Supplementary file

The article points to everything below as "the supplementary file". Appendix A holds the derivations of the propositions, the corollaries of P5, the check of the kernel formulas, the corrected procedure and the standing prohibitions. The tables and figures follow the order in which the article first points to them: Table S1 from §2.1.2 (province-frame harmonization), Table S2 from §3.1 (descriptive statistics), Table S3 from §3.3 (heteroskedasticity), Table S4 from §3.4 (the bandwidth curve), Figure S1 from §3.7 (the permutation null), Table S5 from §3.8 (local coefficients), and Tables S6 to S10 and Figure S2 from §3.9 (the pest term).

A Derivations, corollaries and the corrected procedure

Section 2.3 of the article states five propositions, P1 to P5, each with its remedy. This appendix holds what supports them: the derivations of P1 to P4, each under its statement, the check of the kernel formulas, the three corollaries of P5, and the corrected procedure and the standing prohibitions that Sections 2.4 and 2.5 of the article point to. Equation tags (M1) to (M6) and section numbers refer to the article.

A.1 Adaptive bandwidth on a stacked panel (P1)

The article states P1 in §2.3.1.

Proposition (P1)**.** *Stack a balanced $n \times T$ panel into nT rows, so that the T rows of each unit share the same coordinates. Fit a geographically weighted model with a kernel of compact support and an adaptive bandwidth of k nearest rows, with $T < k \leq nT$. Let $m = \lfloor (k-1)/T \rfloor$. Then:*

(a) exactly Tm rows receive nonzero weight. They are all the rows of the m nearest units, and the focal unit is one of them, at distance zero;

(b) every k from $Tm+1$ to $T(m+1)$ gives the same weights and so the same fitted model. The selection criterion is therefore a step function of k with at most n steps;

(c) a bandwidth reported as a number of rows is not identified. It names a range of T values, not a single value. A golden-section search assumes a criterion with one minimum, and it has no guarantee on a step function.

Derivation. The adaptive rule sets the local bandwidth b_i to the distance from the focal row to its k-th nearest row. Coordinates repeat T times, so the rows sorted by distance come in blocks of T tied rows, one block per unit. The focal unit is the first block, at distance zero. The k-th row falls in block $m+1$. (a) A kernel of compact support gives zero weight at distance b_i, so all T rows of block $m+1$ get zero weight, and the Tm rows of the first m blocks keep nonzero weight. (b) For every k inside block $m+1$, b_i is the same distance, so no weight changes. The sorted distances take only n distinct values, so the criterion changes value at most n times. (c) follows from (b). □

The software `GWmodel` (Gollini et al., 2015) computes kernel weights in compiled code and does not print its formulas. All three kernels were therefore checked against the installed version by computing their weights directly. The bisquare and tricube formulas of the earlier version's Equations (14) and (15) match the software to machine precision. The earlier version's Equation (13) does not. It printed the Gaussian as truncated at the bandwidth, but the software uses the untruncated Gaussian, as the earlier text itself said. The truncation is removed from the formula. No estimate changes, because the software always used the untruncated kernel.

A.2 Intercept identification under grouped folds (P2)

The article states P2 in §2.3.2.

Proposition (P2)**.** *Let a model be estimated on unit-demeaned data, and let cross-validation hold out a whole unit. Then the training data do not identify the held-out unit's level α_i, so a grouped fold scores no model until an auxiliary estimator supplies that level. Setting $\alpha_i = 0$ is defined but uninformative. It scores the ability to predict unit* levels*, which is the nuisance the fixed effects were introduced to absorb, so a local and a global demeaned model fail on it for the same reason and the comparison says nothing about slopes.*

Derivation. The within transformation removes α_i from the estimating equations, so no function of the training data estimates it. A unit holdout withdraws all T rows that carry information about α_i, and the remaining units carry none. Any prediction for a held-out row therefore needs a level from outside the fit. □

A.3 Grid saturation and the fold-dependent ceiling (P3)

The article states P3 in §2.3.3.

Proposition (P3)**.** *Let an adaptive bandwidth be indexed by a unit count m and implemented as $k = Tm + c$ rows with $0 < c < T$, capped at the number of rows available, and let an inner training set hold M units and so MT rows. Then:*

(a) every $m \geq M$ asks for more rows than exist and returns the same weights, so a grid in absolute m admits at most $M - 1$ distinct weight vectors and saturates below its own upper limit, whatever that limit is;

(b) on the plateau the criterion is flat, so the selected bandwidth is not identified and the tie rule, an implementation detail, decides it;

(c) the binding constraint is the inner training size, not the upper limit. Raising the limit alone changes nothing while the grid is saturated, so a single ceiling effect is not a quantity this design can report.

Derivation. (a) With $k = Tm + c$ and only MT rows available, $Tm + c > MT$ for every $m \geq M$, so every such m returns the same weights. Distinct neighbourhoods therefore number $M - 1$, and a grid that runs past $m = M - 1$ evaluates points the training set cannot reach. (b) On the plateau the criterion is exactly flat, so the argmin is a set, and the reported value is whichever member the tie rule returns, the lowest, the highest or the first found. (c) follows from (a), because M and not the grid's upper limit fixes where the saturation starts. □

A.4 One criterion for a local and a global panel model (P4)

The article states P4 in §2.3.4.

Proposition (P4)**.** *Let P be the two-way within projection, which demeans by unit and by period, and let S be the smoother matrix of a geographically weighted fit computed on the demeaned response. Define the composite smoother*

$$S^* \;=\; P + S(I - P). \tag{M2}$$

Then $I - S^* = (I - S)(I - P)$, so the fitted residuals are unchanged and only the complexity charge moves. For the global two-way fixed-effects model, where $S = 0$ on the demeaned residual space and there are p slopes, the composite effective parameter count is $\operatorname{tr}(P) + p = (n + T - 1) + p$, the shared level counted once. On this panel that is $34 + 8 - 1 + 4 = 45.000$, measured on the realised design rather than imposed.

Derivation. $I - S^* = I - P - S(I - P) = (I - S)(I - P)$. The residual vector is therefore $(I - S)(I - P)y$ under either scoping, so the residual sum of squares and $\hat{\sigma}^2$ are the same and only $\operatorname{tr}(S^*)$ differs from $\operatorname{tr}(S)$. For the global model the local part contributes nothing, which leaves $\operatorname{tr}(S^*) = \operatorname{tr}(P) + p$. □

A.5 Three corollaries of the Breusch–Pagan proposition (P5)

The article states P5 in §2.3.5. Its three corollaries follow.

Corollary 1 (the statistic reported in the earlier version)**.** *Where a kernel-varying statistic was reported beside the earlier version's Equation (7), the variation cannot have come from that equation. In the earlier version of this analysis it comes from a second statistic that was not disclosed, Burridge's Lagrange-multiplier test for spatial error dependence (Burridge, 1980), $(e'We/\hat{\sigma}^2)^2 / \operatorname{tr}(W'W + W^2)$, summed onto the first and referred to χ^2 on the combined degrees of freedom. That summation presumes an independence which is neither argued nor true, and the degrees of freedom give it away before any statistic does, being $p + 1$ where the same text says p.*

Corollary 2. *The weight matrix supplied to that second statistic is a geographically weighted kernel matrix on the stacked panel with a unit diagonal. Burridge's test requires a zero diagonal, because no observation is its own neighbour, and all T rows of a unit share one coordinate, so all nT^2 within-unit entries equal one. Most of $e'We$ is then a residual's covariance with itself and with its own unit in other periods, and such a statistic cannot fail to be large whatever the spatial structure. Recomputed admissibly, on a unit-level W with a zero diagonal, row standardised, with residuals averaged to the unit so that no unit appears T times, it does not reject at any neighbourhood size.*

Corollary 3. *A Breusch–Pagan routine applied to a panel-model object works from the model frame, so it tests the* pooled *regression and returns the same statistic for the pooled, one-way within, two-way within and random-effects specifications. A claim that the statistic is computed on fixed-effects residuals is false by construction, because no unit effect was removed.*

A.6 The corrected procedure, assembled

Section 2.4 of the article points to this list. The propositions are constructive, so the procedure is their remedies in sequence. Steps 3 to 8 name their proposition.

1. *Panel.* Balanced 34×8 on the pre-split frame, with the harmonization, the climate design change and the three pest vintages disclosed as in §2.1 of the article. The outcome is log yield, harvested area is a scale control and the pest measure is a rate.
2. *Global baseline.* Two-way fixed effects (M1) with Driscoll–Kraay standard errors.
3. *Diagnostics, P5.* Heteroskedasticity by the studentised statistic (M6) on the two-way within residuals. Spatial error dependence, where it is tested at all, by the admissible statistic of Corollary 2 (§A.5).
4. *Local estimator, P2.* Geographically weighted panel regression fitted on within-transformed data. The transformed variables are named columns of the estimation frame, so model-frame construction cannot reach past them to the untransformed ones, and an assertion checks that the response has mean zero within every unit.
5. *Distance, P1.* Great-circle, set in code at both the search and the fit. Kernel formulas as verified: the Gaussian of the earlier version's Equation (13) without its truncation, and the earlier version's Equations (14) and (15) unchanged.
6. *Bandwidth, P1 and P3.* Defined in provinces and searched as a fraction q of the training units. No tie is broken silently, and the full-data cross-validation curve is reported over the whole grid with the selected value marked.
7. *Validation, P2 and P3.* The nested leave-one-unit-out scheme of §2.3.2 of the article, with its plug-in level and its five leakage assertions. The island-blocked and 2025 results are reported beside the primary one and never override it.
8. *Model comparison, P4.* Every model is placed on one response vector and charged the composite smoother (M2), and the primary criterion is the nested leave-one-unit-out cross-validated R^2 on log yield.
9. *Significance of the local surface.* The goodness-of-fit F-test of the earlier version's Equations (21) and (22) is deleted and replaced by a unit-block permutation test (999 permutations, seed 20260808). It needs no degrees of freedom, and it relabels the units on their own coordinates, so its null is that the geography carries no information. Where a nested F is quoted it is the correctly formed differenced one, with Leung's F_1 (Leung, Mei and Zhang, 2000) beside it.
10. *Local inference.* Local coefficients are ordinary weighted least squares, so a unit-clustered sandwich around them needs no new theory. The inference family is $n \times p$ local slopes. The da Silva–Fotheringham critical values (da Silva and Fotheringham, 2016) come from the corrected fit, not the earlier run, with a Benjamini–Hochberg control beside them, and every local slope is printed with its clustered interval and no stars.
11. *Effective parameters.* Reported as Equation (M3) at composite scope, with the information criteria penalised by $\mathrm{tr}(S^*)$, as §2.3.4 of the article sets out.

A.7 Standing prohibitions

Section 2.5 of the article points to this list. The prohibitions sit with the methods because the methods are where they can be enforced.

1. No formula in this paper may differ from the software actually used. Every formula in the article was checked against the installed implementation rather than transcribed.
2. No passage may cite Breusch–Pagan for coefficient variation (P5).
3. No reported hyperparameter grid may have a fold-dependent upper limit, and no bandwidth may be called selected off a flat plateau (P3).
4. No criterion is reported without its scope and its null, and no model is called best on a margin inside its own indifference band (P4).
5. No observation-level leave-one-out on this panel (P2).
6. RMSE only on the log scale, and no statistic on log yield is placed beside one on log production.
7. No causal language, no unverified citation, and no fabricated statistic or degrees of freedom.

References cited in this appendix

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Supplementary tables and figures

Supplementary Table S1: Province crosswalk: how each source unit maps onto the 34-province frame, by variable. File: `outputs/methods/province_harmonization_crosswalk_2026-08-09.csv`

Source unit	Province	Variable	Years listed	Operation	Missing values
all other 32 provinces	itself	production	2018-2025	retain	dash = 0
all other 32 provinces	itself	harvested_area	2018-2025	retain	dash = 0
Papua	Papua	OPT	2018-2025	sum	dash = 0
Papua Tengah	Papua	OPT	2023-2025	sum	dash = 0
Papua Pegunungan	Papua	OPT	2023-2025	sum	dash = 0
Papua Selatan	Papua	OPT	2023-2025	sum	dash = 0
Papua Barat	Papua Barat	OPT	2018-2025	sum	dash = 0
Papua Barat Daya	Papua Barat	OPT	2023-2025	sum	dash = 0
all other 32 provinces	itself	OPT	2018-2025	retain	dash = 0
Papua	Papua	rainfall	2018-2025	stage-1 station mean then stage-2 unweighted province mean	dash = missing (leaves the denominator)
Papua Tengah	Papua	rainfall	2025	stage-1 station mean then stage-2 unweighted province mean	dash = missing (leaves the denominator)
Papua Pegunungan	Papua	rainfall	2025	stage-1 station mean then stage-2 unweighted province mean	dash = missing (leaves the denominator)
Papua Selatan	Papua	rainfall	2025	stage-1 station mean then stage-2 unweighted province mean	dash = missing (leaves the denominator)
Papua Barat	Papua Barat	rainfall	2018-2025	stage-1 station mean then stage-2 unweighted province mean	dash = missing (leaves the denominator)
Papua Barat Daya	Papua Barat	rainfall	2025	stage-1 station mean then stage-2 unweighted province mean	dash = missing (leaves the denominator)
all other 32 provinces	itself	rainfall	2018-2025	retain	dash = missing (leaves the denominator)
Papua	Papua	temperature	2018-2025	stage-1 station mean then stage-2 unweighted province mean	dash = missing (leaves the denominator)
Papua Tengah	Papua	temperature	2025	stage-1 station mean then stage-2 unweighted province mean	dash = missing (leaves the denominator)
Papua Pegunungan	Papua	temperature	2025	stage-1 station mean then stage-2 unweighted province mean	dash = missing (leaves the denominator)
Papua Selatan	Papua	temperature	2025	stage-1 station mean then stage-2 unweighted province mean	dash = missing (leaves the denominator)
Papua Barat	Papua Barat	temperature	2018-2025	stage-1 station mean then stage-2 unweighted province mean	dash = missing (leaves the denominator)
Papua Barat Daya	Papua Barat	temperature	2025	stage-1 station mean then stage-2 unweighted province mean	dash = missing (leaves the denominator)
all other 32 provinces	itself	temperature	2018-2025	retain	dash = missing (leaves the denominator)

Supplementary Table S2: Descriptive statistics, canonical panel (34 provinces × 8 years = 272)

variable	mean	sd	min	median	max
Yield (t/ha, = production / harvested area)	4.547	0.8713	2.369	4.614	7.279
log yield (the outcome)	1.495	0.2036	0.8627	1.529	1.985
Harvested area (ha)	313561.	472673.	113.0	110997.	1841346.
log harvested area (scale control)	11.44	2.002	4.727	11.62	14.43
Pest-attack area (ha)	8017.	12006.	0	3676.	75589.
OPT rate (pest area / harvested area)	0.04491	0.04667	0	0.02920	0.3393
Rainfall (mm)	2592.	866.3	490.3	2539.	5332.
Temperature (°C)	27.73	0.9115	24.89	27.64	30.04
Production (t, baseline model only)	1635840.	2681930.	305.0	532470.	10499588.

Note: Source: the canonical analysis panel of Section 2.1 (BPS production, harvested area, rainfall and temperature; Pusdatin pest-attack area). 2018 production and harvested area are the final 2018 vintage (BPS ATAP); the five corrected workbook cells are OPT values repaired against the printed Pusdatin source.

Supplementary Table S3: Heteroskedasticity of the error term (one row per specification; not a test of coefficient variation)

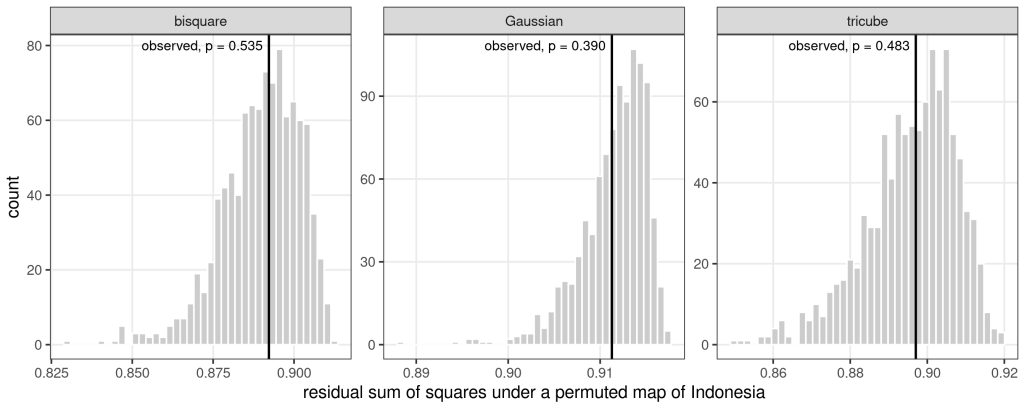
specification	n	df	BP unstudentised	p unstudentised	BP studentised Koenker	p studentised
earlier version: pooled OLS, raw levels	272	4	62.08	1.06×10^{-12}	38.90	7.31×10^{-8}
corrected: log yield, two-way within	272	4	25.84	3.40×10^{-5}	7.318	0.1200

Note: The unstudentised column is the earlier version's Equation (7). The reported statistic is the studentised (Koenker) form on the two-way within residuals of the log-yield model. The earlier version's kernel-by-kernel rows are withdrawn: the printed formula does not depend on the kernel, and the variation came from a second, undisclosed statistic.

Supplementary Table S4: What each of the 34 outer folds selected: the bandwidth-stability diagnostic

selector	outer folds	min selected m	median selected m	max selected m	n folds at the top of the grid	grid ceiling
bandwidth only, bisquare	34	24	26	26	30	26
bandwidth only, Gaussian	34	9	26	26	18	26
bandwidth only, tricube	34	25	26	26	27	26
kernel and bandwidth in-fold (kernels chosen: Gaussian 29, tricube 5)	34	9	26	26	18	26

Note: The inner training set holds 26 provinces, so the absolute-m grid saturates there and the selector pins to the top of its grid in most folds, as Proposition 3 states. This is why the bandwidth is also searched as a fraction q of the training provinces, whose ceiling does not depend on the fold design (last two columns of the model-comparison table in the main text).



Supplementary Figure S1: 999 province-block permutations: the real geography is not distinguishable from a random relabelling. Replaces the withdrawn goodness-of-fit F-test, which could not be reconstructed from any combination of the quantities the earlier version printed. Bandwidth m = 32 provinces, the CV-selected value for every kernel.

Supplementary Table S5: Local slopes at the CV-selected fit (Gaussian, m = 32 provinces), all 34 provinces × 4 slopes, province-clustered intervals, no significance stars

province	coefficient	beta	SE province clustered	ci lo	ci hi	p vs zero	p vs zero BH	t vs global	p vs global	p vs global BH
Aceh	log harvested area	0.004790	0.04311	−0.08292	0.09250	0.9122	0.9933	0.1246	0.9016	0.9976
Aceh	OPT rate	0.5537	0.2046	0.1375	0.9698	0.01068	0.06420	0.1742	0.8628	0.9976
Aceh	rainfall (mm)	7.63×10^{-7}	9.20×10^{-6}	-1.79×10^{-5}	1.95×10^{-5}	0.9344	0.9933	−0.3392	0.7366	0.9976
Aceh	temperature (°C)	0.0003759	0.005379	−0.01057	0.01132	0.9447	0.9933	0.2234	0.8246	0.9976
Bali	log harvested area	−0.0007110	0.04214	−0.08645	0.08503	0.9866	0.9933	−0.003049	0.9976	0.9976
Bali	OPT rate	0.5360	0.2012	0.1266	0.9454	0.01186	0.06420	0.08927	0.9294	0.9976
Bali	rainfall (mm)	1.56×10^{-6}	9.37×10^{-6}	-1.75×10^{-5}	2.06×10^{-5}	0.8686	0.9933	−0.2478	0.8058	0.9976
Bali	temperature (°C)	−0.0002816	0.005523	−0.01152	0.01096	0.9596	0.9933	0.09855	0.9221	0.9976
Banten	log harvested area	0.003053	0.04226	−0.08293	0.08903	0.9428	0.9933	0.08603	0.9320	0.9976
Banten	OPT rate	0.5591	0.2069	0.1382	0.9800	0.01079	0.06420	0.1986	0.8438	0.9976
Banten	rainfall (mm)	5.90×10^{-7}	9.17×10^{-6}	-1.81×10^{-5}	1.92×10^{-5}	0.9491	0.9933	−0.3591	0.7218	0.9976
Banten	temperature (°C)	0.0004011	0.005327	−0.01044	0.01124	0.9404	0.9933	0.2303	0.8193	0.9976
Bengkulu	log harvested area	0.003898	0.04259	−0.08275	0.09055	0.9276	0.9933	0.1052	0.9169	0.9976
Bengkulu	OPT rate	0.5589	0.2065	0.1388	0.9791	0.01068	0.06420	0.1981	0.8442	0.9976
Bengkulu	rainfall (mm)	5.94×10^{-7}	9.17×10^{-6}	-1.81×10^{-5}	1.92×10^{-5}	0.9487	0.9933	−0.3587	0.7221	0.9976
Bengkulu	temperature (°C)	0.0004432	0.005331	−0.01040	0.01129	0.9342	0.9933	0.2380	0.8133	0.9976
DI Yogyakarta	log harvested area	0.001774	0.04184	−0.08335	0.08690	0.9664	0.9933	0.05633	0.9554	0.9976
DI Yogyakarta	OPT rate	0.5554	0.2063	0.1357	0.9750	0.01106	0.06420	0.1810	0.8575	0.9976
DI Yogyakarta	rainfall (mm)	6.30×10^{-7}	9.18×10^{-6}	-1.80×10^{-5}	1.93×10^{-5}	0.9457	0.9933	−0.3545	0.7252	0.9976
DI Yogyakarta	temperature (°C)	0.0002621	0.005353	−0.01063	0.01115	0.9612	0.9933	0.2033	0.8402	0.9976
DKI Jakarta	log harvested area	0.003041	0.04222	−0.08286	0.08894	0.9430	0.9933	0.08583	0.9321	0.9976
DKI Jakarta	OPT rate	0.5586	0.2068	0.1379	0.9792	0.01082	0.06420	0.1961	0.8458	0.9976
DKI Jakarta	rainfall (mm)	5.53×10^{-7}	9.16×10^{-6}	-1.81×10^{-5}	1.92×10^{-5}	0.9523	0.9933	−0.3635	0.7185	0.9976
DKI Jakarta	temperature (°C)	0.0003906	0.005331	−0.01045	0.01124	0.9420	0.9933	0.2282	0.8209	0.9976
Gorontalo	log harvested area	−0.002762	0.04521	−0.09475	0.08923	0.9517	0.9933	−0.04821	0.9618	0.9976
Gorontalo	OPT rate	0.4832	0.1890	0.09867	0.8678	0.01536	0.06420	−0.1840	0.8551	0.9976
Gorontalo	rainfall (mm)	3.42×10^{-6}	1.01×10^{-5}	-1.70×10^{-5}	2.39×10^{-5}	0.7359	0.9933	−0.04581	0.9637	0.9976
Gorontalo	temperature (°C)	−0.001588	0.006139	−0.01408	0.01090	0.7975	0.9933	−0.1241	0.9020	0.9976
Jambi	log harvested area	0.004324	0.04270	−0.08254	0.09119	0.9199	0.9933	0.1149	0.9092	0.9976
Jambi	OPT rate	0.5576	0.2060	0.1385	0.9768	0.01068	0.06420	0.1923	0.8487	0.9976
Jambi	rainfall (mm)	5.29×10^{-7}	9.15×10^{-6}	-1.81×10^{-5}	1.91×10^{-5}	0.9543	0.9933	−0.3665	0.7163	0.9976
Jambi	temperature (°C)	0.0004422	0.005342	−0.01043	0.01131	0.9345	0.9933	0.2374	0.8138	0.9976
Jawa Barat	log harvested area	0.002649	0.04212	−0.08304	0.08833	0.9502	0.9933	0.07672	0.9393	0.9976
Jawa Barat	OPT rate	0.5583	0.2068	0.1375	0.9791	0.01086	0.06420	0.1948	0.8467	0.9976
Jawa Barat	rainfall (mm)	5.96×10^{-7}	9.17×10^{-6}	-1.81×10^{-5}	1.93×10^{-5}	0.9486	0.9933	−0.3585	0.7223	0.9976
Jawa Barat	temperature (°C)	0.0003638	0.005332	−0.01048	0.01121	0.9460	0.9933	0.2231	0.8248	0.9976
Jawa Tengah	log harvested area	0.002128	0.04190	−0.08312	0.08737	0.9598	0.9933	0.06469	0.9488	0.9976
Jawa Tengah	OPT rate	0.5555	0.2062	0.1359	0.9751	0.01103	0.06420	0.1815	0.8571	0.9976
Jawa Tengah	rainfall (mm)	5.63×10^{-7}	9.16×10^{-6}	-1.81×10^{-5}	1.92×10^{-5}	0.9514	0.9933	−0.3625	0.7193	0.9976
Jawa Tengah	temperature (°C)	0.0002834	0.005352	−0.01061	0.01117	0.9581	0.9933	0.2073	0.8371	0.9976
Jawa Timur	log harvested area	0.001276	0.04166	−0.08348	0.08603	0.9758	0.9933	0.04460	0.9647	0.9976
Jawa Timur	OPT rate	0.5515	0.2054	0.1336	0.9693	0.01127	0.06420	0.1627	0.8717	0.9976
Jawa Timur	rainfall (mm)	6.04×10^{-7}	9.17×10^{-6}	-1.80×10^{-5}	1.93×10^{-5}	0.9478	0.9933	−0.3577	0.7229	0.9976

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Supplementary Table S5: Local slopes at the CV-selected fit (Gaussian, m = 32 provinces), all 34 provinces × 4 slopes, province-clustered intervals, no significance stars (continued)

province	coefficient	beta	SE province clustered	ci lo	ci hi	p vs zero	p vs zero BH	t vs global	p vs global	p vs global BH
Jawa Timur	temperature (°C)	0.0001662	0.005382	−0.01078	0.01112	0.9755	0.9933	0.1843	0.8549	0.9976
Kalimantan Barat	log harvested area	0.004523	0.04237	−0.08168	0.09072	0.9156	0.9933	0.1205	0.9048	0.9976
Kalimantan Barat	OPT rate	0.5453	0.2031	0.1321	0.9585	0.01126	0.06420	0.1343	0.8940	0.9976
Kalimantan Barat	rainfall (mm)	8.28×10^{-8}	9.03×10^{-6}	-1.83×10^{-5}	1.85×10^{-5}	0.9927	0.9933	−0.4207	0.6767	0.9976
Kalimantan Barat	temperature (°C)	0.0002027	0.005436	−0.01086	0.01126	0.9705	0.9933	0.1892	0.8511	0.9976
Kalimantan Selatan	log harvested area	0.001476	0.04213	−0.08424	0.08720	0.9723	0.9933	0.04887	0.9613	0.9976
Kalimantan Selatan	OPT rate	0.5303	0.1997	0.1239	0.9366	0.01211	0.06420	0.06133	0.9515	0.9976
Kalimantan Selatan	rainfall (mm)	7.87×10^{-7}	9.19×10^{-6}	-1.79×10^{-5}	1.95×10^{-5}	0.9322	0.9933	−0.3369	0.7383	0.9976
Kalimantan Selatan	temperature (°C)	−0.0002724	0.005573	−0.01161	0.01107	0.9613	0.9933	0.09933	0.9215	0.9976
Kalimantan Tengah	log harvested area	0.003560	0.04203	−0.08195	0.08907	0.9330	0.9933	0.09857	0.9221	0.9976
Kalimantan Tengah	OPT rate	0.5404	0.2022	0.1291	0.9518	0.01160	0.06420	0.1109	0.9124	0.9976
Kalimantan Tengah	rainfall (mm)	7.60×10^{-8}	9.03×10^{-6}	-1.83×10^{-5}	1.85×10^{-5}	0.9933	0.9933	−0.4214	0.6762	0.9976
Kalimantan Tengah	temperature (°C)	6.02×10^{-5}	0.005475	−0.01108	0.01120	0.9913	0.9933	0.1618	0.8724	0.9976
Kalimantan Timur	log harvested area	0.002147	0.04279	−0.08492	0.08921	0.9603	0.9933	0.06378	0.9495	0.9976
Kalimantan Timur	OPT rate	0.5165	0.1962	0.1174	0.9155	0.01278	0.06420	−0.008000	0.9937	0.9976
Kalimantan Timur	rainfall (mm)	9.43×10^{-7}	9.24×10^{-6}	-1.79×10^{-5}	1.97×10^{-5}	0.9193	0.9933	−0.3183	0.7523	0.9976
Kalimantan Timur	temperature (°C)	−0.0005573	0.005721	−0.01220	0.01108	0.9230	0.9933	0.04696	0.9628	0.9976
Kalimantan Utara	log harvested area	0.003823	0.04296	−0.08358	0.09122	0.9296	0.9933	0.1026	0.9189	0.9976
Kalimantan Utara	OPT rate	0.5141	0.1955	0.1163	0.9119	0.01289	0.06420	−0.02006	0.9841	0.9976
Kalimantan Utara	rainfall (mm)	4.71×10^{-7}	9.13×10^{-6}	-1.81×10^{-5}	1.90×10^{-5}	0.9592	0.9933	−0.3737	0.7110	0.9976
Kalimantan Utara	temperature (°C)	−0.0005248	0.005750	−0.01222	0.01117	0.9278	0.9933	0.05238	0.9585	0.9976
Kepulauan Bangka Belitung	log harvested area	0.004062	0.04245	−0.08230	0.09043	0.9243	0.9933	0.1094	0.9135	0.9976
Kepulauan Bangka Belitung	OPT rate	0.5567	0.2060	0.1376	0.9758	0.01079	0.06420	0.1877	0.8523	0.9976
Kepulauan Bangka Belitung	rainfall (mm)	3.84×10^{-7}	9.12×10^{-6}	-1.82×10^{-5}	1.89×10^{-5}	0.9667	0.9933	−0.3837	0.7036	0.9976
Kepulauan Bangka Belitung	temperature (°C)	0.0004118	0.005346	−0.01046	0.01129	0.9391	0.9933	0.2315	0.8183	0.9976
Kepulauan Riau	log harvested area	0.005660	0.04295	−0.08173	0.09305	0.8960	0.9933	0.1453	0.8853	0.9976
Kepulauan Riau	OPT rate	0.5469	0.2029	0.1340	0.9598	0.01099	0.06420	0.1422	0.8878	0.9976
Kepulauan Riau	rainfall (mm)	2.14×10^{-7}	9.06×10^{-6}	-1.82×10^{-5}	1.86×10^{-5}	0.9813	0.9933	−0.4051	0.6880	0.9976
Kepulauan Riau	temperature (°C)	0.0002914	0.005429	−0.01075	0.01134	0.9575	0.9933	0.2058	0.8382	0.9976
Lampung	log harvested area	0.003611	0.04239	−0.08264	0.08986	0.9326	0.9933	0.09892	0.9218	0.9976
Lampung	OPT rate	0.5586	0.2066	0.1382	0.9789	0.01075	0.06420	0.1962	0.8456	0.9976
Lampung	rainfall (mm)	5.08×10^{-7}	9.15×10^{-6}	-1.81×10^{-5}	1.91×10^{-5}	0.9561	0.9933	−0.3688	0.7146	0.9976
Lampung	temperature (°C)	0.0004225	0.005332	−0.01043	0.01127	0.9373	0.9933	0.2341	0.8163	0.9976
Maluku	log harvested area	−0.005009	0.04668	−0.09998	0.08996	0.9152	0.9933	−0.09482	0.9250	0.9976
Maluku	OPT rate	0.4799	0.1882	0.09708	0.8628	0.01558	0.06420	−0.2025	0.8408	0.9976
Maluku	rainfall (mm)	4.98×10^{-6}	1.06×10^{-5}	-1.66×10^{-5}	2.65×10^{-5}	0.6419	0.9933	0.1031	0.9185	0.9976
Maluku	temperature (°C)	−0.001838	0.006201	−0.01445	0.01078	0.7688	0.9933	−0.1632	0.8714	0.9976
Maluku Utara	log harvested area	−0.004032	0.04654	−0.09872	0.09065	0.9315	0.9933	−0.07412	0.9414	0.9976
Maluku Utara	OPT rate	0.4756	0.1874	0.09436	0.8568	0.01605	0.06420	−0.2265	0.8222	0.9976
Maluku Utara	rainfall (mm)	4.54×10^{-6}	1.05×10^{-5}	-1.68×10^{-5}	2.59×10^{-5}	0.6679	0.9933	0.06237	0.9506	0.9976
Maluku Utara	temperature (°C)	−0.001879	0.006259	−0.01461	0.01085	0.7659	0.9933	−0.1682	0.8674	0.9976
Nusa Tenggara Barat	log harvested area	−0.002192	0.04239	−0.08844	0.08405	0.9591	0.9933	−0.03798	0.9699	0.9976
Nusa Tenggara Barat	OPT rate	0.5257	0.1988	0.1212	0.9301	0.01243	0.06420	0.03838	0.9696	0.9976
Nusa Tenggara Barat	rainfall (mm)	1.99×10^{-6}	9.49×10^{-6}	-1.73×10^{-5}	2.13×10^{-5}	0.8348	0.9933	−0.1991	0.8434	0.9976

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Supplementary Table S5: Local slopes at the CV-selected fit (Gaussian, m = 32 provinces), all 34 provinces × 4 slopes, province-clustered intervals, no significance stars (continued)

province	coefficient	beta	SE province clustered	ci lo	ci hi	p vs zero	p vs zero BH	t vs global	p vs global	p vs global BH
Nusa Tenggara Barat	temperature (°C)	−0.0005585	0.005622	−0.01200	0.01088	0.9215	0.9933	0.04757	0.9623	0.9976
Nusa Tenggara Timur	log harvested area	−0.003923	0.04392	−0.09328	0.08543	0.9294	0.9933	−0.07607	0.9398	0.9976
Nusa Tenggara Timur	OPT rate	0.5068	0.1941	0.1119	0.9017	0.01348	0.06420	−0.05794	0.9541	0.9976
Nusa Tenggara Timur	rainfall (mm)	3.28×10^{-6}	9.89×10^{-6}	-1.68×10^{-5}	2.34×10^{-5}	0.7422	0.9933	−0.06082	0.9519	0.9976
Nusa Tenggara Timur	temperature (°C)	−0.001091	0.005837	−0.01297	0.01079	0.8529	0.9933	−0.04539	0.9641	0.9976
Papua	log harvested area	−0.005164	0.04734	−0.1015	0.09116	0.9138	0.9933	−0.09677	0.9235	0.9976
Papua	OPT rate	0.4778	0.1876	0.09609	0.8596	0.01572	0.06420	−0.2142	0.8317	0.9976
Papua	rainfall (mm)	5.52×10^{-6}	1.08×10^{-5}	-1.65×10^{-5}	2.76×10^{-5}	0.6134	0.9933	0.1515	0.8805	0.9976
Papua	temperature (°C)	−0.001939	0.006242	−0.01464	0.01076	0.7580	0.9933	−0.1784	0.8595	0.9976
Papua Barat	log harvested area	−0.005010	0.04711	−0.1009	0.09084	0.9160	0.9933	−0.09397	0.9257	0.9976
Papua Barat	OPT rate	0.4768	0.1875	0.09531	0.8583	0.01587	0.06420	−0.2199	0.8273	0.9976
Papua Barat	rainfall (mm)	5.24×10^{-6}	1.07×10^{-5}	-1.66×10^{-5}	2.71×10^{-5}	0.6283	0.9933	0.1266	0.9000	0.9976
Papua Barat	temperature (°C)	−0.001932	0.006250	−0.01465	0.01078	0.7592	0.9933	−0.1770	0.8606	0.9976
Riau	log harvested area	0.004613	0.04282	−0.08250	0.09172	0.9149	0.9933	0.1213	0.9042	0.9976
Riau	OPT rate	0.5565	0.2056	0.1382	0.9748	0.01068	0.06420	0.1871	0.8527	0.9976
Riau	rainfall (mm)	5.33×10^{-7}	9.15×10^{-6}	-1.81×10^{-5}	1.91×10^{-5}	0.9539	0.9933	−0.3662	0.7165	0.9976
Riau	temperature (°C)	0.0004342	0.005352	−0.01045	0.01132	0.9358	0.9933	0.2355	0.8153	0.9976
Sulawesi Barat	log harvested area	−0.001521	0.04326	−0.08953	0.08648	0.9722	0.9933	−0.02170	0.9828	0.9976
Sulawesi Barat	OPT rate	0.5037	0.1936	0.1099	0.8975	0.01377	0.06420	−0.07417	0.9413	0.9976
Sulawesi Barat	rainfall (mm)	2.06×10^{-6}	9.56×10^{-6}	-1.74×10^{-5}	2.15×10^{-5}	0.8304	0.9933	−0.1902	0.8503	0.9976
Sulawesi Barat	temperature (°C)	−0.001001	0.005862	−0.01293	0.01093	0.8654	0.9933	−0.02988	0.9763	0.9976
Sulawesi Selatan	log harvested area	−0.002291	0.04359	−0.09098	0.08639	0.9584	0.9933	−0.03919	0.9690	0.9976
Sulawesi Selatan	OPT rate	0.5018	0.1931	0.1089	0.8946	0.01388	0.06420	−0.08426	0.9334	0.9976
Sulawesi Selatan	rainfall (mm)	2.49×10^{-6}	9.68×10^{-6}	-1.72×10^{-5}	2.22×10^{-5}	0.7988	0.9933	−0.1439	0.8864	0.9976
Sulawesi Selatan	temperature (°C)	−0.001093	0.005888	−0.01307	0.01089	0.8538	0.9933	−0.04543	0.9640	0.9976
Sulawesi Tengah	log harvested area	−0.002476	0.04443	−0.09287	0.08791	0.9559	0.9933	−0.04263	0.9663	0.9976
Sulawesi Tengah	OPT rate	0.4912	0.1907	0.1032	0.8793	0.01468	0.06420	−0.1404	0.8892	0.9976
Sulawesi Tengah	rainfall (mm)	2.94×10^{-6}	9.86×10^{-6}	-1.71×10^{-5}	2.30×10^{-5}	0.7673	0.9933	−0.09521	0.9247	0.9976
Sulawesi Tengah	temperature (°C)	−0.001364	0.006026	−0.01362	0.01090	0.8224	0.9933	−0.08924	0.9294	0.9976
Sulawesi Tenggara	log harvested area	−0.003489	0.04456	−0.09416	0.08718	0.9381	0.9933	−0.06522	0.9484	0.9976
Sulawesi Tenggara	OPT rate	0.4942	0.1913	0.1050	0.8834	0.01441	0.06420	−0.1245	0.9016	0.9976
Sulawesi Tenggara	rainfall (mm)	3.37×10^{-6}	9.97×10^{-6}	-1.69×10^{-5}	2.37×10^{-5}	0.7379	0.9933	−0.05183	0.9590	0.9976
Sulawesi Tenggara	temperature (°C)	−0.001354	0.005990	−0.01354	0.01083	0.8225	0.9933	−0.08822	0.9302	0.9976
Sulawesi Utara	log harvested area	−0.003128	0.04553	−0.09576	0.08951	0.9456	0.9933	−0.05592	0.9557	0.9976
Sulawesi Utara	OPT rate	0.4812	0.1886	0.09755	0.8649	0.01553	0.06420	−0.1950	0.8466	0.9976
Sulawesi Utara	rainfall (mm)	3.70×10^{-6}	1.02×10^{-5}	-1.70×10^{-5}	2.44×10^{-5}	0.7180	0.9933	−0.01794	0.9858	0.9976
Sulawesi Utara	temperature (°C)	−0.001663	0.006169	−0.01421	0.01089	0.7892	0.9933	−0.1356	0.8929	0.9976
Sumatera Barat	log harvested area	0.004392	0.04278	−0.08265	0.09144	0.9189	0.9933	0.1163	0.9081	0.9976
Sumatera Barat	OPT rate	0.5574	0.2059	0.1385	0.9763	0.01066	0.06420	0.1912	0.8495	0.9976
Sumatera Barat	rainfall (mm)	5.92×10^{-7}	9.16×10^{-6}	-1.81×10^{-5}	1.92×10^{-5}	0.9489	0.9933	−0.3591	0.7218	0.9976
Sumatera Barat	temperature (°C)	0.0004390	0.005345	−0.01044	0.01131	0.9350	0.9933	0.2367	0.8144	0.9976
Sumatera Selatan	log harvested area	0.003956	0.04254	−0.08259	0.09050	0.9265	0.9933	0.1067	0.9157	0.9976
Sumatera Selatan	OPT rate	0.5584	0.2064	0.1385	0.9784	0.01071	0.06420	0.1958	0.8460	0.9976
Sumatera Selatan	rainfall (mm)	5.16×10^{-7}	9.15×10^{-6}	-1.81×10^{-5}	1.91×10^{-5}	0.9553	0.9933	−0.3679	0.7153	0.9976

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Supplementary Table S5: Local slopes at the CV-selected fit (Gaussian, m = 32 provinces), all 34 provinces × 4 slopes, province-clustered intervals, no significance stars (continued)

province	coefficient	beta	SE province clustered	ci lo	ci hi	p vs zero	p vs zero BH	t vs global	p vs global	p vs global BH
Sumatera Selatan	temperature (°C)	0.0004386	0.005334	−0.01041	0.01129	0.9350	0.9933	0.2371	0.8141	0.9976
Sumatera Utara	log harvested area	0.004738	0.04296	−0.08266	0.09213	0.9128	0.9933	0.1239	0.9022	0.9976
Sumatera Utara	OPT rate	0.5554	0.2052	0.1380	0.9729	0.01067	0.06420	0.1824	0.8564	0.9976
Sumatera Utara	rainfall (mm)	6.25×10^{-7}	9.17×10^{-6}	-1.80×10^{-5}	1.93×10^{-5}	0.9461	0.9933	−0.3554	0.7246	0.9976
Sumatera Utara	temperature (°C)	0.0004161	0.005362	−0.01049	0.01133	0.9386	0.9933	0.2316	0.8183	0.9976

Note: The full inference family of 136 local slopes, printed in full as the text promises. Intervals are province-clustered; no local coefficient is described as significant anywhere in the paper, and the earlier version's critical value, 1.973, does not appear.

Supplementary Table S6: How the pest variable enters: the full specification ladder, including the model with no pest term at all

specification	CV R^2 two-way FE	diff vs no pest bootstrap	ci lo	ci hi
rate (declared main specification)	0.10032	−0.023529	−0.071346	0.0073668
totals	0.11826	−0.0055943	−0.020495	0.0027933
OPT / mean_p(area), fixed denom	0.051448	−0.072402	−0.16047	−0.0099447
log(1 + OPT)	0.10047	−0.023381	−0.044222	−0.0059992
raw harvested area, no pest	0.11600	–	–	–
squared log harvested area, no pest	0.12368	–	–	–
no pest term at all	0.12385	–	–	–
rate + raw area	0.090616	–	–	–
totals + raw area	0.11089	–	–	–

Note: Bootstrap columns are paired province-clustered differences against the no-pest model (2000 replicates, seed 20260808). No pest term at all predicts best of everything. The pest term is retained because it is the paper's subject, not because it is informative.

Supplementary Table S7: Placebo comparisons: does the pest column carry pest information?

comparison	difference	ci lo	ci hi	p one-sided
FE: rate → totals	0.017934	−0.011841	0.059944	0.87850
FE: rate → placebo_p (province intensity × area)	0.015281	−0.016994	0.057533	0.82900
FE: rate → placebo_a (raw harvested area)	0.015680	−0.017105	0.057022	0.82450
FE: placebo_a → totals (the pest content itself)	0.0022549	−0.011116	0.012025	0.65100
GWPR nested: rate → totals	0.044977	0.0033451	0.097649	0.98050

Note: The placebo carrying no pest content at all (raw harvested area) is compared with the actual pest totals: the difference is the pest information, and it is indistinguishable from zero.

Supplementary Table S8: Which provinces the OPT-rate column costs out of sample (top 6 contributors to the PRESS increase)

province	dPRESS	share of net PRESS increase	mean OPT rate	mean harvested area ha
Kepulauan Riau	0.01471	0.3954	0.008512	248.1
Maluku Utara	0.01086	0.2919	0.07682	9206.
Papua	0.007452	0.2002	0.02447	56546.
Maluku	0.006765	0.1818	0.08948	25986.
Kalimantan Tengah	0.005128	0.1378	0.02790	122722.
Sulawesi Tenggara	0.003592	0.09652	0.1219	130440.

Note: Shares are of the net increase in PRESS from including the OPT-rate column, 0.0372: 20 provinces contribute positively and 14 offset it, so the shares shown do not sum to one. On the canonical panel the largest contributor is Kepulauan Riau; DKI Jakarta ranks 7 of 34 and does not appear. The earlier version's claim that one urban province drove this comparison was computed before the five workbook cells were corrected.

Supplementary Table S9: The OPT-rate coefficient: which correction carries it

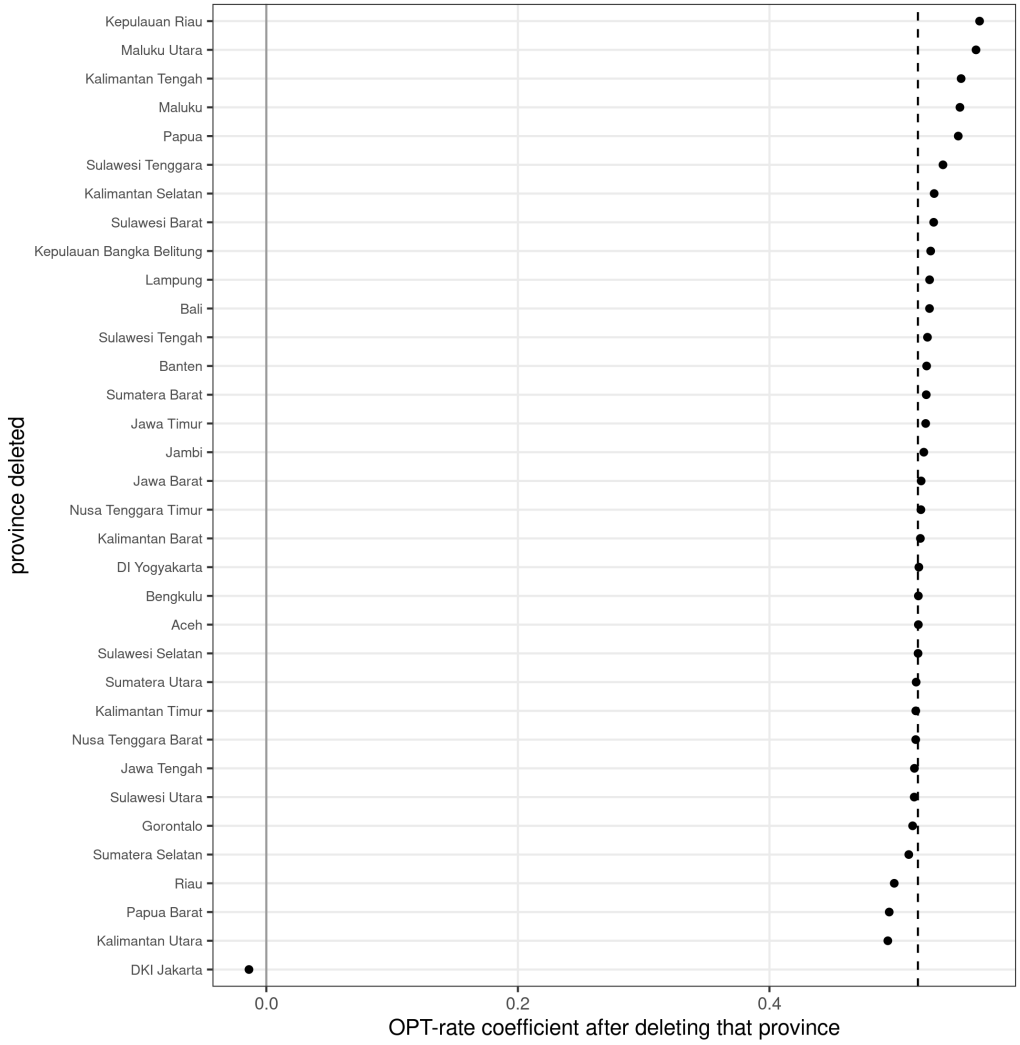
panel	beta	SE DK	p DK	SE naive	p naive	SE clustered	p clustered
before either correction	−0.05289	0.2584	0.8380	0.1618	0.7441	0.2725	0.8463
final 2018 vintage only	0.3671	0.1158	0.001735	0.1592	0.02206	0.1764	0.03856
five corrected workbook cells only	0.05392	0.2518	0.8306	0.1632	0.7415	0.3202	0.8664
both corrections (canonical)	0.5180	0.1412	0.0003043	0.1582	0.001221	0.2218	0.02037

Note: The final 2018 vintage carries the coefficient; the five corrected workbook cells alone do not move it.

Supplementary Table S10: Leave-one-province-out refits of the global model: what happens to the OPT-rate coefficient

province deleted	beta	p DK	shift from full sample
DKI Jakarta	−0.01381	0.9335	−0.5318
Kalimantan Utara	0.4941	0.0005086	−0.02391
Papua Barat	0.4952	0.02976	−0.02280
Kalimantan Tengah	0.5524	0.0006969	0.03436
Maluku Utara	0.5642	5.89×10^{-5}	0.04620
Kepulauan Riau	0.5671	0.0002827	0.04903

Note: Three largest and three smallest shifts, of 34 refits. The full-sample coefficient is +0.518. Deleting DKI Jakarta alone moves it by more than its own size; all 33 other deletions leave it between the values shown. DKI Jakarta is disclosed, not dropped.



Supplementary Figure S2: The positive pest coefficient is one province. Dashed line: the full-sample coefficient, 0.518. Deleting DKI Jakarta returns it to -0.014 (Driscoll–Kraay p = 0.934). The province is disclosed, not dropped.