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Fragmentation and stability of markets

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ABSTRACT

Trading skills are highly rewarded in practice but largely ignored in theoretical models of financial markets. This paper demonstrates the importance of skills by examining their interaction with market fragmentation and market stability. We consider a computational model where traders' abilities to accurately price assets are endogenous. In contrast to models that do not consider skills, we find that centralising markets can lead to higher price volatility and less resilience to shocks because it increases the equilibrium proportion of unskilled traders.

1. Introduction

Skills command huge premia in the job market for professionals, particularly in the financial sector. The ability to identify mispriced assets and the most profitable trades, even without informational advantages, can result in big returns both for the individual and the employer (Coval et al., 2005). Despite this, skills are mostly ignored in the academic literature on asset markets. Bayesian rationality, the mainstay of decision theory, simply disregards the possibility that some investors may not have the ability to make good decisions: In the standard model all agents are able to solve the appropriate optimisation problem. In that world, information matters, but skills do not.

In this paper we consider the opposite scenario: a world with complete and symmetric information – but one in which individuals differ in their trading skills. We present a computational equilibrium model of a market for financial assets in which traders develop skills endogenously. Skill is defined in this paper as a trader's ability, under full symmetric information, to price financial contracts accurately. For instance, a skilled trader could follow an asset pricing theory that enables her to

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make good decisions on the purchase or sale of incorrectly valued assets. Although skill is irrelevant in perfectly efficient markets, it matters when a trader has to post a price at which others can trade, e.g., in order-driven markets, or when asset prices in a competitive market deviate from their fair values.

Empirical studies have shown that markets are usually populated by skilled and unskilled traders. The first group is able to consistently make above average risk-adjusted returns and the latter is not, e.g., Oliven and Rietz (2004), Barras et al. (2010), Fama and French (2010), Barber et al. (2014). Traders develop these skills through learning (e.g., Coates and Page, 2009), potentially participating in unprofitable trades early in their career in the hope that they will acquire the ability to submit profitable orders with experience (Coval et al., 2005). Mimicking the trading strategies of superior investors can be profitable: For instance Grinblatt et al. (2012) find that investors with a high IQ exhibit superior stock picking skill and that copying their trades leads to abnormal annual returns of 11% over low IQ investors.

In this paper we apply an evolutionary learning process where natural selection ensures that profitable trading strategies survive and spread in the market.[1] This approach is motivated by the above evidence and by human decision-making behaviour in 'large worlds', i.e., situations in which it is impossible to foresee all potential consequences of one's actions. Binmore (2007) argues that in large worlds Bayesian decision theory has to be replaced by other forms of learning and decision-making. Some progress towards that end has been made in game theory, notably by Ellison and Fudenberg (1993), where the players apply decision rules learned in one set of games when playing a new game in which they have no prior experience. This learning mechanism is a key feature in the model considered here. It describes an adaptive market in the sense of Lo (2004): The agents must either learn and become skilled or free-ride on others' skills, and their incentives to do the one or the other depends upon the institutional setting and the behaviour of other traders. This differs from the approach taken by Grossman and Stiglitz (1980) in which individuals decide whether or not to purchase information.

An important feature of this modelling approach is that risk preferences and other trader characteristics are endogenous (Lensberg et al., 2015). In particular, there are no utility functions and no preassigned roles as skilled/unskilled trader. Instead, the model implements Alchian's (1950) 'as if' view of rational behaviour as the outcome of a competitive evolutionary process. We find that market prices are rational but, at the same time, there is substantial heterogeneity with respect to skill and trading behaviour.

We consider market structures with multiple trading venues, in which the traders quote prices at which other traders can buy or sell. The market is centralised if there are few venues and many traders at each venue, and fragmented if there are many venues and few traders at each venue. We find that a move from a fragmented to a centralised market structure can harm market stability and increase volatility by adversely affecting the proportion of skilled traders. Centralised markets protect unskilled traders from the consequences of bad decisions by allowing them to free-ride on the prices discovered by skilled traders. In the real world, traders free-ride by placing market orders, i.e., orders to buy (or sell) at any price. In the model, traders can place buy or sell market orders by quoting very high or very low prices.

In centralised markets with many traders, transaction prices tend to be efficient, and small market orders tend to have little price impact. Therefore, the incentives to acquire skills are weak, and, in equilibrium, most traders are unskilled. In fragmented markets, market orders have more price impact. Consequently, skilled traders, who quote prices close to fundamental values, make money by trading with unskilled traders who do not, and therefore most traders are skilled in equilibrium. As a result, fragmented markets are more resilient. Inter-market price variation, defined as the variation in prices between trading venues is, however, increasing in market fragmentation.

Regulators are concerned with the potential lack of competition among exchanges; economies of scale and network externalities make these institutions natural monopolies (Mendelson, 1987). Regulations such as MiFID in Europe and Regulation ATS and RegNMS in the US aimed to increase competition for order flow (Fink et al., 2006). As a consequence there has been a rise in the number of alternative trading venues such as crossing networks and dark pools which attract traders away from the main exchanges (Stoll, 2008). Despite the increase in the number of places to trade, the US market, for instance, has become, as described by O'Hara and Ye (2011), a 'single virtual market with multiple points of entry'.

Market centralisation during the last two decades has been accompanied by a dramatic increase in the stock market participation of non-professional investors (Bogan, 2008) who adopt investment strategies without fully understanding the risks (Bikhchandani et al., 1998). Our model shows that the increase in the proportion of unskilled traders following market centralisation is an equilibrium phenomenon.

Section 2 sets out a model of a market with multiple trading venues and endogenous skills. Section 3 discusses data collection and performance measurement. Section 4 presents results on the relationship between market fragmentation and pricing errors, the prevalence of skills, and the consequences for price volatility and market resilience. Section 5 concludes. Tests of model convergence and robustness are provided in Appendix A.

2. Model

We consider markets populated by agents who trade option contracts at one or more trading venues during a sequence of trading rounds. A *market* for an option contract is a list (I, N, A, C), where I is the number of traders; N is the number of

[1] Yeh (2008) employs a similar method to show that more intelligent traders may contribute to increased market efficiency.