Zig Zag: When Noisy Regression Discontinuities Yield Exaggerated Claims

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The Problem

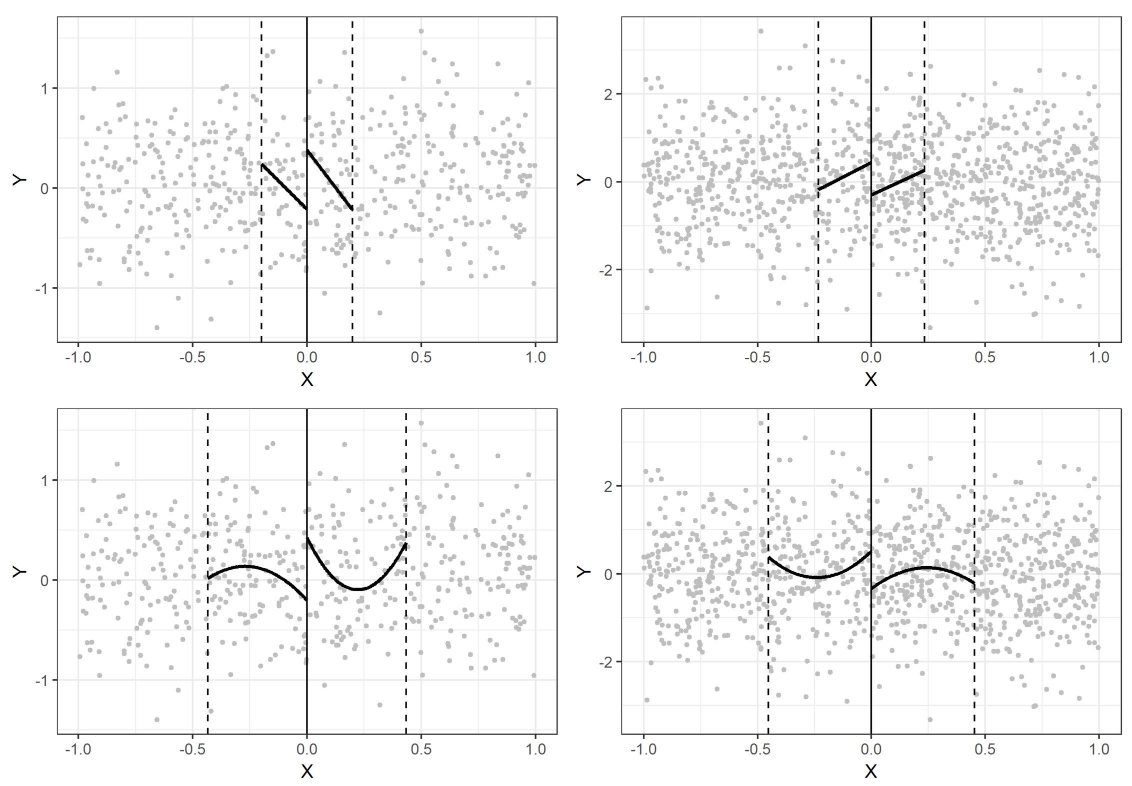


Fig. 1: Significant RD results from pure noise; characteristic "zig zag" pattern.

Consider the following Monte Carlo simulation:

$$X \sim U(-1, 1)$$
$$Y_i = \mathbf{1}(X_i \geq 0)\tau + X_i\beta + \varepsilon_i$$
$$\varepsilon \sim \mathcal{N}(0, \sigma^2)$$

When an RDD is low-powered ($\tau = 0.1$, $\sigma^2 = 1$), "publishable" results are either too large in magnitude (Type M Error) or the sign is in the wrong direction (Type S Error) [2]. In either case, the estimated slope parameters are implausibly large.

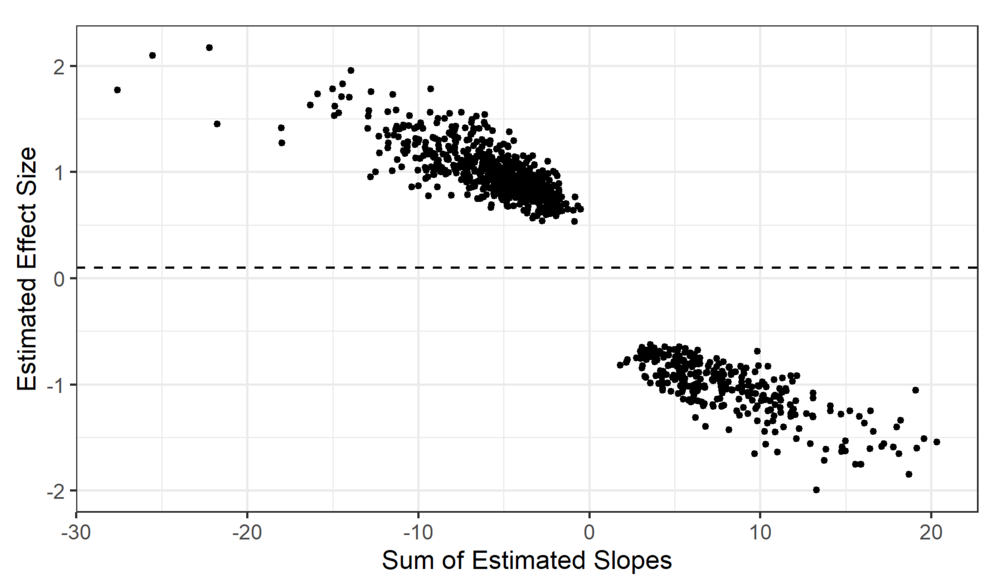


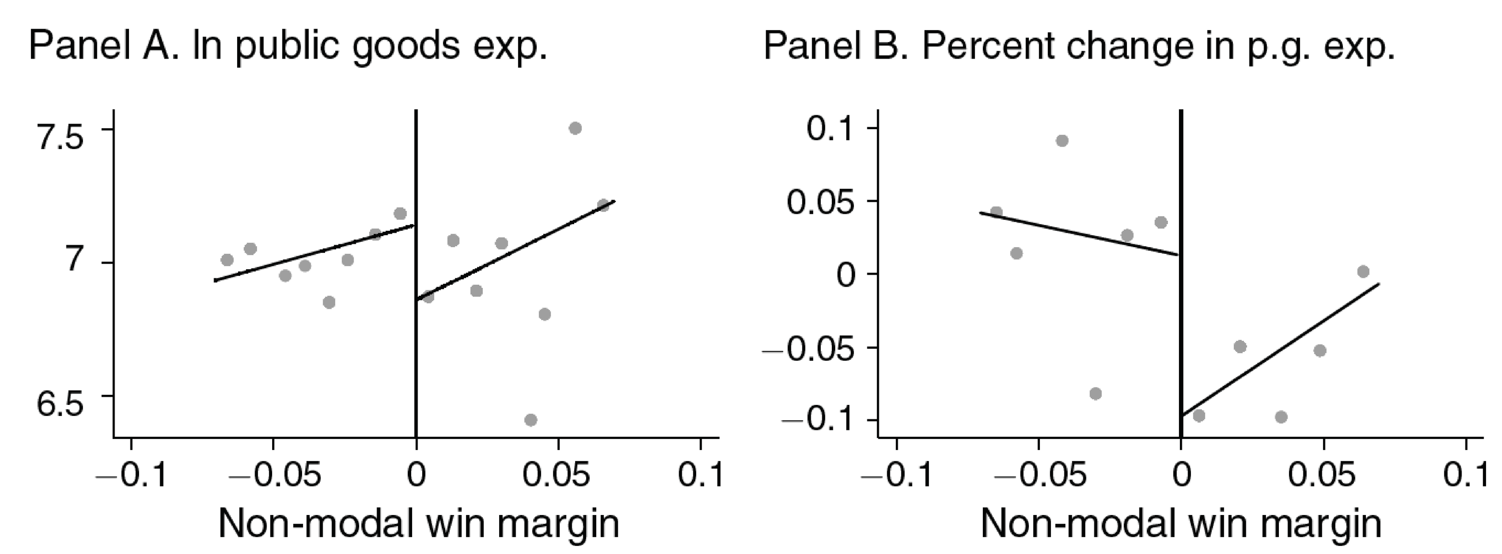
Fig. 2: Monte Carlo Results for $p < 0.05$ ($\tau = 0.1$, $\sigma^2 = 1$, $\beta = 0$).

Conventional Robustness Tests Are Insufficient

Robust To...	%
Alternative Bandwidths	70.5
Quadratic Specification	74.5
Uniform Kernel	64.3
Global Polynomial Specification	49
Density Manipulation Test	96.9
All But One Test	50.7
All Tests	29.3

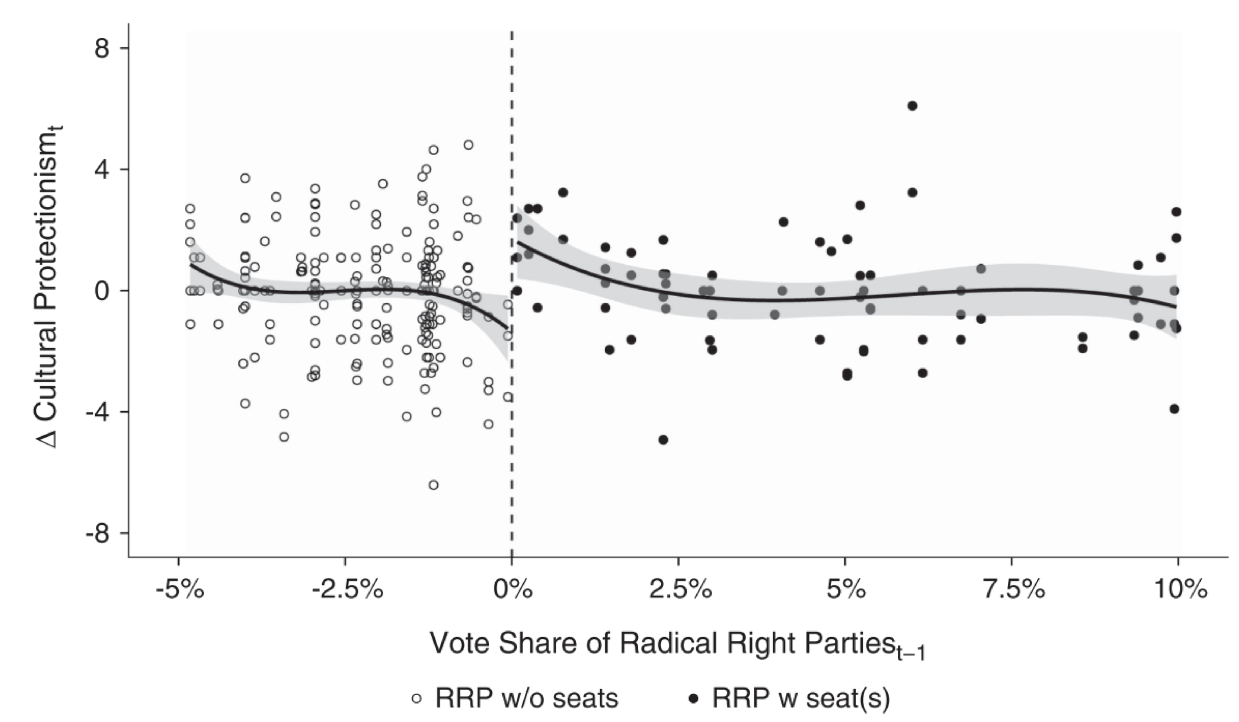
A Few Recent Examples

Beach & Jones (2017):



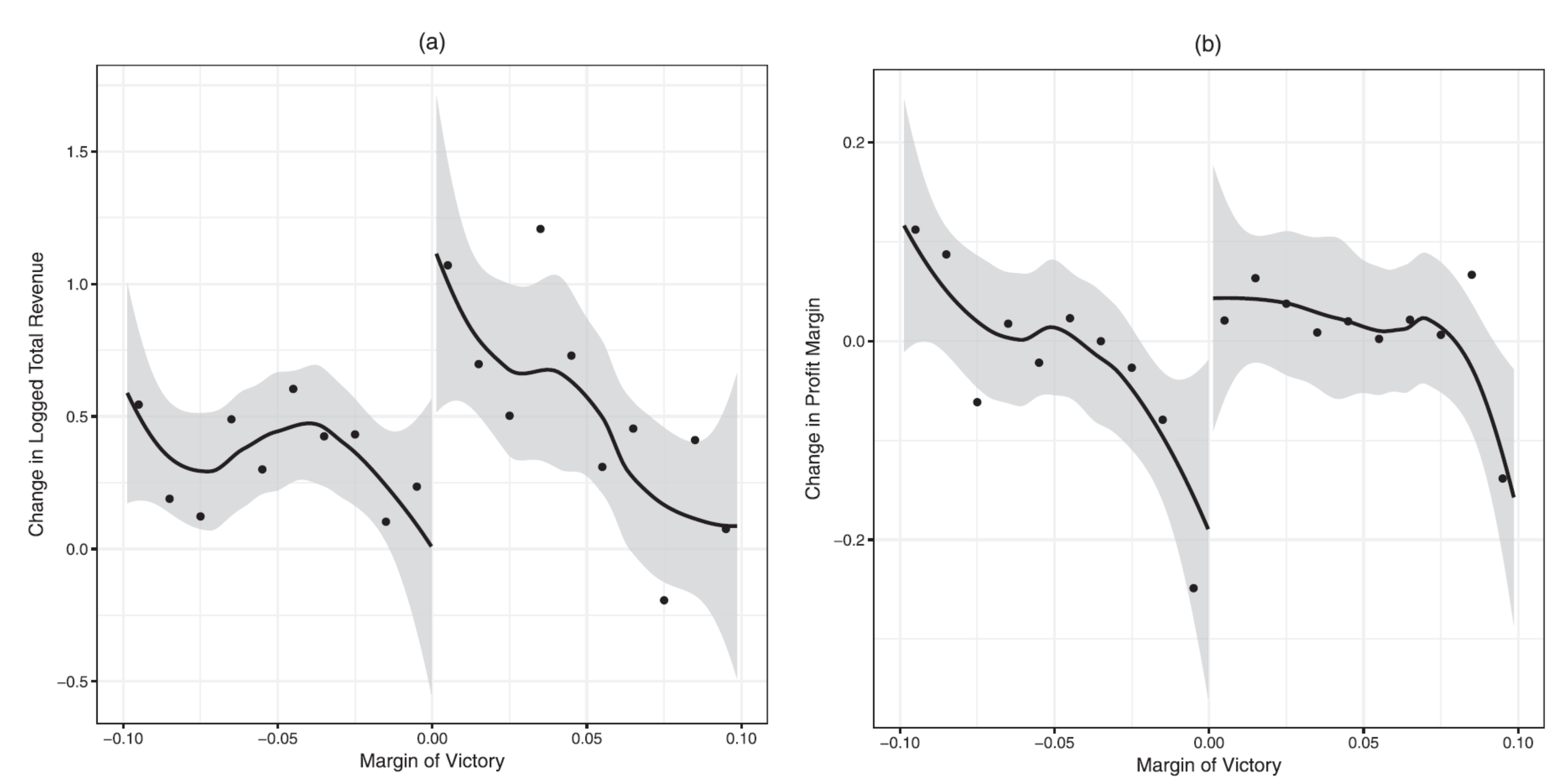
When city councils become more racially diverse, public goods spending drops by 11-30%.

Abou-Chadi & Krause (2018):



When Radical Right parties gain parliamentary representation, mainstream parties adopt **much** more culturally conservative platforms (converging with the average Populist party).

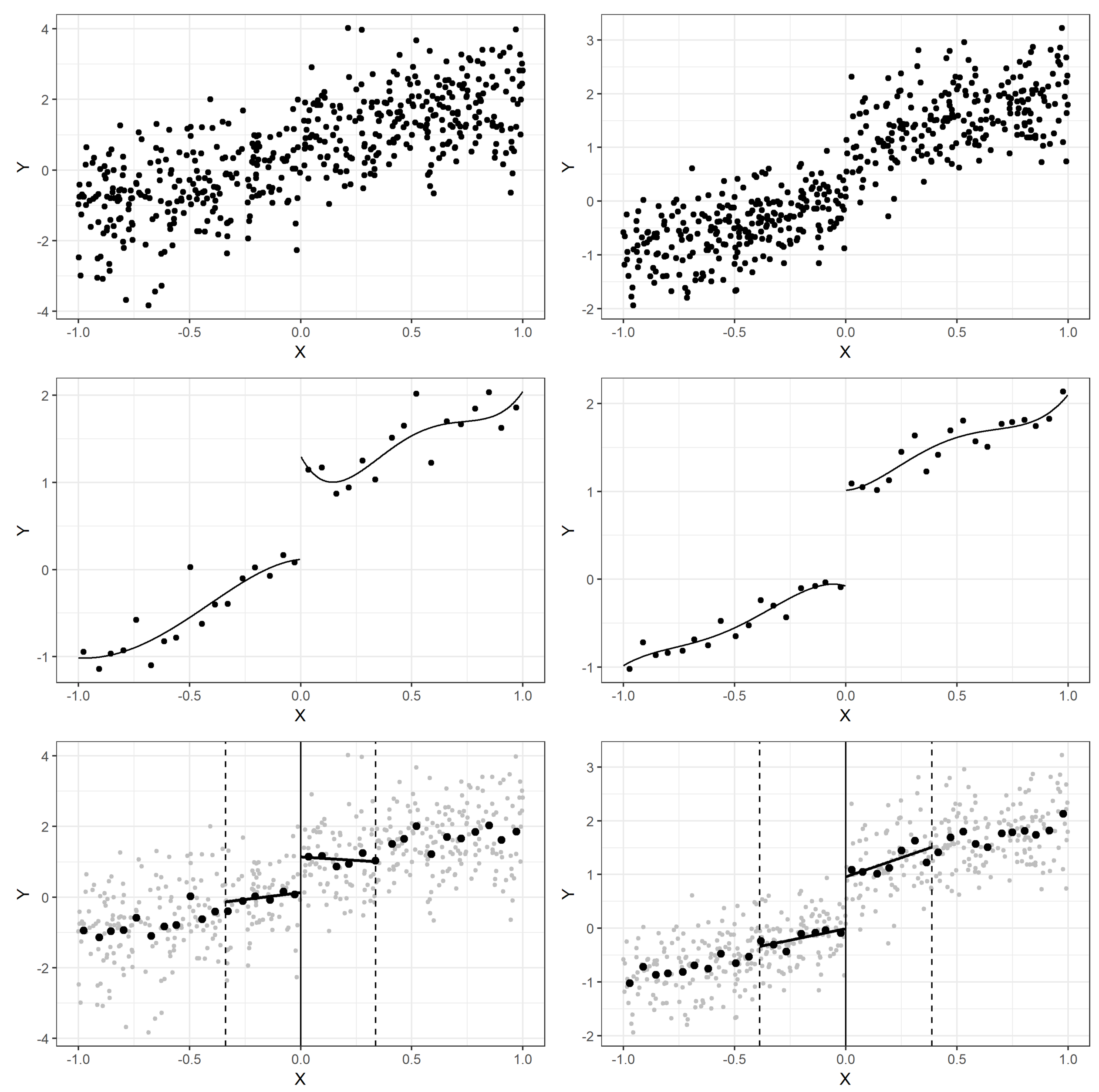
Szakonyi (2018):



When Russian businesspeople become legislators, their firms see 60% higher revenues and 15% higher profits.

Solution 1: Better Visualizations

Bottom panel combines (a) raw data, (b) binned scatter plot, (c) bandwidth selection, and (d) local polynomial fit.



Solution 2: Power Calculations

A useful summary statistic: what is the *smallest effect size* that your RD can reliably detect?

$$MDE = \sqrt{\mathbf{V}^{bc}}\left(\Phi^{-1}\left(1 - \frac{\alpha}{2}\right) + \Phi^{-1}(1-\beta)\right)$$

where α is the significance threshold and $1 - \beta$ is power:

$$1 - \beta = \Phi\left(\frac{\tau}{\sqrt{\mathbf{V}^{bc}}} - \Phi^{-1}\left(1 - \frac{\alpha}{2}\right)\right) + \Phi\left(-\frac{\tau}{\sqrt{\mathbf{V}^{bc}}} - \Phi^{-1}\left(1 - \frac{\alpha}{2}\right)\right)$$

See [1] for a more detail + software implementation.

References

[1] Matias D. Cattaneo, Rocío Titiunik, and Gonzalo Vazquez-Bare. "Power calculations for regression-discontinuity designs". In: *The Stata Journal* 19.1 (2019), pp. 210–245.

[2] Andrew Gelman and John Carlin. "Beyond power calculations: Assessing Type S (sign) and Type M (magnitude) errors". In: *Perspectives on Psychological Science* (2014), pp. 1–11.

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