borough-level analysis is a natural extension.

8.2. Policy implications

Three levers follow directly from the diagnosis, in increasing order of ambition. First, **shorten the cycle**: moving from triennial to annual (or indexed) rolls would eliminate the staleness component that dominated 2021–2022; several U.S. states and British Columbia already operate annual cycles. Second, **pool assessment capacity**: the regressivity gradient by municipality size argues for regional or provincial mass-appraisal services — scale is the cheapest known technology for assessment quality. Third, **audit vertically, not just horizontally**: Quebec's oversight regime monitors median ratios and CODs but sets no explicit PRB requirement; adding the IAAO vertical standard to the ministry's audit criteria, with published municipality-level statistics like those in this paper, would make the equity dimension visible and contestable. Because low-priced-segment owners appeal least (Avenancio-León and Howard, 2022; Plummer, 2014), supply-side correction — better models — will do more than demand-side remedies.

8.3. Limitations

Four limitations bound the interpretation. First, sale prices below $50,000 are absent from the source registry and some residual non-arm's-length transfers may survive our screens; the robustness battery (dropping sub-$100k sales, tightening trims) shows the conclusions survive, but the bottom-

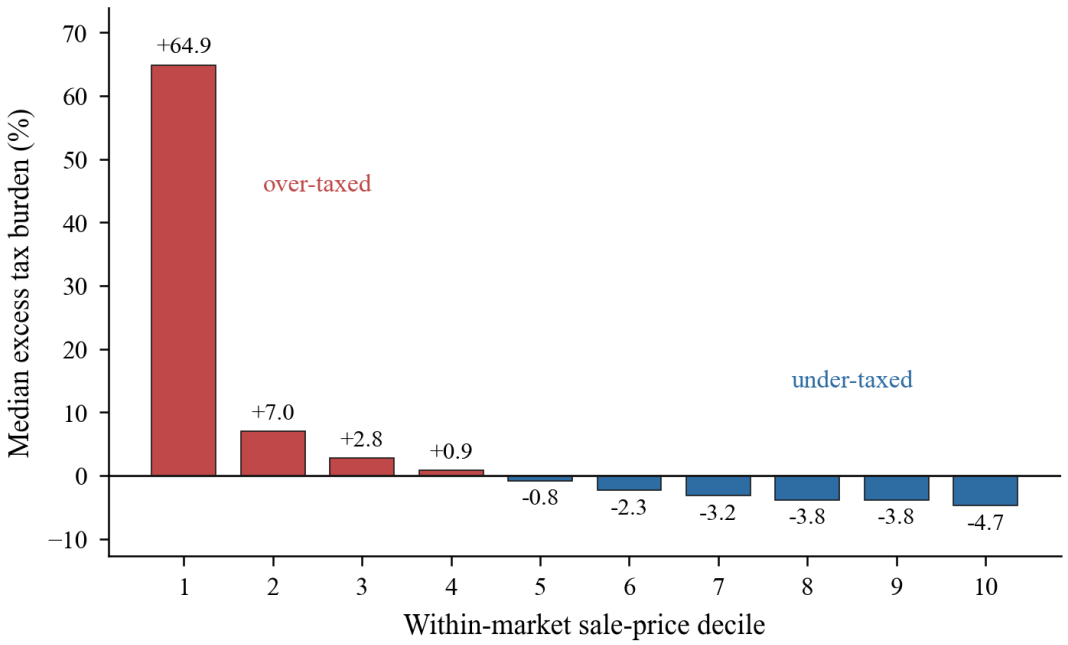

Figure 9. The implied property-tax shift. Median relative assessment error $e_i = r_i / \text{med}_{c(i)}(r) - 1$ by within-market sale-price decile. Because the levy is proportional to the rolled value, e_i equals the percentage over- or under-payment relative to uniform assessment.

decile tax-shift magnitude should be read as an upper bound on that decile. Second, our data cover 2021–2026, an unusually turbulent market; the within-market elasticity is stable across the window, but levels statistics from calmer periods would differ. Third, we observe no appeals, renovations between assessment and sale, or conditions of sale; some of what we call horizontal noise is genuine unobserved quality change. Fourth, without owner demographics we cannot speak to the distributional incidence across income or racial groups as Avenancio-León and Howard (2022) do — linking these assessments to census tract characteristics is the obvious next step.

9. Conclusion

Matching more than half a million residential sales to the assessment rolls that tax them, this paper delivers the first province-wide audit of assessment equity in Canada. The verdict is unambiguous. Quebec's property-tax base is systematically regressive: within the same municipality, roll and year, the assessment ratio falls by 34% per log-point of price in the descriptive fixed-effects estimate, and by 8% under the most conservative measurement-error correction available. Ninety-five percent of municipalities fail the IAAO vertical-equity standard, ninety-nine percent fail its uniformity standard, and the median dwelling in the bottom local price decile pays roughly two thirds more property tax than uniform assessment would imply, while the top decile pays less. The inequity concentrates where mass appraisal is hardest — old houses, plexes, land-heavy and luxury properties,

Table 7. Excess tax burden by within-market price decile

Price decile	*n*	Mean excess burden (%)	Median excess burden (%)	Std. error
1	51,007	+101.7	+64.9	(0.51)
2	52,458	+24.2	+7.0	(0.23)
3	51,976	+11.2	+2.8	(0.16)
4	52,385	+6.3	+0.9	(0.14)
5	52,879	+3.0	-0.8	(0.11)
6	51,767	+0.8	-2.3	(0.10)
7	52,236	-0.7	-3.2	(0.09)
8	52,364	-1.9	-3.8	(0.09)
9	52,123	-2.2	-3.8	(0.08)
10	53,574	-3.6	-4.7	(0.08)

Notes: Relative assessment error by within-cell sale-price decile. The mean is sensitive to extreme low-price sales; the median is the preferred summary. Standard errors of the mean in parentheses.

thin markets — doubles when triennial rolls fall behind a booming market, and disappears almost nowhere except Montréal.

These findings reframe the presumption that centralized, professionally regulated assessment systems are immune to the pathologies documented in the fragmented U.S. system. Quebec has uniform statutes, certified evaluators and statutory market-vintage synchronization — and produces regressivity of U.S. magnitude anyway. The binding constraint is not governance but valuation technology and revaluation frequency, which is in fact encouraging: cycle length, pooled assessment services and vertical audit standards are policy variables, and inexpensive ones relative to the redistribution at stake.

The matched sale–roll architecture built here supports a research agenda beyond this audit: linking assessment gaps to neighbourhood socio-demographics, exploiting the discrete arrival of new rolls to study price anchoring, and using the land–building decomposition to measure land-value dynamics at the parcel level. We pursue these in companion work.

Table 8. Robustness of the vertical-inequity elasticities

Sample variant	γ_{FE}	Std. err.	γ_{IV}	Std. err.	n
Baseline	-0.344***	(0.029)	-0.083***	(0.021)	522,769
Condominiums only	-0.125***	(0.015)	+0.058***	(0.016)	77,976
Excluding sales < \$100k	-0.295***	(0.026)	-0.048***	(0.017)	507,024
Match score = 220 (max)	-0.415***	(0.040)	-0.095***	(0.029)	210,820
Match distance $\leq$ 10 m	-0.355***	(0.030)	-0.087***	(0.022)	481,476
Single-family only	-0.454***	(0.018)	-0.146***	(0.010)	337,855
Ratio trim 5/95	-0.147***	(0.022)	-0.042***	(0.016)	465,318
Sales 2021-2023	-0.350***	(0.030)	-0.101***	(0.025)	279,958
Sales 2024-2026	-0.337***	(0.029)	-0.062***	(0.016)	242,811
Munis $\geq$ 300 sales	-0.341***	(0.033)	-0.077***	(0.022)	474,004
Cells $\geq$ 50 sales	-0.340***	(0.032)	-0.078***	(0.022)	476,001

Notes: Each row re-estimates the Cheng fixed-effects and Clapp IV regressions on the indicated variant; cells with fewer than 20 sales after restriction are dropped. Municipality-clustered standard errors in parentheses. *, **, *** denote significance at 10%, 5%, 1% against $\gamma = 0$.

Table 9. Quantile-regression coefficients

Quantile τ	0.10	0.25	0.50	0.75	0.90
$\beta(\tau)$	0.871***	0.858***	0.816***	0.698***	0.494***
	(0.0012)	(0.0008)	(0.0009)	(0.0018)	(0.0049)

Notes: Quantile regressions of within-cell demeaned $\ln AV$ on demeaned $\ln SP$, estimated on a seeded 250,000-sale subsample. Stars test $H_0: \beta(\tau) = 1$.

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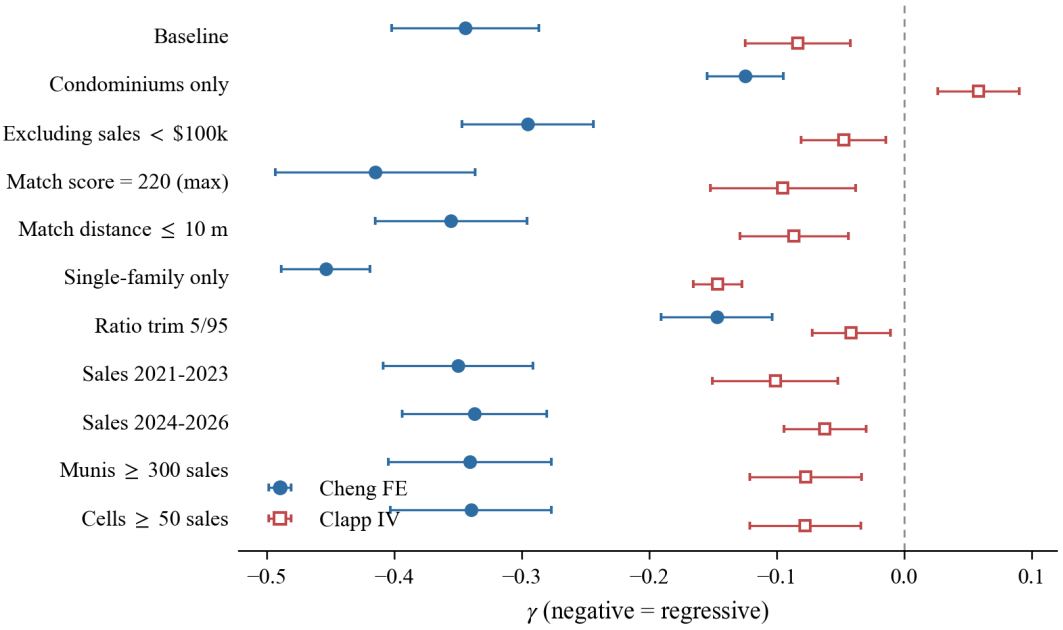

Figure 10. Stability of γ across sample variants. Filled circles: fixed-effects estimates; open squares: Clapp IV. Whiskers are 95% confidence intervals, municipality-clustered.

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