Intermediary Option Pricing
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- We know: put options are expensive (volatility smirk)

- This paper: This is true also after Δ hedging ... but effect solely realized during the night

- Market makers can adjust their Δ hedges during the day as needed...

- ... but not during the night when the underlying does not trade

$\Rightarrow$ **Intermediaries require compensation for the gap risk they bear during the night**

THE PAPER IN A NUTSHELL

Figure 1: Option Risk Premia Occur Where Dealers are Short and Liquidity is Low

(a) Option Returns
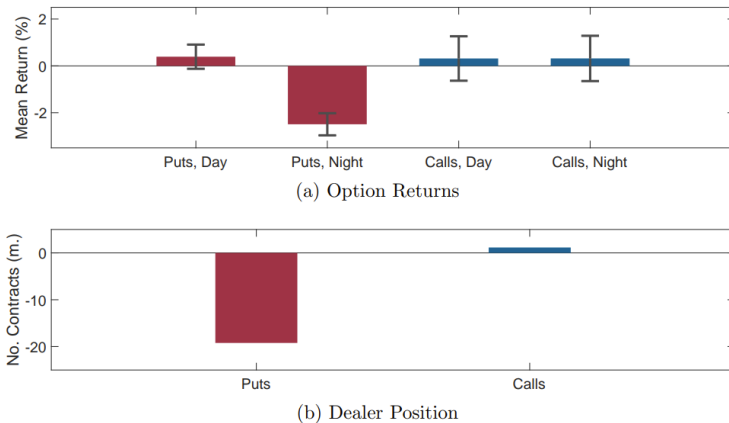
(b) Dealer Position

Note: This figure shows that option risk premia between 2011 and 2023 materialize overnight in put options, where dealers have a net-short position. Panel (a) shows 95% confidence intervals for return averages of out-of-the-money S&P 500 put-and call options. Returns are measured over "Day" periods between 09:45 and 16:15 and over "Night" periods between 16:15 and 09:45 (E.T.). Returns are delta-hedged at the beginning of the respective period. Panel (b) shows dealers' average net position in S&P 500 options. The net position is the cumulative sum of dealers' net buys, where net buys are the number

Main specification

$$R_t^i = \beta_1 GapRisk_{t-1}^i + \beta_2 Night_t + \beta_3 GapRisk_{t-1}^i \times Night_t + \varepsilon_t^i$$

Table VI: Option Returns on Dealers' Gap Risk: Significant Overnight

	(1)	(2)	(3)	(4) Puts	(5) Calls
Dealers' Gap Risk	-32.3***	-32.2***	-4.0	-3.5	-35.5
	(-4.80)	(-4.79)	(-0.47)	(-0.31)	(-1.44)
Night		-85.0***	-84.6***	-153.3***	-12.1
		(-3.28)	(-3.27)	(-7.71)	(-0.29)
Dealers' Gap Risk x Night			-56.5***	-67.0***	-7.4
			(-4.19)	(-3.73)	(-0.19)
Constant	-23.2*	18.6	18.5	17.3	19.7
	(-1.79)	(0.98)	(0.97)	(1.11)	(0.74)
Observations	43,256	43,256	43,256	22,084	21,172
R2-adjusted	0.00	0.00	0.00	0.01	0.00

Note: This table shows that dealers' equity market gap risk predicts option risk premia, but only over night periods. The table presents regression estimates of Equation 5. I regress portfolio-level option returns on the portfolio-level measure of dealer gap risk presented in Section V and a dummy for night-periods. Option returns are overnight and intraday for the four out-of-the-money put- and call option portfolios from tables II and A.12. Returns are in basis points and are delta-hedged at the beginning of the respective period. Column (4) contains only the four put portfolios, column (5) contains only the four call portfolios. Gap risk is standardized to zero mean and unit variance. Standard errors are clustered within each day. The sample period is 2011 to 2023.

Natural experiment: overnight equity trading

Figure 2: Increasing Equity Trade Volume Lowers Option Risk Premia
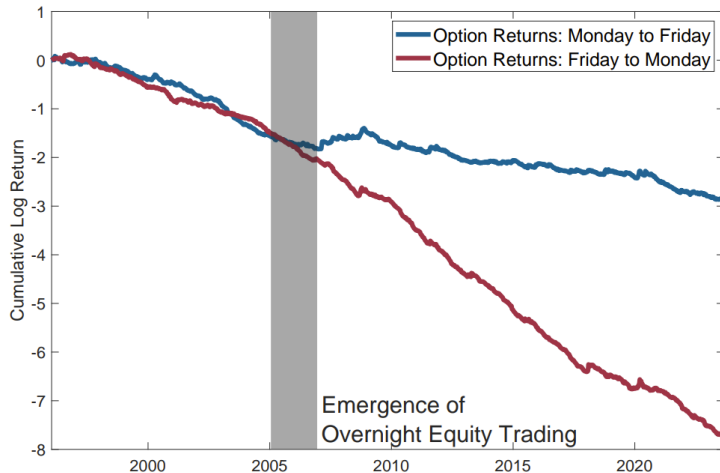
COMMENT 1: INCREASE EXPOSURE WHEN RISK PREMIA ARE HIGH?

- Take risk premia as exogenously given, including the difference between day and night

- **Write more puts when risk premia are high**

  - ▶ consistent with what we see in the data

  - ▶ have to be careful when disentangling how market makers "set risk premia" versus move along their demand curve

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- Could there be other reasons for why risk premia vary between day and night?
  - ▶ Someone else (households? broker dealers?) is marginal and Δ hedging
  - ▶ Recent literature has emphasized the role of events for when risk premia are earned in different settings (e.g., Hillenbrand, 2023)
  - ▶ If such events are more likely at night, this could create a difference in risk premia between day and night

COMMENT 2: INTERMEDIARY-BASED ASSET PRICING

- Intermediary asset pricing recognizes that financial intermediaries are the marginal investors in many markets
  - ▶ especially in complex asset classes (Haddad and Muir, 2021; Eisfeldt et al, 2021)
- The intermediary asset pricing literature has emphasized:
  1. the role of balance sheet constraints (e.g., Brunnermeier and Sannikov, 2014)
  2. the overall health of the intermediary sector (e.g., He and Krishnamurthy, 2013)

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- This paper emphasizes #1: writing more put options $=$ larger gap risk

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- Suggestion 1: Alternative research designs could vary how binding balance sheet constraints are... e.g., CIP violations at quarter ends in Du, Tepper, and Verdelhan (2018)
- Suggestion 2: How about the health of the intermediary sector? When intermediary wealth is low (e.g., after following losses), or leverage is high? Broker-dealers?

# COMMENT 3: $GapRisk_{t-1}^i$ IN THE DATA

(a) Puts
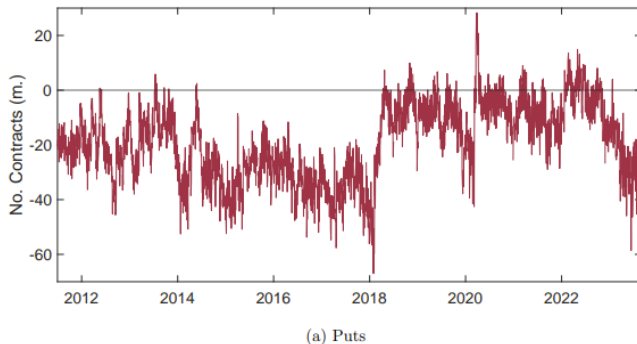
- Practically, this looks like diff-in-diff (after vs before 2018)
- We know we need parallel trends... is that reasonable? What happened in 2018?
- "Volmageddon:" did market-makers learn writing puts is risky? and responded to it?

COMMENT 4: WHAT IF... AROUND-THE-CLOCK TRADING?

- What if... we introduced around-the-clock trading in equities?

- This paper $\Rightarrow$ better liquidity makes option risk premia go away

- Suggestion: How does this square with intra-day volume patterns?

- Doess less liquidity around noon also translate into option risk premia?
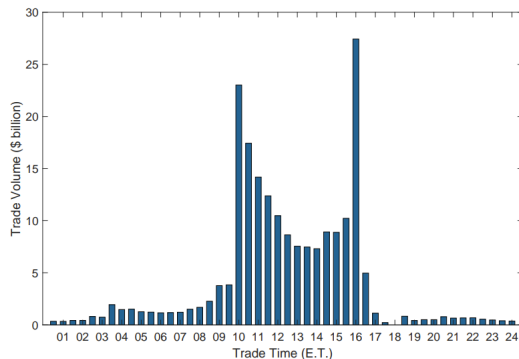
(a) Futures

Comment 5: Do magnitudes make sense?

- To generate the differences in put risk premia between day and night, intermediaries need to care a lot (?) about Δ hedging during overnight crashes

- Is there a way of quantifying how much intermediaries need to care given what we observe in the data?

Conclusion

- Fascinating paper!

- Very careful execution

- Count me as convinced that put option premia are connected to intermediary balance sheets

Best of luck for the job market!