



Hedging costs, liquidity, and inventory management: The evidence from option market makers[☆]

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Abstract

Hedging the risk of holding undesired inventory is very important for market makers. However, prior studies seldom capture the role of inventory positions in measuring hedging costs. This study measures hedging costs directly using data on inventory positions of market makers in the Taiwan Index Options market. We break down rebalancing costs into two sources: rebalancing costs due to inventory changes and rebalancing costs due to delta changes. Contrary to prior studies on stock options, we find rebalancing costs are more important than initial hedging costs in explaining option spreads. Our findings underscore the importance of inventory management.

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1. Introduction

This study examines the role of hedging costs in determining market makers' quotations. The focus is on the relation between option spreads and the cost of a delta-neutral hedge at the portfolio level using futures as the hedging tool. We highlight the importance of inventory management by using market makers' inventory positions to measure hedging costs. Market makers provide liquidity by buying and selling according to the prevailing market demand; bid–ask spreads are to compensate market makers for providing liquidity. To provide liquidity, market makers carry inventories and bear inventory risk. In general, market makers manage their inventory risk by (i) directly adjusting bid and ask prices to obtain the optimal level of inventory or (ii) hedging against inventory risk. Both policies play an important role in determining asset prices and liquidity.

The theoretical works of [Garman \(1976\)](#), [Amihud and Mendelson \(1980\)](#), and [Ho and Stoll \(1981\)](#) show that monopolistic market makers actively adjust the bid and ask prices to manage their inventories. [Ho and Stoll \(1980, 1983\)](#) come to a similar conclusion under a competing dealer framework. If market makers actively adjust quotes for inventory control purposes, bid and ask prices should be negatively related to the level of inventory. Many studies have empirically tested the predictions of these models. [Hasbrouck and Sofianos \(1993\)](#) and [Madhavan and Smidt \(1993\)](#) analyze the NYSE specialist inventory data and only find slow position adjustment, while [Kavajecz and Odders-White \(2001\)](#) find that the specialist inventory has no influence on quoted prices. [Panayides \(2007\)](#) finds that specialists engage in significant inventory rebalancing but only when they are not constrained by the price continuity rule. Focusing on London Stock Exchange, [Hansch, Naik, and Viswanathan \(1998\)](#) and [Naik and Yadav \(2003\)](#) find that market makers aggressively manage their inventories by strategically positioning their quotes.

Very few studies in derivative markets use market makers' inventory data. [Ho and Macris \(1984\)](#) analyze stock options traded on AMEX and show that a dealer's inventory level affects bid–ask quotes, which in turn influences the observed option returns. [Manaster and Mann \(1996\)](#) examine the futures transaction data from the Chicago Mercantile Exchange and find that although market makers aggressively manage their inventories, their inventory holdings are positively correlated with their reservation prices, which is contrary to the prediction of inventory control theory. These studies highlight the importance of inventory management through adjusting quotes and its effect on security prices and liquidity.

In addition to quotes adjustment, market makers can also establish a hedging position to manage their inventory risk. However, hedging results in additional transaction costs, which in turn affects bid–ask spreads. Hedging has been largely ignored in the stock market but is critical in the option market. [Giannetti, Zhong, and Wu \(2004\)](#) note that market makers seldom maintain “naked” option positions and that they systematically hedge their inventory risk by trading the underlying asset. This implies that hedging is an important means to manage option market makers' inventory risk.

Whereas substantial studies have focused on inventory management through adjusting quotes, researchers' understanding of the relation among market making activity, hedging costs, and security liquidity remains at a preliminary stage. [Boyle and Vorst \(1992\)](#) show that option replication in discrete time with proportional transaction costs results in differences between long call and short call prices. This finding implies that transaction costs due to hedging activity may significantly affect the quoted spreads of option market makers. [Giannetti, Zhong, and Wu \(2004\)](#) and [Stoikov and Saglam \(2009\)](#) both theoretically highlight the important effect

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