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## BACKGROUND

Hospital data breaches are increasing in number over time and threaten the benefits that hospitals offer investors, patients, and the broader community.

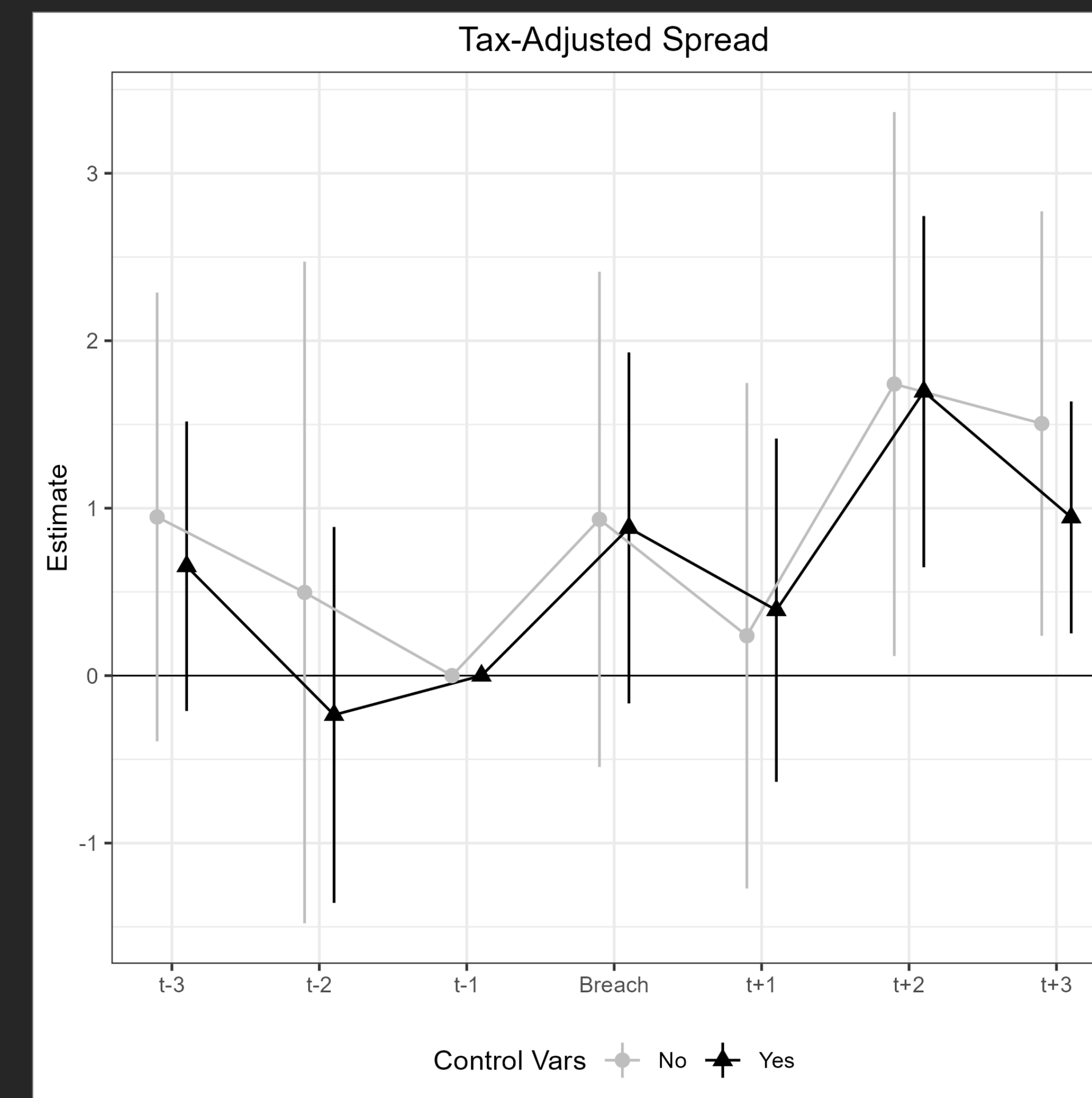
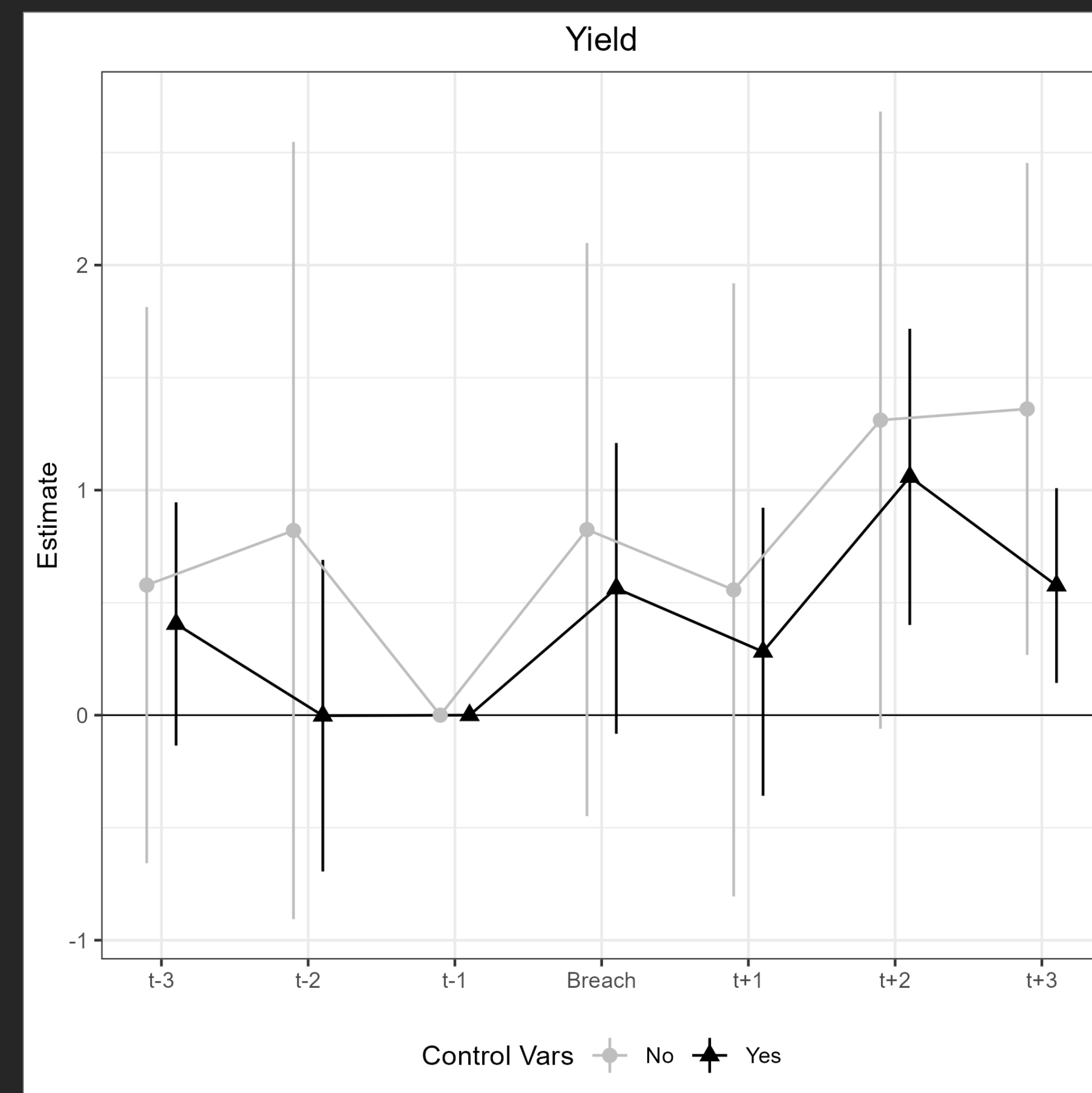
## METHODS

1. Identify a sample of **82 data breaches** that are associated with municipal bond issuers or hospitals that report to CMS
2. Examine issuer **primary municipal bond market costs** with a stacked difference-in-differences over a 7-year window
3. Consider **channels**
  - a) Issuer credit ratings
  - b) Hospital cash flows and balance sheets
  - c) Patient treatment quality
4. Test how **attention** influences the effect of hospital data breaches

## RESULTS

1. The **average breach costs hospitals about \$2M more** over their average bond's life, but the pricing effect occurs only after investors can see underlying fundamentals
2. Channels
  - a) **Ratings drop** about 2.25 notches
  - b) **Hospital cash flows suffer post-hack**
  - c) **Patient care suffers post-hack**
3. **Investors do not incrementally price hacks**, despite having the worst outcomes
4. Greater **attention** leads to stronger effects

# The market views data breaches as risky for hospitals, but investors don't price the worst events.



**The Incremental Effects of Hacks on Hospital Financing**

	Yield		Adjusted Spread	
	(1)	(2)	(3)	(4)
Breach×Post×Hack	-0.297 (-0.663)	-0.261 (-0.702)	-0.835 (-1.27)	-0.449 (-0.746)
Breach×Post	0.655** (2.29)	0.584* (1.87)	0.978* (1.89)	0.992** (1.99)
Controls	No	Yes	No	Yes
Issuer×Event FEs	Yes	Yes	Yes	Yes
Year×Event FEs	Yes	Yes	Yes	Yes
Observations	11,987	11,987	11,987	11,987
Adj R <sup>2</sup>	0.472	0.893	0.476	0.789

**Data Breaches and Hospital Cash Flows**

	Pat Rev	Out Rev	In Rev	Bed Util
	(1)	(2)	(3)	(4)
Breach×Post×Hack	-0.060* (-1.684)	-0.015 (-0.294)	-0.101** (-2.342)	-0.023* (-1.683)
Breach×Post	-0.009 (-0.300)	-0.017 (-0.409)	0.019 (0.614)	0.022* (1.962)
Controls	Yes	Yes	Yes	Yes
Issuer×Event FEs	Yes	Yes	Yes	Yes
Year×Event FEs	Yes	Yes	Yes	Yes
Observations	Yes	Yes	Yes	Yes
Adj R <sup>2</sup>	44,665	44,663	44,665	44,645

**Data Breaches and Patient 30-Day Readmission Rates**

	PN	HF	AMI	COPD
	(1)	(2)	(3)	(4)
Breach×Post×Hack	0.026* (1.77)	0.060* (1.75)	0.055*** (4.23)	0.050** (2.03)
Breach×Post	-0.009 (-0.983)	-0.023 (-0.974)	-0.040*** (-3.55)	-0.038* (-1.98)
Controls	Yes	Yes	Yes	Yes
Issuer×Event FEs	Yes	Yes	Yes	Yes
Year×Event FEs	Yes	Yes	Yes	Yes
Observations	1,173	1,162	946	1,138
Adj R <sup>2</sup>	0.968	0.966	0.989	0.972



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