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Trading in derivatives when the underlying is scarce ☆

Snehal Banerjee [a,*], Jeremy J. Graveline [b]

[a] Northwestern University, Kellogg School of Management, United States
[b] University of Minnesota, Carlson School of Management, United States

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ABSTRACT

Regulatory restrictions and market frictions can constrain the aggregate quantity of long and short positions in a security. When these constraints bind, we refer to the security as *scarce*, and its price becomes distorted relative to its value in a frictionless market. We show that an otherwise redundant derivative can reduce the price distortion of the underlying security by relaxing its scarcity. We also show that it is especially important to analyze the underlying and derivative markets jointly when evaluating the impact of regulation, such as short-sales bans and position limits in derivatives, that restricts trade.

1. Introduction

> It is critical that regulatory rulemaking ... is done right, with the proper analysis to ensure that any new rules do not impede the function of the markets they are meant to protect.[1]

Many recent policy changes have focused on restricting trade in derivatives and the securities that underlie them. For example, the Securities and Exchange Commission (SEC) imposed short-selling bans on financial stocks in the fall of 2008, and many European countries imposed similar restrictions for bank stocks during the recent Eurozone crisis. On the derivatives side, the European Union has banned naked credit default swap (CDS) positions on sovereign debt, and the CFTC has proposed position limits on certain commodity derivatives to "diminish, eliminate or prevent" excessive speculation.

By restricting trade in a security, these regulations may distort prices. For instance, a short-sales ban prevents pessimistic short-sellers from trading, but it also prevents long positions from being larger, in aggregate, than the

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* Corresponding author at: Kellogg School of Management, Northwestern University, 2001 Sheridan Road, Evanston, IL 60208, United States. Tel.: +1 847 491 8335.
E-mail addresses: snehal-banerjee@kellogg.northwestern.edu (S. Banerjee), jeremy@umn.edu (J.J. Graveline).

[1] Timothy Ryan, chief executive officer of Securities Industry and Financial Markets Association (SIFMA), in response to the position limits on commodity derivatives proposed by the Commodity Futures Trading Commission (CFTC) under the mandate of the Dodd-Frank Act (see *Financial Times*, December 5, 2011). In December 2011, SIFMA and the International Swaps and Derivatives Association (ISDA) filed suit against the CFTC over the proposed position limits. In September 2012, less than two weeks before the limits were set to take effect, US district judge Robert Wilkins ruled against the proposed limits, arguing that more analysis was required by the CFTC to assess if the proposals were necessary and appropriate under the law.

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security's outstanding supply. More generally, regulatory restrictions and market frictions, such as transactions costs, search costs, short-sales constraints, and margin requirements, can constrain the aggregate quantity of long and short positions in a security. When these constraints bind, we refer to the security as *scarce*, and the price of the security must adjust to clear the market.

In frictionless markets, a simple derivative security is redundant because it provides exposure to the same source of risk as the underlying asset. However, we show that this redundancy no longer applies when the underlying can be scarce. In fact, the presence of a derivative may affect the price of the underlying itself. Intuitively, derivatives can reduce the scarcity of the underlying by providing a substitute for long and short positions. We characterize how equilibrium prices and trading volume in the underlying asset and its derivative are jointly determined, and provide sufficient conditions under which the presence of a derivative reduces both the scarcity of the underlying and the associated price distortion.

Our model provides a framework to analyze the effect of proposed regulations that restrict trade in the underlying or derivative securities. It is important to note that prices and quantities that are empirically observed in the absence of these proposed trading restrictions cannot be used directly to test the impact of the restrictions. Instead, to evaluate the effects of such policy, one must jointly characterize the equilibrium in the underlying and derivative markets under the counter-factual assumption that the restrictions are in effect. To provide a role for regulatory trading restrictions, we assume that some investors may trade for non-informational motives, and therefore, distort prices relative to the underlying asset's fundamental value. In this framework, we show that even if trade in the derivative is always accompanied by distortionary trading by speculators, restricting trade in the derivative may *increase* the overall price distortion for an underlying asset that is scarce. Moreover, if the underlying asset is scarce and the derivative is not a perfect substitute, then we show that a short-sales ban can actually *lower* the price of the security, instead of raising it. As such, our analysis highlights the importance of accounting for scarcity in the underlying, and jointly modeling the underlying and derivative markets, when evaluating policy decisions.

Our analysis is applicable to any security that may be scarce, including both liquid and illiquid assets. Generally speaking, liquidity captures the ease with which a particular security can be traded, and the literature has focused on the role of various frictions in generating illiquidity.[2] In contrast, the notion of scarcity reflects the aggregate demand for both long and short positions in an asset *relative to* the capacity for such positions that it can support. For example, on-the-run Treasuries are extremely liquid, but the demand for long and short positions in these securities often exceeds the supply that are available to be borrowed in the financing, or repo, market. When this situation occurs, the Treasury is scarce — it is costly to borrow and trades "on special" in the financing market. Off-the-run Treasuries are also extremely liquid, but they are not typically scarce, since the demand for positions is most often concentrated in their on-the-run counterparts. Conversely, while the corporate bond market is much less liquid than the Treasury market, corporate bonds can also be scarce when the demand for positions to hedge or speculate on default risk exceeds the supply of corporate bonds that are available to be traded. Other illiquid assets, such as real-estate and commodities, can also be scarce if there is sufficient demand for positions but they are inherently difficult to borrow and sell short.

The rest of the paper is organized as follows. In the next section, we briefly discuss the related literature. In Section 3, we develop a benchmark model and characterize equilibrium prices and quantities in both markets. We also derive sufficient conditions on preferences and payoff distributions under which the presence of a derivative security reduces the price distortion in the underlying. In Section 4, we develop a general framework that allows us to analyze the implications of scarcity on standard policy changes such as limits on derivative trading and short-selling bans. Section 5 concludes. All proofs are in Appendix A.

2. Related literature

In general, the equilibrium prices of existing securities change when a derivative security, exposed to risks that are not spanned by those securities, is introduced into an economy (e.g., see Detemple and Selden, 1991; Zapatero, 1998; Boyle and Wang, 2001; Bhamra and Uppal, 2009).[3] In contrast to these earlier papers, where derivatives complete the market by allowing investors to trade new sources of risk, we show that the presence of a derivative security can affect the price of the underlying asset, even when both securities span the same risks. In our setup, the derivative makes the market more "complete" by relaxing the constraint on the aggregate capacity for positions in the underlying asset.[4] As such, the mechanism through which derivatives affect the price of the underlying is also distinct from, but complementary to, other channels that have been suggested in the literature, such as reducing transactions costs and search frictions (e.g., Merton, 1989; Gârleanu, 2009).

Our paper is closely related to the large literature that explores the effect of trading frictions on asset prices and, in particular, to earlier models that generate costly

[2] These frictions include transactions costs (e.g., Amihud and Mendelson, 1986; Duffie, 1996; Vayanos, 1998; Krishnamurthy, 2002; Acharya and Pedersen, 2005; Bongaerts, De Jong, and Driessen, 2011), search frictions (e.g., Duffie, Gârleanu, and Pedersen, 2002; Vayanos and Weill, 2008), and asymmetric information (e.g., Kyle, 1985; Wang, 1993; Gârleanu and Pedersen, 2004). See Amihud, Mendelson, and Pedersen (2005) and Vayanos and Wang (2012) for excellent surveys of the literature on liquidity and asset prices.

[3] However, much of the existing literature on derivatives assumes that the presence of such a derivative does not affect the price of the underlying security — this is described by Hakansson (1979) as "The Catch 22 of Option Pricing."

[4] Jordan and Kuipers (1997) provide direct empirical evidence of the effect of trading in a derivative on the price of the underlying security in U.S. Treasury markets.