



Why do option-buyers lose money?

Rajarshi Som^a

^a*Indian School of Business*

Abstract

Option-buyers lose money on average, and most of the losses are borne by retail investors who do not understand why option-buyers are supposed to lose money.

Options transfer risk from the buyer to the seller, and the buyer pays the seller a compensation commonly called the volatility risk premium. This premium can be further decomposed into premia for volatility risk and for jump risk, and includes premia for higher-order risks like volatility-of-volatility risk and jump-of-volatility risk.

I. Introduction

Across asset classes and geographies, option-buyers tend to lose more money than they make. For example, a strategy of buying and holding at-the-money ('ATM') straddles⁵ on the S&P 500 index (ticker: 'SPX') for one day⁶ from January 1996 to August 2025 generated a daily return of -0.25%. Similar strategies on other US stock indices, namely the S&P 100 index ('OEX'), the Dow Jones Industrial Average ('DJX') and the NASDAQ 100 index ('NDX') yield average daily returns of -0.17%, -0.17% and -0.30% respectively (see Figure 1). The same pattern holds in single-stock options: a strategy of buying and holding at-the-money straddles (Goyal and Saretto 2009) or variance swaps (Carr and Wu 2009) on individual stocks loses money on average.

Unsurprisingly, the bulk of option-trading losses are borne by retail investors. Studying a sample of trades in KOSPI 200 options in 2010 - 14, Hu et al. (2024) find that institutional traders make money on average while retail traders lose money on almost all strategies except short-volatility (i.e., selling straddles) and volatility-switching. A study by the Indian regulator, SEBI, have found that 93% of retail traders lost money in options from 2021 to 2024. Collectively, all evidence seems to suggest that retail traders, for the most part, lack an understanding about the economics of option prices and profits (or losses).

Through this article, I seek to help readers build an intuition about why option-buyers are *supposed* to lose money. In Section 2, I describe the underlying asset return process. In Section 3, I explain how option-buying losses are a compensation that option-buyers pay for offloading volatility risk and jump risk to option-sellers. In Section 4, I discuss a few more risks that options are exposed to. Section 5 concludes.

II. The underlying asset return process

Consider options on an underlying asset whose price (the 'spot price') at time t is S_t . The underlying asset prices follow the following generalized return process⁷:

⁵ All options discussed in this article are traded on the Chicago Board Options Exchange (CBOE). Price data on the options is available at OptionMetrics IvyDB US.

⁶ This strategy entails buying an ATM straddle (i.e., one ATM call option and one ATM put option) at the close of one trading day and selling the straddle on the close of the next trading day.

⁷ Bates (1996), Duffie, Pan, and Singleton (2000), and Eraker (2004) use variations of this return process.

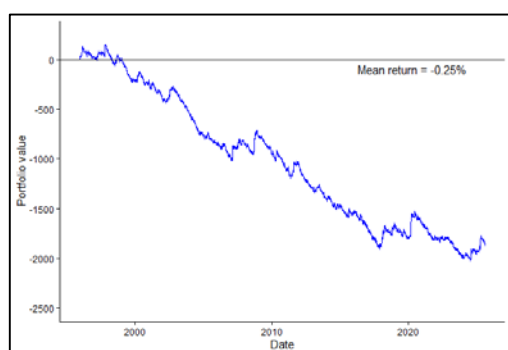
$$(1) \quad \frac{dS_t}{S_t} = \mu^S dt + \sigma_t^S dW_t^S + dJ_t^S$$

In equation (1), $\frac{dS_t}{S_t}$ is the underlying asset's instantaneous return over an infinitesimally short period of time dt , while μ^S is the asset price drift rate (i.e., the asset's mean return). The first term on the right-hand side, $\mu^S dt$, captures the deterministic (and therefore, riskless) component of the asset's return.

Figure 1

This figure plots, from January 1996 to August 2025, the portfolio value of a strategy which buying an at-the-money straddle and holding for one day. At the close of each trading day, I buy \$ 100 worth of a straddle comprised of an at-the-money call option and an at-the-money put option expiring on the third Friday of the next calendar month⁸. I exit the straddle position after holding it for a day.

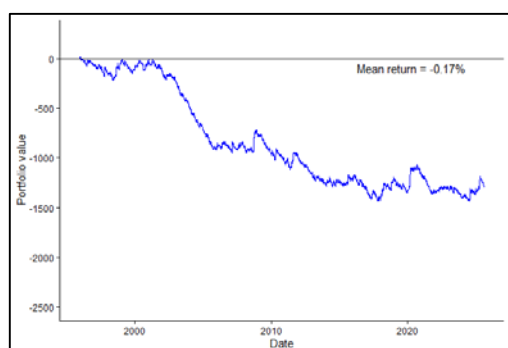
Panel A: SPX straddles



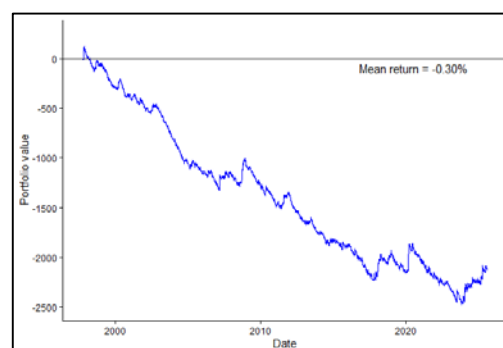
Panel B: OEX straddles



Panel C: NDX straddles



Panel D: DJX straddles



⁸ This expiry date is considered the standard expiry for CBOE – traded options.

The second term on the right-hand side, $\sigma_t^S dW_t^S$, is the product of two variables: (i) time-varying (stochastic) volatility σ_t^S , and (ii) a random Brownian motion dW_t^S . Stochastic volatility σ_t^S captures the standard deviation of returns around the mean, while dW_t^S represents “how many times the standard deviation” the return moves away from its deterministic path in instant dt . Therefore, $\sigma_t^S dW_t^S$ captures a fairly smooth wobbling of the underlying asset return around its mean and is called the diffusion term. The sum of the first two terms, $\mu^S dt$, represents the smooth movement of returns along and around the mean. The third term on the right-hand side, dJ_t^S , is a jump term which captures rare by violent moves in the underlying asset return.

The drift term ($\mu^S dt$) represents the riskless drift component of return, while the sum of the diffusion term and the jump term ($\sigma_t^S dW_t^S + dJ_t^S$) represents the risky component. See Figure 2 for a visual illustration.

Figure 2

This figure illustrates the economic interpretations of the different components of the instantaneous returns. The first term ($\mu^S dt$) is the riskless component of return, while the sum of the next two terms ($\sigma_t^S dW_t^S + dJ_t^S$) is the risky component of return.

$$\frac{dS_t}{S_t} = \underbrace{\mu^S dt}_{\text{Drift}} + \underbrace{\sigma_t^S dW_t^S}_{\text{Diffusion}} + \underbrace{dJ_t^S}_{\text{Jump}}$$

Wobbling
Riskless
Risky

Note that the Black-Scholes model (Black and Scholes 1973), commonly taught to business students and to early-career practitioners, builds on a simplified return process that differs from the process in

equation (1) in two ways. First, Black and Scholes (1973) do not include a jump term (dJ_t) in their model. Second, the Black-Scholes model uses a time-invariant (deterministic) volatility (σ) instead of stochastic volatility (σ_t). More formally, the Black-Scholes model belongs to a family of models with deterministic volatility without jump⁹, and can be expressed as follows:

$$(2) \quad \frac{dS_t}{S_t} = \mu^S dt + \sigma^S dW_t^S$$

In practice, the volatility (σ^S) is unknowable at the time of trading and actual trading takes place in dollars. From the market price of an option (in dollars), one can infer the volatility that traders had priced into their calculations; this volatility (that is inferred from the dollar price) is commonly called the ‘implied volatility’ or ‘IV’. In contrast, the return volatility that is subsequently realized (after the option is traded and until the option expires) is called ‘realized volatility’ or ‘RV’.

While the Black-Scholes model is good enough most practical uses, it does not help develop a holistic understanding of the sources of risk embedded in the underlying asset return process itself (and therefore the risks priced into options on these assets). In the Black-Scholes world where volatility is deterministic and the underlying asset can be continuously traded¹⁰, a delta-hedged option is a riskless asset which earns the risk-free return. However, the generalized return process in equation (1) has two sources of risk: (i) the stochastic nature of the volatility term (commonly called ‘volatility risk’), and (ii) the jump term (‘jump risk’).

III. Risks and risk premia in options

Risk is not free. Investors who bear risk expect a reward (called ‘risk premium’) while investors who offload risk must pay the premium. This relationship between risk and reward is one of the most fundamental paradigms in finance and drives the pricing of all asset classes. For example, stocks yield higher average returns than corporate bonds issued by the same firm, while corporate bonds yield higher average returns than government bonds of the same maturity. Riskier stocks yield higher average returns than less risky stocks.

Options are a mechanism through which option-buyers offload risk to option-sellers, thereby making options-buyers less risky (and in a position to benefit from increased volatility or from jumps) option-

⁹ The Binomial model of Ross, Rubinstein, and Cox (1979) builds on the same return process.

¹⁰ This is one of the assumptions in the Black-Scholes derivations of option prices.

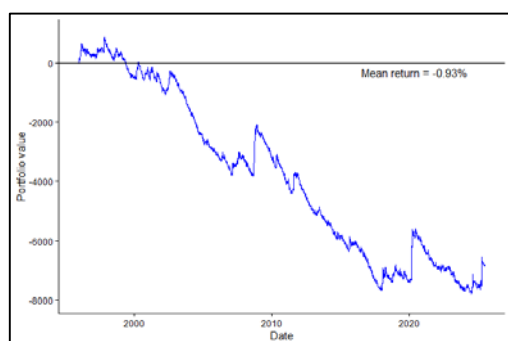
sellers riskier (who stand to lose from increased volatility or from jumps). Rational option-sellers must, therefore, demand a risk premium as a compensation for the risks associated with short-option positions.

Figure 3

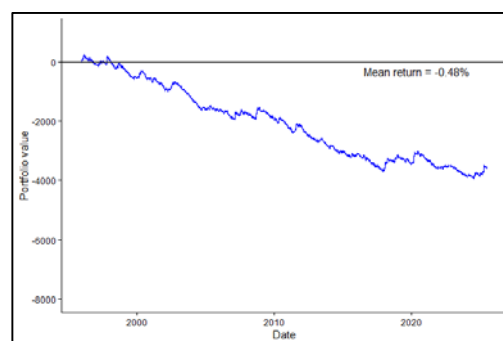
This figure plots, from January 1996 to August 2025, the portfolio values of two spread strategies constructed from options of two different expiry dates: (i) a pure-volatility position (with positive vega, no gamma, and no delta), and (ii) a pure-jump position (with positive gamma, no vega, and no delta). In each strategy, I build the position worth \$100 at the end of a trading day and hold it for one day.

Panel A and Panel B illustrate, respectively, the evolution of the portfolio values of the pure-volatility strategy and the pure-jump strategy.

Panel A: Pure-volatility strategy



Panel B: Pure-jump strategy



Recall Figure 1A. A strategy of buying SPX straddles and holding them for a day yields an average return of -0.25% per day. This return is commonly interpreted as the ‘volatility risk premium’ in SPX options, the compensation that SPX option-buyers pay SPX option-sellers to bear volatility risk. However, the common practice of interpreting straddle returns as the volatility risk premium does not distinguish between volatility risk (that comes from the stochastic volatility term in equation 1) and jump term (that comes from the jump term in equation 1). To disentangle volatility risk from jump risk, Cremers, Halling, and Weinbaum (2015) use CME-traded S&P 500 futures options of different expiries to construct a pure-volatility position (that has positive vega but no gamma and no delta) and a pure-jump position (that has positive gamma but no vega and no delta)¹¹. I recreate the pure-volatility

¹¹ I direct interested readers to Cremers, Halling, and Weinbaum (2015) for methodological details.

and pure-jump strategies using CBOE-traded SPX options and plot their cumulative returns in Figure 3. Empirically, it appears that the premium for volatility risk (-0.93% per day) is almost double the premium for jump risk (-0.48% per day)¹².

IV. Extension: Higher-order risks

The underlying asset return process in equation (1) stopped at decomposing the total asset return into (i) a (riskless) drift component ($\mu^S dt$), (ii) a (risky) diffusion component (which is the product of a stochastic volatility variable (σ_t^S) and a random Brownian motion variable (dW_t^S)), and (iii) a (risky) jump component (dJ_t^S). This decomposition allowed option returns to be interpreted as a combination of volatility risk premium (a compensation for σ_t) and a jump risk premium (a compensation for dJ_t).

The stochastic volatility (σ_t) process can be expressed as follows:

$$(3) \quad (\sigma_t^S)^2 = \kappa(\theta - (\sigma_t^S)^2)dt + \xi \sigma_t^S dW_t^{\sigma^2} + dJ_t^{\sigma^2}$$

The $(\sigma_t^S)^2$ on the left-hand side of equation (3) is the underlying asset return variance, i.e., the square of the underlying asset return volatility (σ_t^S). The first term on the right-hand side represents the mean-reversion process; here, θ is the long-run variance (i.e., the level to which variance tends to revert) and κ is the speed of mean-reversion. The second term represents the diffusion-of-volatility process; here, ξ is the volatility of volatility and $dW_t^{\sigma^2}$ is a Wiener process that generates normally distributed random shocks. The third term ($dJ_t^{\sigma^2}$) represents jumps in variance.

Delving deeper into the stochastic volatility process unearths two additional sources of risk. First, the *volatility-of-volatility risk* arises because of the second term ($\xi \sigma_t^S dW_t^{\sigma^2}$). In a high-volatility regime, i.e., when the underlying asset return volatility (σ_t^S) is high, the product $\xi \sigma_t^S$ is also high and leads to a wider range of oscillation in σ_t^S and therefore in the underlying asset return $\frac{dS_t}{S_t}$. Second, the *jump-of-volatility risk* arises because of the $dJ_t^{\sigma^2}$ term, which captures rare but large shocks to the underlying asset volatility (and therefore, to the underlying asset return $\frac{dS_t}{S_t}$). Collectively, volatility-of-volatility risk and jump-of-volatility risk capture the two principal dimensions of volatility risk.

¹² The premia for volatility risk and for jump risk are not additive; readers should not add the two premia and expect to arrive at straddle returns. Rather, readers can compare the two premia and interpret their magnitudes relative to each other.

Note that there are two jump processes: (i) the dJ_t^S term in equation (1), and (ii) the $dJ_t^{\sigma^2}$ term in equation (2). If the two jump processes are independent, e.g. in Bates (1996), there is no additional risk. However, if the two jump processes are positively correlated (Duffie, Pan, and Singleton 2000; Eraker 2004), then a jump in the underlying asset return is likely to take place at the same time as a jump in return volatility; this correlation introduces an additional risk. Furthermore, if the probability of jumps depends on the level of volatility (σ_t^S) (e.g. in Eraker (2004)), then the two jumps are more likely to take place in higher-volatility states; in other words, high levels of volatility would lead to larger moves in the underlying asset price simply by triggering simultaneous jumps in returns (dJ_t^S) and in volatility ($dJ_t^{\sigma^2}$).

While a conceptual understanding of higher-order risks is perhaps not difficult to develop, empirically measuring these risks (and isolating their associated premia) remains a challenge.

V. Conclusion

Option-buyers tend to lose money on average and most of these losses are borne by retail investors, who tend to lack an economic understanding of the risks and risk premia embedded in option prices (and why option-buyers are *supposed* to lose money). Through this article, I attempt to explain the various risks that are priced into options, including (i) volatility risk, (ii) jump risk, (iii) volatility-of-volatility risk, and (iv) jump-of-volatility risk.

The purpose of this article is not to offer a tutorial on how to generate profits (or reduce the magnitude of losses) from buying options, but simply to educate traders (especially retail investors) on why option-buyers usually lose money. I hope it helps!

VI. References

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