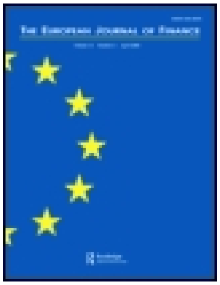

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Editorial introduction: 'new facets of the economic complexity in modern financial markets'

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EDITORIAL

Editorial introduction: 'new facets of the economic complexity in modern financial markets'

Today, much of the applied and theoretical research in finance is influenced by the mainstream view that financial liberalization, global integration, financial innovation, credit creation, increasing market size and liquidity promote growth, improve market stability and positively impact welfare. This view was seemingly supported by the phenomenon dubbed 'the great moderation', characterized by low inflation, reduced financial volatility and smooth sustained GDP growth observed in most developed countries in the last 20 years preceding 2007. The belief was that the above supposedly beneficial processes have led to a genuine taming of the economic beast. However, the emergence of the recent financial crisis, unfolded with the bankruptcy of Lehman Brothers, the occurrence of stock market drawdowns larger than 40%, with the subsequent need for massive bank bailouts as well as the unprecedented monetary actions of the Federal Reserve/European Central Bank, obliged even the firmest believers of 'the great moderation' to reconsider.

As recalled by Merton (1992): 'financial innovation is viewed as the "engine" driving the financial system towards its goal of improving the performance of what economists call the real economy'. Amongst the many examples supporting this stance, we can mention that specialized investment banks emerged in the nineteenth century to evaluate the profitability of railroad companies (Tufano 1997), or that venture capital firms evolved to analyze and fund high-tech entrepreneurs (Gisler, Sornette, and Woodard 2011). According to Michalopoulos, Laeven, and Levine (2009), technological innovation and thus economic growth stops unless financiers continuously innovate. Therefore, financial innovation seems to kill two birds with one stone. It ensures the continuation of technological innovation by providing financial resources to entrepreneurs by credit creation and, therefore, supports economic growth. At the same time, it makes the market more complete by the issuance of new securities that contribute to its greater stability.

When confronted with reality, advocating that financial and technological innovations are inextricably linked leads to a paradox. Indeed, financial innovations in the last 20 years have mainly been concerned with accounting, regulatory and tax arbitrage (Knoll 2008; Smith and Smithson 1990). In recent years, financial innovation has not played its expected role in improving market processes, which should have been to reallocate risk, reduce agency costs and raise liquidity (Finnerty 1992). Among the main constituting factors of financial innovation, such as tax and regulatory arbitrage, classic arbitrage, reduction of the expected costs of financial distress, and increase of corporations' debt capacity (Smith and Smithson 1990), Miller (1992) argues that the exploitation of regulatory inconsistencies has been one of the main drivers of financial innovation,

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while Stiglitz[1] concludes that 'the people who invented [derivative instruments] have incentives to abuse them'.

Schumpeter (1912) pointed out that the key element of growth was the transfer of capital from old to new and more innovative businesses through the extension of credit via the fractional reserve banking system (FRB) that enables banks to create credit virtually out of nothing, helped in this task by financial innovation. Minsky (1986, 1993) emphasized the importance of credit as a key driver in the banks' pursuit of profit maximization through continuous innovation. His classification of income–debt relations as part of his 'Financial Instability Hypothesis' identifies distinct stages of the economy as it moves from stability to instability. Contrary to equilibrium economics, his qualitative model demonstrated the intrinsically dynamic nature of the economy, driven by various degrees of financing. The contemporary economist Werner (2005), like Schumpeter, emphasizes the FRB system as a key driver of credit and makes an important contribution to understanding the nature of credit by distinguishing between credit that is part of GDP and credit that merely drives up asset prices.

Regarding the actual benefits of financial innovation, Gennaioli, Shleifer, and Vishny (2011) show that, if there is room for financial innovation, new securities tend to be over-issued due to 'local thinking'. Hence, markets for new securities are more fragile. When news about unattended risks catch investors by surprise, they dump the 'false substitutes' and fly to the safety of traditional securities. In their comprehensive analysis of worldwide financial crises, Reinhart and Rogoff (2009) report that 'for the advanced economies during 1800–2008, the picture that emerges is one of serial Banking crises'. In rich as well as poor countries, systemic banking crises are 'typically preceded by asset price bubbles, large capital inflows and credit booms'.

Driven by the aforementioned issues, newly presented tools and techniques provided evidence that standard financial economic approaches can fail to provide realistic interpretations of bubbles and crashes that can be of practical use (Kaizoji and Sornette 2009). Indeed, neither the academic nor professional literature provides a clear consensus for an operational definition of financial bubbles. Moreover, there does not seem to be accepted methodologies for their *ex ante* diagnosis. Instead, the literature reflects a permeating culture that simply assumes that any diagnostic of a bubble's demise is inherently impossible, perhaps taking the efficient market hypothesis too literally. In the same way that financial innovation and credit creation are thought to be critical catalytic elements of economic growth, bubbles may also show a positive Janus face. This can take the form of innovations both in the financial and technological spheres that lead to significant long-term welfare gains (Gisler and Sornette 2009, 2010; Gisler, Sornette, and Woodard 2011). But this does not need to be always the case, especially when the bubbles are seemingly confined to the banking sector.

Financial innovation suffers from another important shortcoming. Indeed, according to financial theory, financial engineers and 'quants' price contingent claims on the basis of the hedging cost of the issued security, that is, under the condition of no-arbitrage. But as recalled by Barberis and Thaler (2003), the absence of arbitrage does not mean that prices are right. No-arbitrage prices are equilibrium prices provided that each asset has an infinitesimal weight in the economy (Connor 1982; Dybvig 1983; Grinblatt and Titman 1983). This assumption is seriously in contradiction with empirical evidence, due to the fat-tailed distribution of financial asset sizes known as Zipf's law (Saichev, Malevergne, and Sornette 2009). This later stylized fact turns out to be instrumental in explaining the cross-section of asset returns (Malevergne, Santa-Clara, and Sornette 2009). In opposition to equilibrium prices, arbitrage prices do not account for the supply and demand of assets and, therefore, neglect the feedback that trading and hedging strategies have on asset prices, which can lead to market instabilities.

In this respect, if Kyle (1985) was the first to account for the feedback of trading practices on market prices, only recently have several empirical and theoretical results shown that such feedback effects can cause dynamic instabilities due to portfolio optimization that increase cross-correlations between assets (Marsili, Raffaelli, and Ponso 2009), or can affect volatility due to heterogeneous beliefs (Zapatero 1998) or options trading (Bhamra and Uppal 2009; Ni, Pearson, and Poteshman 2005; Sircar and Papanicolaou 1998) or even reveal rich macroeconomic dynamics (Kyrtsou and Labys 2006, 2007). This calls for a view of financial markets as dynamical systems made of several entangled interacting components with complex feedback loops (Schweitzer et al. 2009).

In this view, trading strategies can affect the market in important ways. Furthermore, the proliferation of financial instruments, in a model with heterogeneous agents, is found to lead to market instability. Brock et al. (2010) formalized this idea and proved that the introduction of hedging instruments – which is supposed to make the market more complete and hence more stable – may destabilize it in the presence of traders who have heterogeneous expectations and adapt their behavior according to experience-based reinforcement learning. The destabilization becomes more likely as a consequence of the leverage effect of buying more of the risky stock while hedging by shorting the Arrow securities. In addition, the presence of fully rational traders does not always stabilize the financial system. This model does not, however, explain the origin of the market instability. It only states that, if the market is genuinely unstable, the introduction of hedging instruments makes the instability more likely and pronounced.

In a series of papers, Caccioli and Marsili, (2009), Caccioli Marsili, and Vivo (2009) and Marsili (2009) provide a possible answer to the question of the origin of the market instability in relation with the introduction of contingent claims. They identify bifurcations in the dynamic system that describes the financial market when it becomes less incomplete. In this context, the market becomes more unstable as additional Arrow securities are introduced and approaches the ideal situation of completeness. Basically, the intuition is that, as the market becomes less incomplete, the possibility to replicate the same cash flows using different portfolios increases the leverage and enhances the price fluctuations. Hence, according to Haldane and May (2011), once there are enough derivatives to span the space of available states of nature (i.e. when the net supply of derivatives within the system reaches the level necessary to meet the true hedging demand from non-banks), the market can be considered closer to its equilibrium. But as long as there is an incentive to supply new instruments – in the form of a positive premium for trading – banks will continue to expand gross positions, independent of true hedging demand from non-banks. Such trades are essentially redundant, increasing the dimensionality and complexity of the financial network at a cost in terms of stability, with no welfare gain because market completeness has already been achieved. Working differently, Kyrtsou and Malliaris (2009) emphasized the role of the nonlinear underlying dynamics in financial markets that are mainly fed by non-standard and nonlinear trading strategies. Within this framework, it turns out that the incoming news can easily disturb final prices when nonlinearity is at work. Similarly, Harras and Sornette (2011) developed an agent-based model in which the agents are continuously updating their trading strategies to the current market regime as a function of the relative merits of the available public news versus the social influence with respect to their recent predicting performance. It is shown that bubbles and crashes emerge naturally by the amplification of random news by over-learning of boundedly rational agents.

The present volume is clearly motivated by the disruptions introduced by the financial crisis and the many attempts that have followed to propose new ideas and remedies, as briefly summarized above. The volume assembled contributions by authors from a variety of backgrounds, illustrating the potentials resulting from the marriage of financial economics, complexity theory and an out-of-equilibrium view of the economic world.

In the absence of a clear theoretical framework in the literature on what is/are the process/processes of bubble formation, *Lin and Sornette* provide an alternative modeling approach that emphasizes the existence of a critical time at which the bubble bursts. The key innovation is the concept of a stochastic finite-time singularity (FTS). The working hypothesis is built on the interplay between momentum-positive feedback and value-negative feedback investors. Although rational, the presence of heterogeneous expectations about the end time of the bubble can keep alive a speculative bubble via the synchronization problem. The empirical results for four financial markets provide supportive evidence that positive feedback mechanisms are prone to fuel financial bubbles.

In a related conceptual analysis in term of FTS, *Geraskin and Fantazzini* present a comprehensive review of log-periodic power law models for understanding financial bubbles. By means of different diagnostic tools, they investigate the gold dynamics around December 2009. Their findings confirm estimations contained in earlier publications of the aforementioned authors. In this context, it is worthwhile to mention that the presence of FTS dynamics with transient faster-than-exponential growth has recently received support from detailed analyses (Hüsler, Sornette, and Hommes 2012) of controlled laboratory experiments (Heemeijer et al. 2009).

It turns out that heterogeneity in agents' expectations is a determinant factor of bubble dynamics. However, the destabilizing character of heterogeneity has a broader impact. In the race for understanding how exchange rates are determined, the paper by *Chiarella, He, and Zheng* takes the macroeconomic impact of heterogeneity combined with nonlinear attributes into account. Through simulation experiments, it is shown that their model is capable of capturing real stylized facts, such as volatility clustering and multiple regimes, which are very often observed in exchange rate markets.

Huang, Zheng, and Chia present a more stock-market-oriented study emphasizing the role of endogenous heterogeneity. They deviate from the traditional interpretation of a bubble by considering upward movements in prices rather than deviations from fundamentals. The totally deterministic construction of the model allows for long-term dependences and leverage effect in the market prices, pointing out that, even when noise-free mechanisms generate fluctuations, real-life anomalies can still occur.

The inappropriateness of the traditional paradigm, suggesting that exogenous shocks are the sole factors responsible for economic instabilities, has been forced on economists by the pressure of evidence. The extent of the current crisis, which started in 2007, revealed the limits of the assumption that the dynamics of economic systems are naturally converging to a steady state. *Anand, Kirman, and Marsili* draw our attention on this issue. They suggest that many dysfunctions in the credit derivative market can be attributed to the application of specific behavioral rules among the market participants. They show that, in this game, the absence of transparency, as well as the pervading asymmetric information, has contributed the most to push the prices away from their fundamentals.

In line with the heterodox consideration that agents interact so as to promote herding behavior in the market, *Alfarano, Molakovic, and Raddant* show that social interaction can produce non-Gaussian statistical properties that thus rationalize the existence of heavy tails and clustered volatility. It is argued that the interdependence (or herding) between agents' decision processes does not constitute the unique source of financial volatility. The hierarchical structure embodying the socially interacting managers in institutional structures can act additionally as a significant contributing factor.

Besides the behavioral heterogeneity, many other aspects of the complexity of economic systems have emerged throughout the prolonged financial crisis. This has impacted seriously the efficiency of modern asset management and economic policy. Especially, in the presence of unidentified endogenous dynamics, it may be extremely difficult to identify the origin of fat-tail events and risk components. In this context, *Brookfield, Boussabaine, and Su* argue that, within complex economic environments, alternative methodologies such as spanning trees based on cross-sectional correlations can offer significant information that might be capable of supporting investors' strategies. Their empirical findings confirm the working hypothesis of the paper that the book-to-market ratio is a predictive tool for cash flows and subsequent returns.

In the light of theoretical considerations that have been worked out about the traditional capital asset pricing model, which assumes homogenous, totally rational and static investors, *Wenzelburger* incorporates option markets into a class of agent-based models permitting investors to form and update their own beliefs. As he concludes, the inclusion of heterogeneous beliefs makes prices for options to deviate from their arbitrage-free valuations. In addition, short selling of option contracts is shown to increase the volatility of individual wealth. His results appear to be extremely interesting for pension funds, which are prone to use financial derivatives in order to offset risk exposure.

The role of derivatives and their contribution to the high degree of complexity in financial markets has attracted the attention of many researchers in the last few years. Given the complexity of these products, a deep understanding of the securitization process is, therefore, required if we are interested in avoiding the reproduction of inefficiencies. *Aboul-Enein, Dionne, and Papageorgiou* provide a detailed analysis of the factors that might influence the performance of a new category of assets, the Collateralized Fund Obligations (CFOs), which are securitized portfolios of hedge funds. According to their results, the CFOs can create value for the equity tranche investors even during periods of financial distress.

Although the risk of individual assets is a determinant component for the construction of efficient portfolios, their large number can hinder the usefulness of optimization. In their paper, *Caccioli, Still, Marsili, and Kondor* suggest imposing conditions of regularization in the distribution of asset weights in order to address the problem of market impact. This approach tackles the divergent fluctuations that arise in large portfolios. Such regularization scheme can, thus, become a better investment strategy compared with traditional portfolio optimization techniques.

At long last, *Pavlidis, Paya, Peel, and Siriopoulos* perform an analytical study regarding the empirical impression of the above behavioral characteristics as well as market-specific factors into prices. They conclude that, under similar conditions, it is possible to obtain contradictory results, implying the necessity for a continuous update of the set of fitted models and of unit root tests that are usually employed in real-time applications.

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Note

1. http://www.economist.com/debate/days/view/471

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