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Market size matters: A model of excess volatility in large markets ☆

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ABSTRACT

I present a model of excess volatility based on speculation and equilibrium multiplicity generated by the self-fulfilling nature of information aggregation: if individuals trade more on the basis of speculation rather than hedging, then prices reveal more information on payoff risk which justifies less need for hedging. The findings show that multiplicity arises only in large markets. Across multiple equilibria, excess volatility is negatively associated with liquidity, trade volume, and traders' welfare. Other findings include: (i) excess volatility increases with payoff volatility and (ii) the asset that attracts more traders is more likely to experience a jump in excess volatility.

1. Introduction

Excess volatility – price movements not easily explained by changes in fundamentals – seems prevalent in modern stock markets (West, 1988; Shiller 2003; 2014). Moreover, extreme episodes of excess volatility, such as bubbles and crises, are observed even in markets with a very large number of traders. Intuitively, one might think that excess volatility should be less likely in large markets. For

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[1] The Online Appendix is available at SSRN and also at my website: http://sites.google.com/site/econkeikawakami/research.

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example, in large markets idiosyncratic shocks cancel out and each trader's influence on prices (i.e., price impact) will be negligible.[2] But on the other hand, it seems natural that coordination effects will be larger when there are many traders. Moreover, coordination is more difficult to sustain precisely when many traders interact anonymously. In large markets where coordination becomes powerful but fragile, equilibrium multiplicity might be relevant for excess volatility. The aim of this paper is to understand the role of market size for excess volatility in this context.

To have a meaningful notion of market size, I abandon a common modeling device in the literature (i.e., a continuum of traders and/or noise traders). More specifically, I develop a model in the spirit of Kyle (1989), where a finite number of risk-averse traders have diverse private information about the payoff value of the asset. Unlike Kyle (1989), however, there is no noise trading and each trader has two distinct motives to trade: (i) speculation based on privately observed noisy signals, and (ii) hedging needs for his endowment position. Signal noise can be interpreted as non-fundamental shocks to beliefs about asset *quality*, while endowment positions represent *quantity* shocks. Both shocks can be correlated among traders. I define excess volatility as the variance of prices conditional on the payoff value and aggregate endowment of the asset. Excess volatility exists because speculation causes prices to fluctuate due to belief shocks unrelated to fundamentals. The key to equilibrium multiplicity is the self-fulfilling nature of information aggregation: coordinating on more speculation and less hedging makes prices sufficiently more revealing about payoff risk, which in turn justifies less need for hedging, and vice versa. I show that market size plays a key role behind this mechanism.

The model yields many new insights that are not available in a framework with a continuum of traders and/or noise traders. Most importantly, I show that a change in market size can create or eliminate equilibrium multiplicity. Other implications from the model include a systematic relationship between excess volatility, liquidity,[3] trade volume, and traders' welfare. Importantly, all of these market outcomes are endogenously determined in the model. This also differentiates the model from other models where liquidity, trade volume, and traders' welfare are either exogenous or not well defined.

In the model, cross-sectional correlation in belief shocks and in endowment shocks act as two aggregate shocks: a shock to the aggregate belief (i.e., pure noise in the average belief), and a shock to the aggregate endowment. Importantly, both shocks affect prices but cannot be separately disentangled, and rational traders estimate them by using their private information. Thus, each piece of private information has a secondary role in estimating different aggregate shocks in prices, in addition to its primary role. Importantly, the secondary role works as a discounting factor of the primary role. To see this, consider the dual roles for a signal. First, the signal is used to estimate the payoff value of the asset (a primary role). Second, because prices aggregate individual signals, a high realization of prices can be either due to the high payoff value of the asset or to a high realization of the common shock in the signal. When traders estimate the impact of the common shock in prices by using their signal (a secondary role), the overall impact of the signals on traders' orders is reduced. Similarly, the individual endowment also has dual roles. A high realization of the endowment makes traders want to hedge the asset's payoff risk (a primary role). In the mean time, a high realization of the endowment implies that prices are low in part due to a high realization of the common shock in endowments. Again, when traders estimate the impact of the common shock by using their individual endowment (a secondary role), the overall impact of endowment on traders' orders is reduced. In circumstances where the common shocks in prices are important, the secondary roles of signals and endowment become more important relative to their primary roles.

I first establish conditions for multiplicity (Proposition 1). I show that multiplicity occurs (a) only if the cross-sectional correlation of endowment shocks is sufficiently high relative to the cross-sectional correlation of belief shocks, (b) only in markets that are sufficiently large, and (c), given the conditions

[2] Gabaix, Gopikrishnan, Plerou, and Stanley (2006) proposes a model of excess volatility caused by price impact of large traders.

[3] I measure liquidity by the inverse of price impact (i.e., the extent to which each trader can affect prices).