Opioid Crisis and Firm Downside Tail Risks: Evidence from the Option Market

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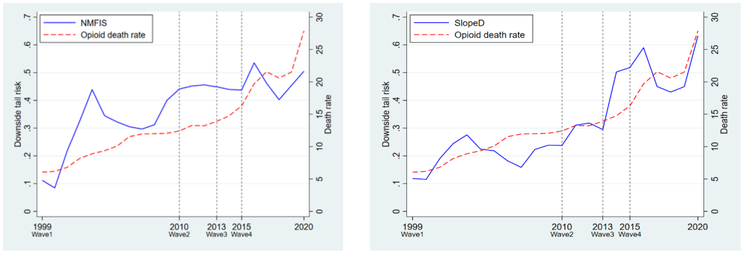
RESEARCH QUESTION

How does the opioid crisis exposure affects firm downside tail risks implied from equity options?

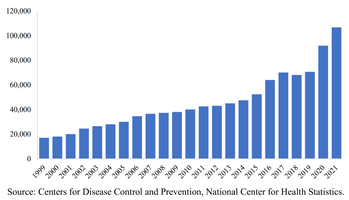
OPIOID CRISIS

- The opioid crisis refers to a widespread public health emergency characterized by the addiction and overdose deaths associated with opioid drugs.
- The typical U.S. public firm becomes riskier on the left tail, and the risk level tends to fluctuate with the opioid death rate.

Firm downside risks and opioid-related death rates

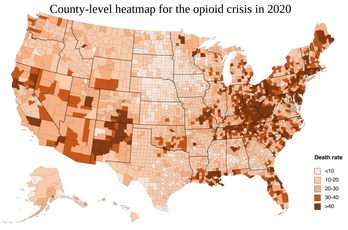


National Drug-Involved Overdose Deaths



Source: Centers for Disease Control and Prevention, National Center for Health Statistics.

County-level heatmap for the opioid crisis in 2020



MOTIVATION

- The opioid crisis escalates rapidly, with alarming rates of opioid-related overdose deaths.
- Little is known about the impact of the opioid crisis on firm downside risk.
- The opioid crisis can exert an adverse influence on firms' workforce and productivity by compromising employee health.
- The degree to which opioid crisis risk will affect individual firms remains highly uncertain.

MAIN FINDING

- Using a large sample of U.S. public firms from 1999 to 2020, we find that firms headquartered in regions with higher opioid death rates face higher downside tail risks, i.e., the cost of option protection against left tail risks is higher.
- The effects are reversed following exogenous anti-opioid legislation, supporting a causal interpretation.
- Further analysis shows that the opioid crisis heightens firm risk by lowering labor productivity. We document more pronounced impacts among firms with higher reliance on labor, limited local labor supply, and lower workplace safety.

DATA AND RESEARCH DESIGN

- Opioid death rate: the number of drug-related deaths, adjusted for county population (per 100,000) at county level from 1999 to 2020.
- MFIS (the opposite value of model-free implied skewness): the relative expensiveness of protection against left-tail events compared to right-tail events.
- SlopeD (Implied volatility slope): the regression coefficient of implied volatilities of OTM puts on deltas, representing the relationship between left-tail implied volatility and moneyness.

$$Tail\ risk_{i,t} = \alpha + \beta \times Death\ rate_{i,t} + Controls_{i,t-1} + FEs + \varepsilon_{i,t}$$

- Tail risk: MFIS and SlopeD for firm *i* in year *t*. A more positive value indicates a higher tail risk.
- Death rate: county-level opioid death rate for firm *i* in year *t*.
- Controls: firm-level and county-level controls.

BASELINE RESULT

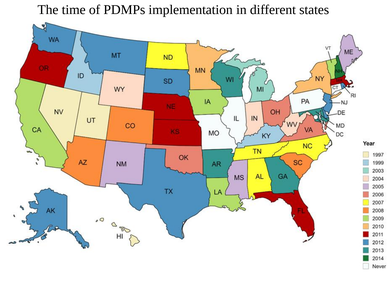
- A one-standard-deviation increase in Death rate (8.188) is associated with an increase of 0.020 in NMFIS and an increase of 0.016 in SlopeD, which is approximately 5% of the variable's standard deviation for both NMFIS and SlopeD

Dependent variable	MFIS (1)	SlopeD (2)	MFIS (3)	SlopeD (4)
Death rate	0.0025***	0.0020***	0.0025***	0.0020***
	(3.82)	(3.29)	(4.00)	(3.04)
Controls	Yes	Yes	Yes	Yes
Firm & Year FE	Yes	Yes	Yes	Yes
Cluster	County	County	County, Year	County, Year
Observations	35,890	35,890	35,890	35,890
Adj. R^2	0.546	0.546	0.558	0.558

IDENTIFICATION

- We utilize the staggered adoption of state-level PDMPs (Prescription Drug Monitoring Programs) as exogenous shocks to reduce the opioid-related death rate.

The time of PDMPs implementation in different states



Dependent variable	County-level analysis Death rate (1)	Firm-level analysis MFIS (2)	Firm-level analysis SlopeD (3)
PDMP	−1.8467***	−0.0385***	−0.0311**
	(−4.31)	(−2.94)	(−2.49)
Controls	Yes	Yes	Yes
FE	County, Year	Firm, Year	Firm, Year
Observations	6,536	31,974	31,974
Adj. R^2	0.760	0.548	0.564

UNDERLYING CHANNELS

The opioid crisis, employee productivity, and corporate hiring

- Labor productivity is the ratio of sales to the number of employees in year *t*.
- # Job posting is the number of jobs posted by a firm within the year *t+1* divided by sales of year *t*.
- Unrecruited ratio is the number of jobs not filled one year after posting divided by the total number of jobs of each firm each year, adjusted for industry-year average.

Dependent variable	Labor productivity (1)	# Job posting (2)	Posting duration (3)
Death rate	−1.3154**	0.0059**	0.0006**
	(−2.37)	(2.32)	(1.97)
Controls	Yes	Yes	Yes
Firm & Year FE	Yes	Yes	Yes
Cluster	County	County	County
Observations	35,890	15,586	13,922
Adj. R^2	0.868	0.566	0.298

Cross-sectional tests on the role of labor intensity

- High Labor Intensity: firms in labor-intensive industries, including the mining industry, construction industry, and manufacturing industry.

Dependent variable	MFIS		SlopeD	
	High Labor Intensity (1)	Low Labor Intensity (2)	High Labor Intensity (3)	Low Labor Intensity (4)
Death rate	0.0031***	0.0015	0.0023***	0.0011
	(3.87)	(1.55)	(2.90)	(1.14)
Controls & FE	Yes	Yes	Yes	Yes
Observations	21,580	14,310	21,580	14,310
Adj. R^2	0.553	0.541	0.564	0.553
Difference (High-Low)	0.002***		0.001***	
p-value	(0.000)		(0.010)	

Cross-sectional tests on the role of local labor supply

- Labor supply: the ratio of the labor force over the total population of each county each year.
- Low Labor Supply: firms located in the county with labor supply below the median.

Dependent variable	MFIS		SlopeD	
	Low Labor Supply (1)	High Labor Supply (2)	Low Labor Supply (3)	High Labor Supply (4)
Death rate	0.0037***	0.0021***	0.0027***	0.0015*
	(3.33)	(2.58)	(3.01)	(1.76)
Controls & FE	Yes	Yes	Yes	Yes
Observations	15,902	19,982	15,902	19,982
Adj. R^2	0.540	0.564	0.565	0.568
Difference (Low-High)	0.002***		0.001***	
p-value	(0.000)		(0.000)	