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Market making with asymmetric information and inventory risk ☆

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Abstract

Market makers in some financial markets often make offsetting trades and have significant market power. We develop a market making model that captures these market features as well as other important characteristics such as information asymmetry and inventory risk. In contrast to the existing literature, a market maker in our model can optimally shift some trades with some investors to other investors by adjusting bid or ask. As a result, we find that consistent with empirical evidence, expected bid–ask spreads may *decrease* with information asymmetry and bid–ask spreads can be positively correlated with trading volume.

JEL classification: D42; D53; D82; G12; G18

Keywords: Market making; Illiquidity; Bid–ask spread; Asymmetric information; Imperfect competition

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1. Introduction

As shown by the existing empirical literature,[1] market makers in some financial markets tend to make offsetting trades and have significant market power. In this paper, we develop a market making model that captures these market features as well as other important characteristics such as information asymmetry and inventory risk. In contrast to the existing rational expectations models and microstructure models with information asymmetry,[2] this model introduces an alternative equilibrium setting where some uninformed investor with market power (e.g., a market maker) can optimally adjust bid or ask to shift some trades with potentially informed investors to other investors. As a result, this model can help explain the puzzle that bid–ask spreads may decrease with information asymmetry, as shown by empirical studies.[3] Moreover, we show that consistent with empirical evidence,[4] bid–ask spreads can be positively correlated with trading volume. In contrast to double auction models (e.g., Kyle, 1989; Rostek and Weretka, 2012), supply and demand function competition models (e.g., Vives, 2011), and Nash Bargaining models (e.g., Atkeson et al., 2014), some agent in our model serves a dual role: a buyer in one market and simultaneously a seller in another. Our solution shows how this dual role affects the equilibrium outcome in these markets.

Specifically, we consider a one-period model with three types of risk averse investors: informed investors, uninformed investors, and an uninformed market maker. On date 0, all investors optimally choose how to trade a risk-free asset and a risky security (e.g., a less liquid stock, a corporate bond, or a derivative security) to maximize their expected constant absolute risk averse (CARA) utility from the terminal wealth on date 1. All may be endowed with some shares of the risky security whose payoff becomes public on date 1. Informed investors observe a private signal about the date 1 payoff of the security just before trading on date 0 and thus have trading demand motivated by private information. Informed investors also have non-information-based incentives to trade, which we term as a liquidity shock and model as a random endowment of a nontradable asset whose payoff is correlated with that of the risky security. It follows that informed investors also have trading demand motivated by the liquidity needs for hedging.

Both informed and uninformed investors must trade through the market maker. We assume that the market maker posts bid and ask price schedules first as in a Stackelberg game, taking into account their impact on other investors' trading demand, other investors then trade optimally taking the posted price schedules as given.[5] The equilibrium bid and ask depths are determined by the market clearing conditions at the bid and at the ask, i.e., the total amount the market maker buys (sells) at the bid (ask) is equal to the total amount other investors sell (buy). In equilibrium, the risk-free asset market also clears.

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[1] E.g., Sofianos (1993), Shachar (2012), Garman (1976), Lyons (1995), Ang et al. (2011).

[2] E.g., Grossman and Stiglitz (1980), Diamond and Verrecchia (1981), Glosten and Milgrom (1985), Kyle (1985), Admati and Pfleiderer (1988), Boulatov et al. (2010), Goldstein et al. (2014).

[3] For example, Brooks (1996) finds a negative relationship between bid–ask spreads and information asymmetry around earnings and dividends announcements. Huang and Stoll (1997) find that the asymmetric information component of the bid–ask spread can be *negative* and statistically significant. Acharya and Johnson (2007) show that in the credit default swap (CDS) market, spreads can be lower with greater information asymmetry.

[4] See, for example, Lin et al. (1995) and Chordia et al. (2001).

[5] This is equivalent to a setting where other investors submit demand schedules to the market maker (similar to Kyle, 1989 and Cespa and Vives, 2012), who then chooses bid and ask prices. The order size dependence of price schedules is consistent with the bargaining feature in less liquid markets.