Essays on Complexity in the Financial System

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The goal of this thesis is to study the two key aspects of complexity in the financial system: interconnectedness and nonlinear relationships.

In the first chapter, entitled Short Selling in the Extremes, I contribute to the literature that models the nonlinear relationship between variables at the extremes of their distribution. In particular, I study the nonlinear relationship between stock prices and short selling activity.

Whereas most of the academic literature has focused on measuring the relationship between short selling and asset returns on average, I focus on studying the relationship that arises in the extremes of the two variables.

I show that the association between financial stock prices and short selling can become extremely strong under exceptional circumstances, while at the same time being weak in normal times. Moreover, the tail relationship is stronger for small cap firms, a result that is intuitively in line with the empirical findings that stocks with lower liquidity are more price-sensitive to short selling.

Finally, results show that the adverse tail correlation between increases in short selling and declines in stock prices was not always lower during the ban periods, but had declined markedly towards the end of the analysis window. Such results cast doubts about the effectiveness of bans as a way to prevent self-reinforcing downward price spirals during the crisis.

In second chapter, entitled Measuring Interconnectedness, I propose a measure of interconnectedness that takes into account the time-varying nature of connections between financial institutions. Here, the parameters underlying comovement are allowed to evolve
continually over time through permanent shifts at every period. The result is an extremely flexible measure of interconnectedness, which uncovers new dynamics of the US financial system and can be used to monitor financial stability for regulatory purposes.

Various studies have combined statistical measures of association (e.g. correlation, Granger causality, tail dependence) with network techniques, in order to infer financial interconnectedness (Billio, Getmansky, Lo, and Pelizzon, 2012, Barigozzi and Brownlees, 2016, Hautsch, Schaumburg, and Schienle, 2015). However, these standard statistical measures presuppose that the inferred relationships are time-invariant over the sample used for the estimation. To retrieve a dynamic measure of interconnectedness, the usual approach has been to divide the original sample period into multiple subsamples and calculate these statistical measures over rolling windows of data.

I argue that this is potentially unsuitable if the system studied is time-varying. By relying on short subsamples, rolling windows lower the power of inference and induce dimensionality problems. Moreover, the rolling window approach is known to be susceptible to outliers because, in small subsamples, these have a larger impact on estimates (Zivot and Wang, 2006). On the other hand, choosing longer windows will lead to estimates that are less reactive to change, biasing results towards time-invariant connections. Thus, the rolling window approach requires the researcher to choose the window size, which involves a trade-off between precision and flexibility (Clark and McCracken, 2009). The choice of window size is critical and can lead to different results regarding interconnectedness.

The major novelty of the framework is that I recover a network of financial spillovers that is entirely dynamic. To do so, I make the modelling assumption that the connection between any two institutions evolves smoothly through time. I consider this assumption reasonable for three main reasons. First, since connections are the result of many financial contracts, it seems natural that they evolve smoothly rather than abruptly. Second, the assumption implies that the best forecast of a connection in the future is the state of that connection today. This is consistent with the notion of forward-looking prices. Third, the assumption allows for high flexibility and for the data to speak for itself.

2008. During these two events, I found that large banks and broker/dealers were among the most interconnected sectors and that real estate companies were the most vulnerable to financial spillovers. At the individual financial institution level, I found that Bear Stearns was the most vulnerable financial institution, however, it was not a major propagator, and this might explain why its default did not trigger a systemic crisis. Finally, I ranked financial institutions according to their interconnectedness and I found that rankings based on the time-varying approach were more stable than rankings based on other market-based measures (e.g. marginal expected short fall by Acharya, Engle, and Richardson (2012) and Brownlees and Engle (2016)). This aspect is significant for policy makers because highly unstable rankings are unlikely to be useful to motivate policy action (Danielsson, James, Valenzuela, and Zer, 2015, Dungey, Luciani, and Veredas, 2013).

In the third chapter, entitled Short Selling and Excess Correlation, rather than assuming interconnectedness as an exogenous process that has to be inferred, as is done in Chapter 2, I model interconnectedness as an endogenous function of market dynamics. Here, I take interconnectedness as the realized correlation of asset returns. I seek to understand how short selling can induce higher interconnectedness by increasing the negative price pressure on pairs of stocks.

It is well known that realized correlation varies continually through time and becomes higher during market events, such as the liquidation of large funds. Most studies model correlation as an exogenous stochastic process, as is done, for example, in Chapter 2. However, recent studies have proposed to interpret correlation as an endogenous function of the supply and demand of assets (Brunnermeier and Pedersen, 2005, Brunnermeier and Oehmke, 2014, Cont and Wagalath, 2013, Yang and Satchell, 2007). Following these studies, I analyse the relationship between short selling and correlation between assets.

First, thanks to new data on public short selling disclosures for the United Kingdom, I connect stocks based on the number of common short sellers actively shorting them. I then analyse the relationship between common short selling and excess correlation of those stocks. To this end, I measure excess correlation as the monthly realized correlation of four-factor Fama and French (1993) and Carhart (1997) daily returns.
I show that common short selling can predict one-month ahead excess correlation, controlling for similarities in size, book-to-market, momentum, and several other common characteristics. I verify the confirm the predictive ability of common short selling out-of-sample, which could prove useful for risk and portfolio managers attempting to forecast the future correlation of assets. Moreover, I showed that this predictive ability can be used to establish a trading strategy that yields positive cumulative returns over 12 months.

In the second part of the chapter I concentrate on possible mechanisms that could give rise to this effect. I focus on three, non-exclusive, mechanisms. First, short selling can induce higher correlation in asset prices through the price-impact mechanism (Brunnermeier and Oehmke, 2014, Cont and Wagalath, 2013). According to this mechanism, short sellers can contribute to price declines by creating sell-order imbalances i.e., by increasing excess supply of an asset. Thus, short selling across several stocks should increase the realized correlation of those stocks.

Second, common short selling can be associated with higher correlation if short sellers are acting as voluntary liquidity providers. According to this mechanisms, short sellers might act as liquidity providers in times of high buy-order imbalances (Diether, Lee, and Werner, 2009). In this cases, the low returns observed after short sales might be compensations to short sellers for providing liquidity. In a multi-asset setting, this mechanism would result in short selling being associated with higher correlation mechanism.

Both above-mentioned mechanisms deliver a testable hypothesis that I verify. In particular, both mechanisms posit that the association between short selling and correlation should be stronger for stocks which are low on liquidity. For the first mechanism, the price impact effect should be stronger for illiquid stocks and stocks with low market depth. For the liquidity provision mechanism, the compensation for providing liquidity should be higher for illiquid stocks. The empirical results cannot confirm that uncovered association between short selling and correlation is stronger for illiquid stocks, thus not supporting the price-impact and liquidity provision hypothesis.

I thus examine a third possible mechanism that could explain the uncovered association between short selling and correlation i.e., the informative trading mechanism. Short sellers have been found to be sophisticated market agents which can predict future returns (Dechow,
Hutton, Meulbroek, and Sloan, 2001). If this is indeed the case, then short selling should be associated with higher future correlation.

I found that informed common short selling i.e., common short selling that is linked to informative trading, was strongly associated to future excess correlation. This evidence supports the informative trading mechanism as an explanation for the association between short selling and correlation. In order to further verify this mechanism, I checked if informed short selling takes place in the data, whilst controlling for several of the determinants of short selling, including short selling costs. The results show evidence of both informed and momentum-based non-informed short selling taking place.

Overall, the results have several policy implications for regulators. The results suggest that the relationship between short selling and future excess correlation is driven by informative short selling, thus confirming the sophistication of short sellers and their proven importance for market efficiency and price informativeness (Boehmer and Wu, 2013). On the other hand, I could not dismiss that also non-informative momentum-based short selling is taking place in the sample. The good news is that I did not find evidence of a potentially detrimental price-impact effect of common short selling for illiquid stock, which is the sort of predatory effect that regulators often fear.

References


