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Asset Markets in the Lab:

A Literature Review

Andrea Morone, Simone Nuzzo

ASSET MARKETS IN THE LAB:
A LITERATURE REVIEW

Andrea Morone[a,b], Simone Nuzzo[a]

ABSTRACT

This paper aims at providing an overview of several topics that have been addressed in the field of experimental asset markets. Rather than being exhaustive in any single topic, this review is meant to gather the several research strands, and to provide a powerful picture of the main advances on the use of experimental techniques for the study of financial markets.

Keyword: experimental Asset Markets

[a] Dipartimento di Economia, Management e Diritto d'impresa, Università degli Studi di Bari, Aldo Moro, Italy

[b] Departamento de Economía, Universidad Jaume I, Castellón, Spain

1. Motivational Framework

"The social scientist who would like to study in isolation and under known conditions the effects of particular forces is, for the most part, obliged to his "experiment" by the application of general reasoning to abstract models"

Chamberlin (1948)

Because of the real world complexity, field data do not always manage to control for all the factors that are expected to be relevant when a given phenomenon is studied. As a consequence, validating theoretical model predictions by the use of field data might present some limitations. This drawback has led to an increasing body of scientific research focusing on the use of experimental methodologies to test theoretical models in a controlled environment, like a laboratory. The latter, differently from field techniques, allows researchers to keep under control all the variables that are supposed to be prominent[1].

Asset markets are among those fields that best suit a controlled laboratory environment. Indeed, variables like the fundamental value of a financial asset, the information conditions, and the asset life period are difficult to be accounted for in real world markets, causing research on asset markets to be unmanageable to carry out through the use of field data. Differently, in a laboratory environment, researchers can exogenously control and observe the key parameters of the market. This latter benefit has been one of the main driver leading research on experimental asset markets. At the end of the '90s some prominent surveys were published. In his seminar paper Sunder (1995) gave an authoritative survey of experimental asset markets focusing on (i) informational efficiency of markets, (ii) bubbles, and (iii) econometric comparison of field and laboratory data. Duxbury (1995) provided a critical review of the concept of market efficiency and how to test it. Cadsby and Maynes (1998) gave a survey on laboratory experiments in corporate and investment finance.

Asset market experiments are neat, and are an area of increased research interest. After 1995 many papers on different fields of financial markets have been published, and there are several recent contributions that update the work of Sunder (1995). Noussair and Tucker (2013) reviewed experimental research on asset pricing; Palan (2013) surveyed

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[1] Also the external validity of the findings should be taken into account when choosing between the use of field or experimental approaches.

bubbles and crashes; Powell and Shestakova (2016) reviewed the latest research on experimental asset markets, where the values of the traded assets are homogeneous across all agents; Duxbury (2015a, 2015b) presented some interesting literature related to experimental and behavioral finance, focusing on biases, moods and emotions.

The aim of our paper is to provide a literature review of those parts of experimental financial economics that have not been yet updated since the end of the '90s.

To be more precise in section 2 we will describe issues related to information release and market structure. Section 3 reports on the interaction between private and public information. Section 4 explores some stylized facts of the distribution of returns in experimental asset markets. Section 5 reviews the role of market institutions on trading activity. Section 6 briefly reports some new works on bubbles and crashes and discusses the role of traders' emotions and bounded rationality on asset markets. Section 7 analyzes the role of payment incentives in asset markets. Finally, section 8 concludes.

2. Information Release and Market Structure

Plenty of research has been conducted to shed light on the relationship between market performance and market structure, with a particular focus on how information is released in the market. Indeed, there are some papers where information is polarized, i.e. some subjects are insiders and some others are uninformed (Plott and Sunder, 1982; Camerer and Weigelt, 1991; Brandouy et. al., 2000; Noussair and Xu, 2015); where subjects can buy information during the trading period (Hey and Morone, 2004; Ferri and Morone, 2014; Alfarano et al., 2011, 2015); and/or where a fixed amount of partially trustable information is exogenously provided to all subjects before the trading period starts (Barreda et al., 2016a, 2016b; Lux et al., 2016; Morone and Nuzzo, 2016).

Brandouy et. al., (2000) provide evidence about price formation, asymmetric information and insider trading influence. They investigate, by means of a laboratory experiment, the effects of several manipulations of asymmetric information and communication in a double-auction stock market. They find that asymmetric information leads to inefficient trades when it is not revealed to market participants, causing insiders to make higher than average profits. On the contrary, the revelation of the presence of insiders significantly increases market efficiency but only in relation with bad news. Risk adverse traders' strategies may be responsible for the lower market efficiency when market participants are provided with good news. Communication of uncertain information

(agents were forbidden to prove the veracity of their communications) decreases price efficiency, since the consequent rumour weakens insiders' signals.

Schnitzlein (2002) studied order-driven dealer markets where there is uncertainty about the number of insiders in the market. He found that insiders were more likely to compete aggressively when the number of insiders was common knowledge with respect to the treatment in which there was no disclosure. Moreover, the uncertainty about the actual number of insiders causes the convergence towards the fundamental value of the asset to be slower. So, price efficiency is higher when the number of insiders is publicly known. This occurred because, in the disclosure treatment, the aggressive competition tended to reveal a lot of information and this allowed non-insider subjects to easily infer the insiders' information, and to accordingly adjust their behaviour. In the no disclosure treatment, non-informed agents do not succeed in making such an inference. Therefore, not only the presence of insiders but also what non-informed traders know about the insider presence affects market performance.

In an extension of the Benarjee (1992) and Bickchandani et al. (1992) models, Hey and Morone (2004) study a (double auction) market where partially trustable information can be purchased at some positive cost. In this framework, on one hand, when information is private, socially undesirable herd behaviour may result; on the other hand private information may be aggregated efficiently through the price mechanism. The authors find that socially undesirable behaviour does result, i.e. misinformed agents acting on their private information mislead the market. Nevertheless, socially undesirable behaviour can be eliminated through the market. Moreover, greater volatility is detected when the reliability and the cost of information were, respectively, lower and higher. Both conditions are responsible for less information and more noise in the market.

Huber et al. (2008) provide additional experimental evidence about the role of privileged information. In a framework where information is cumulatively distributed, the authors studied whether having more information does lead to higher returns. While some research (Copeland and Friedman 1992, Ackert et al. 2002) shows that insider profits outperform the non-informed ones' when only two levels of information exist, Huber et al. (2008) design an experiment where having more information than others means to have the same plus some extra information. This study shows that there is a wide range of levels of information in which having additional information does not provide benefits in terms of

higher returns. A positive relationship between information and higher profits was detected only for very high levels of information.

Hanke et al. (2010) study the economic consequences of the imposition of a Tobin Tax. The latter tax aims at fighting speculation and stabilizing foreign exchange markets. The experimental design consists of two double-auction markets where a foreign currency can be exchanged for the home currency. Each agent can simultaneously be active in both markets. Treatments differ with respect to two features: the market on and the moment when the tax is levied. Results show that volume is negatively affected by the tax imposition, since transactions move from the taxed to the untaxed market. Market inefficiency does not change when both markets are taxed but significantly increases in the taxed market when only one market is taxed. The latter result confirms the findings of Bloomfield et al. (2009) and Cipriani and Guarino (2008). Finally, market volatility is not affected by the tax imposition.

One year later, Kirchler et al. (2011) show that the impact of a Tobin tax on market volatility depends on the presence of market makers. They show that, when a Tobin tax is levied on one market, volatility increases if no market makers are present. On the contrary, when there are market makers on the unique taxed market, volatility declines. In the last case, in which both markets are taxed, no significant effects on volatility are detected.

Noussair and Xu (2015) studied the occurrence of financial contagion and its relationship with information mirages in an experimental asset market. Two assets are traded and the value of one of them is, at some point, reduced by an exogenous shock. The correlation between the two assets may be known or unknown with 50% chance. In the former case, only half of the traders know the correlation. The setting differs from that of Camerer and Weigelt (1991) in that the assets' correlation and not the asset pay-out is the direct source of knowledge. Noussair and Xu (2015) show that, during periods when insiders were present, the private information was rapidly revealed by prices. However, during periods with no privileged information, information mirages occurred, reflecting misleading information on the non-shocked asset's value. The latter can be then interpreted as a form of financial contagion, implying that a market-specific shock can be transmitted from one asset to another without a justifiable underlying reason.

Barreda et al. (2016a) study the conditions under which information is aggregated in a market where heterogeneously informed traders are given the option to share their informative set before trading starts. The experiment runs over five treatments, which

differ in the ex-ante distribution of the partially trustable private information. In treatment 1 all agents received 1 piece of information; in treatment 2 base-informed (BI) agents received 1 piece of information and quasi-insider (QI) agents received 3 pieces of information; in treatment 3 all agents received 3 pieces of information; in treatment 4 base-informed (BI) agents received 1 piece of information and quasi-insider (QI) agents received 9 pieces of information; in treatment 5 all agents received no information. Barreda et al. (2016a) show that, when information is polarized, base-informed agents do not massively use the cooperation device to increase the number of their per-capita signals and compete against quasi-insider agents. Market efficiency is found to be significantly higher when quasi-insider agents are in the market with respect to the uniform information distribution case. The awareness that someone else is superiorly informed leads traders to focus more on what others are doing in the same market. Differently, when traders are uniformly informed, they do not recognize the presence of a leader in the market and, as a consequence, they focus more on processing their own private information. In a companion paper, Barreda et al. (2016b) find similar results.

Despite the previous powerful evidence, the systematic relationship between information distribution among traders and market performance is still an open issue. Lux, Morone and Nuzzo (2016) provided a further contribution to address the issue. In a framework where subjects are exogenously assigned some informative signals prior to the trading start, a baseline treatment in which information is uniformly distributed among traders is compared to treatments in which the same amount of information is distributed in a bimodal fashion. Lux, Morone and Nuzzo (2016) show that treatments in which information distribution is bimodal bring about higher informational efficiency than treatments where information is uniformly distributed. These findings, as well as those coming from Barreda at al. (2016a), are consistent with Keser and Markstädter (2014), who report that multi-period call-auction asset markets with asymmetrically informed traders exhibit smaller price deviations from the asset fundamental value compared to markets without insiders.

3. Private and Public Information

While in the research presented so far, information is private, we now review a strand of research where public information is injected into the market. This research strand is relatively recent and it finds its main theoretical driver in Morris and Shin (2002). In a

Keynes' beauty contest reminiscence, the authors build a model where agents access both private and public information on the underlying fundamentals. If on one hand subjects perform actions appropriate to the fundamentals, they also have incentive to coordinate one another, since the reward increases in the closeness between their actions and the actions of others. Morris and Shin (2002) show that greater accuracy of the public signal always increases social welfare when no private information is accessible. On the contrary, when subjects can access private information, the greater the accuracy of the latter, the more detrimental an increased provision of public information might be in terms of social welfare. In the following years, many models – i.e. Svensson (2005), Colombo and Femminis (2008), Cornand and Heinemann (2008), Kool et al. (2011), Arato and Nakamura (2011), Chen et al. (2014) – have investigated the role of public information in a market context. To the best of our knowledge, experimental investigations on the interplay between private and public information have been carried out by Ferri and Morone (2008), Alfarano et al. (2015), and Enke and Zimmermann (2013).

Ferri and Morone (2014) test whether the introduction of a rating agency in a financial market where agents are provided with partially trustable private information reduces erroneous herding (see Hey and Morone, 2004) and stimulates the price convergence toward the fundamental value of the asset. The experimental design crucially differs from Hey and Morone (2004) in the fact that in some treatments agents receive a costless public signal prior to the trading start. Both private and public information are not totally informative of the asset's fair value. Treatments differ in the precision of both private and public signals. Ferri and Morone (2014) show that the herding likelihood is negatively related to an increase in the accuracy of public information. Furthermore, the public signal also accelerates the price discovery process, producing a benefit in terms of market efficiency.

In a similar framework, Alfarano et al. (2015) test whether investors rely on public information more than what the public signal accuracy would require. While in the first two treatments agents can only purchase imperfect private information, in treatments three to five subjects also receive an imperfect and costless public signal. Treatments differ in the combination of the precision of both private and public information. Alfarano et al. (2015) show that public information crowds out private information. In other words, subjects' demand for private information is downward shifted as a public signal is injected into the market. In spite of the crowding-out effect, market informativeness does not

change significantly, since the public signal introduction compensates the reduction in the private information demand. As far as market efficiency is concerned, the authors find that, in spite of the unchanged market informativeness, the introduction of a public signal might produce a detrimental effect. Indeed, in the presence of poor quality private information, the public signal leads market prices. If this mechanism is beneficial for market efficiency when public information is correctly released in the market, undesirable and large deviations from the asset fundamentals may occur in case of incorrect public signal. This result is fully in line with Morris and Shin (2002).

Several information structures, especially those in which information is publicly released but also those where subjects can share their private information within a network[2], may generate correlated rather than independent informative signals. This creates potential for double-counting problems, since subjects may fall prey to cognitive biases when updating their information set, i.e. they might treat the informative signals as if they were mutually independent rather than correlated. An influential contribution on this issue has been provided by Enke and Zimmermann (2013). By employing a series of laboratory experiments, they find evidence that people neglect redundancy in information when it comes to updating their beliefs, implying over-sensitivity to connected information sources. They also show that this evidence persists in an experimental asset market and that correlated news can lead to price distortions.

4. Stylized facts of the distribution of returns

Over the last three decades, several models – Beja and Goldman (1980), Day and Huang (1990), Chen et al. (2001), Farmer and Joshi (2002), LeBaron (2000), Gaunersdorfer and Hommes (2005), Gaunersdorfer et al. (2008), Ariofovic and Gencay (2000), Georges (2006) – on dynamic interaction in financial markets have been developed. These models have shed light on some stylized facts of financial markets such as leptokurtic returns and autoregressive dependence in volatility. There is abundant literature testing these stylized facts in the field of agent-based model (ABM). Outcomes of these models can be found in Arthur et al. (1997), Brock and Hommes (1998), Hommes (2002), Iori (2002), Lux (1995, 1998), Lux and Marchesi (1999, 2000), Raberto et al. (2001). In particular, according to Lux and Marchesi (1999, 2000), fat tails of returns distributions as well as volatility clustering have to be imputed to agents switching their trading strategies. When the

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[2] For further details, see Barreda et al. (2016a)

proportion of chartists becomes prominent relative to that of fundamentalists, extreme returns dominate the market and prices deviate from the asset's fundamental value, inducing bubbles or crashes. On the opposite, in times of large price deviations from the asset fair value, fundamental strategies become more profitable, inducing traders to discard chart analysis and to focus on fundamentals. This mechanism slowly leads prices back to the asset's fundamental value, causing a decay in the absolute returns autocorrelation function.

The latter evidence has led some researchers – Kirchler and Huber (2007), and Morone (2008) – to verify if theses stylized facts were also detected in laboratory financial markets. In contrast with Lux and Marchesi (1999, 2000), Kirchler and Huber (2007) show – by means of a laboratory experiment – that heterogeneity of fundamental information is the leading driver for fat tails and volatility clustering. More precisely, Kirchler and Huber (2007) find that decreasing absolute returns are positively correlated with the arrival of new fundamental information. Then, neither noise nor switching from chartist/fundamentalist strategies play a prominent role in explaining stylized facts.

Morone (2008) compares a "real" asset market with an experimental one in which the quantity of information is endogenously determined while the quality of information is exogenous. The author finds that price volatility decreases in both the quantity and the quality of information. While information aggregation does occur when the quality of information is relatively high, the leptokurtosis of the returns distribution increases in the cost of information.

5. Trading Institutions

Several studies (see Plott ,1982; Holt, 1993) show that market institutions matter for efficiency and convergence to the market clearing outcome. Trading institutions commonly refer to the set of exchange rules which determines how purchase and sales proposals are matched and, consequently, how the price formation process evolves. As Cason and Friedman (1996) state, "market institutions exist in the world in order to solve the incentive, coordination and logistical problems associated with price formation and exchange".

The continuous double auction (CDA) and the single call market (SCM) have been the two most frequently employed trading institutions in both theoretical and experimental works. In a continuous double auction mechanism, each trader, at any moment during the

trading period, is free to enter a bid (an offer to buy one unit of the asset for a specific amount of cash) or an ask (an offer to sell one unit of the asset for a specific amount of cash). Submitted proposals appear on the book and become public information. Traders can also accept outstanding bids and asks, closing the transaction and making the relative price public information. These characteristics make the CDA the richest trading institution in terms of trading opportunities and within-period information. On the opposite extreme, in a single call market mechanism, each trader privately submits his purchase or sale order. For a single unit of the asset, the purchase order consists of the highest acceptable purchase price and the sale order represents the lowest acceptable sale price. When the trading period closes, the demand and supply scheme is derived and all the infra-marginal orders are executed at a unique price (clearing price), that is the intersection point of the demand and supply functions. Differently from the CDA, the SCM allows only one trading opportunity per period (reducing the trading strategy space) and information feedback is totally absent within the trading period. Among the several variants of the two main trading institutions, the uniform price double auction[3] (UPDA) and the multiple call market[4] (MCM) have also been widely used (see Cason and Friedman, 1996).

In any case, not so many experimental studies have been produced on the relationship between trading institutions and market efficiency.

Smith et al. (1982) compared the continuous double auction with several variants of the single call market institution in a stationary environment. The authors found the price convergence process to be more rapid in the continuous double auction. The latter institution also outperformed in terms of allocational efficiency except when a multiple unit recontracting variation of the single call market mechanism was introduced. In this case, the single call market showed the same allocational efficiency as the continuous double auction.

In a relevant contribution, Friedman (1993a) studied the impact of both a continuous double auction and a call market trading mechanism (with multiple orders per period) on market performance. Treatments differed in the pay-out contingent states across traders (homogeneous *vs.* heterogeneous) and in the sequential rather than simultaneous arrival of information. While the two employed trading institutions exhibited similar

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[3] This trading institution preserves the huge and continuous amount of information feedback within the period while limiting to one the number of trading opportunities (like in the SCM).
[4] Differently from the SCM, in the MCM the market is cleared more than once within the period, increasing the number of trading opportunities per period.

performance in terms of informational efficiency, the continuous double auction showed slightly greater allocational efficiency with respect to the call market. Market depth, meant as the difference[5] between the best rejected bid and ask prices, was found to be higher when trading used call market rules. On the contrary, market volume, thought as the number of shares sold or bought, was higher when trading was conducted through a double auction mechanism.

Cason and Friedman (1996) compare the performance of four market institutions: the continuous double auction (CDA), the uniform price double auction (UPDA), the single call market (SCM) and the multiple call market (MCM). The authors find that trading efficiency, expressed as the realized percentage of the maximum gains from exchange, is remarkably higher in CDA and MCM sessions, suggesting that multiple trading opportunities within a period (like those allowed in the CDA and MCM mechanisms) stimulate higher trading efficiency. On the opposite, the UPDA and the SCM institutions generate the highest informational efficiency, since they exhibit fewer deviations of transaction prices from the competitive equilibrium prediction levels. Then, the presence of multiple trading opportunities on one hand improves trading efficiency – inducing traders not to under reveal their true values and costs – but, on the other hand, generates greater mispricing with respect to the case in which only one trading opportunity is permitted.

Schnitzlein (1996), in an experimental framework based on Kyle (1985), compares continuous and call auctions under asymmetric information. He finds that, in addition to being no less efficient than continuous auctions, call auctions also enhance market liquidity and imply lower adverse selection costs for noise traders.

Theissen (2000) compared continuous double auctions, call markets and dealer markets. The author focused on informational efficiency within a sequential arriving information framework. He found that, in the call market institution, opening prices were closer to the fundamental value of the asset than opening prices in the continuous auction and in the dealer markets. Concurrently, the call market showed a significant tendency to underreact to the arrival of new information, exhibiting poor ability of transmitting the new information into prices. The continuous auction and the dealer markets were found to be more efficient at the average period price level, in the sense that, on average, these

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[5] In the double auction mechanism, the difference between the lowest ask and the highest bid is recalculated every time it changes and depth is computed as the time-weighted average when both bids and asks are available in the sub-period.

institutions exhibited fewer deviations from the true value of the asset. Nevertheless, the dealer market presented the highest transaction costs.

In an experimental framework based on Theissen (2000), Hinterleitner *et al.* (2015) investigate whether the market opening structure does impact on subsequent trading. The experiment compares a five-minute stand-alone continuous double auction market with two complement markets. In both the latter markets, a two-minute call market precedes a five-minute continuous double auction. The two complement markets differ in the transparency[6] level of the call auction phase. Hinterleitner *et al.* (2015) find that implementing a call auction in the market pre-opening phase does have a dual beneficial effect. Indeed, on one hand, it improves market efficiency and liquidity at the beginning of the trading day but, on the other hand, it also has positive effect on subsequent trading. No relevant differences were detected between the transparent and non-transparent variant in terms of opening prices and market liquidity.

Van Boening et al. (1993) showed that the price bubbles and crashes typically observed in the double auction institution were also found with regularity in a 15-round closed-book call market treatment. Trading prices were more likely to track the fundamental value of the asset only when the same group of experienced traders was involved in three consecutive 15-round markets.

In a market where uninformed agents cannot be sure about the presence of insiders, Morone and Nuzzo (2015) investigate the impact of trading institutions on both the occurrence of information mirages and the price discovery process. In this framework, a single-unit double auction institution is compared with a multiple call auction mechanism. They showed that the likelihood of detecting information mirages increases when trading is conducted through a double auction mechanism. Then, the call auction institution promotes better convergence toward the efficient price when no insiders are in the market. In addition, the call market institution also outperforms the double auction one in reducing market noise and stabilizing trading prices when there is no information in the market. Contrarily, when insiders are in the market, none of the two institutions presents an informational efficiency advantage.

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[6] While in the non-transparent call market traders can access no information on the order flow or the indicative prices, in the transparent specification, market participants can see the complete order book as well as the indicative prices.

Differently from the previous surveyed studies, Lugovskyy et al. (2011) employ a tâtonnement institution[7] to test its capacity to mitigate bubbles[8] with respect to double auctions and call auctions. The authors show that the tâtonnement institution induces a positive effect on bubbles reduction and facilitate learning about the fundamental value. Lugovskyy et al. (2011) argue that their result is due to the fact that the price adjustment iterations work as a learning tool, since they help the establishment of common expectations and drive subjects to converge toward a collective agreement.

6. Bubbles, crashes, and traders' emotions

King et al. (1993) define a bubble as "trade in high volumes at prices that are considerably at variance from intrinsic values". Asset market's propensity to generate bubbles has been first detected by Smith et al. (1988) and has been confirmed in later works[9], i.e. King et al. (1993), Van Boening et al. (1993), Porter and Smith (1995), Fisher and Kelly (2000). In a market where a one-period-life asset with common dividend across subjects is traded, these authors found that prices, instead of tracking the intrinsic asset value, exhibited phases of "boom" and "crash". At that time, the prominent explanation for bubbles and false equilibria was related to Smith et al. (1988) results, according to which bubbles arise because of the possibility to generate capital gains. This idea finds its main source in the hypothesis that agents' rationality is not common knowledge. In other words, if a rational trader believes there are some irrational traders willing to buy at prices considerably higher than the asset fair value, he or she could also be willing to buy at prices higher than fundamentals because he or she expects to resell the asset at even higher prices to either an irrational trader or to a rational trader with bull market expectations.

Palan (2013) gave an accurate survey of bubbles and crashes in asset markets, reviewing the experimental findings in several variations of the market design pioneered by Smith et al. (1988). To date, some of the strands inspected by Palan (2013) have been further developed in later research. In particular, the relationship between bubbles and short selling capacity has been very recently updated by Haruvy and Noussair (2016). If, on one hand, the latter study confirms the evidence that allowing traders to short sell

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[7] After the initial price is randomly selected in every period, subjects submit their purchase/sale proposals at that given price. The market clears whenever the aggregate demand is equal to the aggregate supply, otherwise the market proceeds and prices move either upward or downward if there is demand excess or supply excess respectively.

[8] Experimental evidence on bubbles are provided in the next section.

[9] For a comprehensive review of the literature on bubbles and crashes, see Palan (2013).

lowers trade prices (see Ackert et al., 2006), on the other hand, it finds that sufficiently large short selling capacity leads actual prices below the fundamental value. Then, according to Haruvy and Noussair (2016), while avoiding prices to exceed the fundamental value, short selling does not ultimately solve mispricing issues. Noussair and Tucker (2016) update the experimental evidence about the effect of asset- to-cash ratio on bubbles. In contrast with the well-established findings that greater cash provision leads to higher prices when fundamental values decrease over time, some works (see Kirchler, Huber and Stöckl 2012; and Kirchler et al. 2015) have shown that cash does not induce any effects on bubbles in presence constant fundamental values. Reconciling the previous set of findings, Noussair and Tucker (2016) show that, even when fundamental values are constant over time, a positive association between higher cash and greater prices is in place if cash is introduced before the market opens. In this sense, the authors argue that, besides the size, the timing[10] of the cash injection plays a major role on bubbles formation when fundamental values are constant. In particular the later (in the asset-life) the cash is injected, the lesser prominent its impact on bubbles is expected to be. The authors claim that this might be due to the fact that confusion, as a driver for bubbles, is usually less prominent later in the life of the asset.

Baghestanian and Walker (2014) extend the previous research on the relation between subjects' confusion and bubbles, providing the evidence that bubbles occurrence can be reduced when fundamental values are displayed in graphical form. Michailova and Schmidt (2016) detect a positive relationship between traders' overconfidence and bubbles occurrence.

Cason and Samek (2015) compare the roles of passive and active participation in mitigating bubble occurrence. A passive trader observes[11] the same information and receives the same payout as a "prior" trader, but he or she does not take decisions. In the experimental design, each passive trader is matched with a trader from a different "prior" market. Cason and Samek (2015) find that passive participation reduces mispricing in subsequent markets, leading to conclude that passive observation learning can then be used as a confusion reducing tool.

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[10] In both Kirchler, Huber and Stöckl (2012), and Kirchler et al. (2015), additional cash provision took place after one or more periods were elapsed.
[11] The observational learning properties to reduce bias in decision making has been detected in several economic games (Merlo and Schotter, 2003; Kocher et al., 2016).

Cheung et al. (2014) assert that, rather than training on fundamentals, the common knowledge that other agents in the market are trained plays a crucial role in reducing mispricing. When all subjects in the market are trained with decreasing fair values but this is not commonly known, mispricing is not significantly different from the no-training case. Differently, when training is common knowledge, mispricing is significantly reduced.

Lugovskyy et al. (2014) designed an experiment to study the effect of individual asset-holdings on bubbles and crashes. They showed that permanent caps reduce positive bubbles, but tend to generate negative bubbles in later periods. All in all they concluded that, if properly designed, asset-holdings caps can be effective in eliminating bubbles.

One more force driving bubbles occurrence has been identified in the role of traders' emotions. While some empirical evidence was provided at the beginning of the 2000s (see, for example, Hirshleifer and Shumway, 2003; and Kamstra et al. 2003), only little experimental evidence on this topic is available at the present time. These works start from the classical design à la Smith et al. (1988) and stimulate heterogeneous emotional states in market participants. Andrade et al. (2016) use video clips to induce emotions before the market opens. A larger range of emotions is induced with respect to Lahav and Meer (2012). Indeed, Andrade et al. (2016) show traders videos inducing excitement, neutral mood, fear or sadness. Greater average bubble magnitudes were produced by subjects undergoing the exciting video clips relative to subjects to whom neutral, fearful or sad videos were shown.

Breaban and Noussair (2015) provide real-time emotions tracking. Through a face reading software, participants' facial expressions are monitored before and while the market is running. Similar to the previous findings, positive emotions are positively correlated with overpricing and fear leads to declining price patterns.

Kocher et al. (2016) investigate the relationship between market pricing and variations in self-control abilities. Two markets settings are implemented. While in one market agents' self-control is not reduced (control market), in the other market, participants' self-control is reduced[12]. In the latter treatment, significantly larger overpricing is detected. The paper provides evidence that self-control problems can lead to exuberant behaviour and mispricing.

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[12] Exogenous self-control reduction is accomplished through a Stroop task. Baumeister et al. (1998) have shown the performance of the Stroop task in reducing people's ability to exert self-control.

7. The role of payment incentives in asset markets

It is a general economic principle that people behaviour is incentive-oriented and that subjects discount the costs and benefits associated to a specific task. As a recent example, the global financial crisis in 2007-2008 has come to light that this principle applies to financial markets as well. Indeed, excessive risk taking by financial professionals was one of the main reasons leading to asset markets instability and security pricing far from fundamental values (i.e. bubbles and crashes). What was this massive risk taking driven by? From the 1970s on, the entrustment of retail investors' money to financial professionals (i.e. mutual funds, investment banks, insurance companies, hedge funds etc.) has become a relevant and widely observed phenomenon in finance industry. While, on one hand, this delegation process has provided tangible benefits (i.e. transaction costs reduction, expanded access to capital and better risk sharing), on the other hand, it has also configured a principal (retail investor) / agent (investment manager) interaction conflict, creating a basis for information asymmetry and moral hazard. To mitigate the latter two issues, different payment schemes have been implemented, i.e. salary *plus* bonus, option-like contracts, incentives with caps, penalties and so on. Nevertheless, some theoretical works (see Rajan, 2006; Wagner, 2013; Bebchuk et al., 2010) have pointed that these incentive-based contracts might have played a major role in reinforcing market instability through the channel of stimulating excessive risk taking by institutional investors. As a matter of fact, whether or not financial market participants payment systems affect market performance and how the optimal remuneration scheme should be designed are still unanswered questions. In recent years, remarkable attention by experimental economists has been devoted to the topic.

James and Isaac (2000) analyse the effects of tournament[13] contract incentives on market performance. From a double auction market in which a generic asset is traded over 15 rounds (with no re-initialization), the authors show that tournament incentives (unanimously applied to all traders in the market) sort a detrimental effect in asset markets, since they mislead rational price formation and cause divergence from the intrinsic asset value.

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[13] A tournament contract stands for a payment scheme in which the baseline salary is incremented by a bonus. The latter is proportional to the amount by which traders' performance are superior to the average market performance. Tournament contracts are often labeled as either "salary plus bonus contracts" or "beat-the-market contracts".

In a later contribution, Isaac and James (2003) test whether their previous findings persist even in presence of mitigating factors. The original experimental design (see James and Isaac, 2000) is modified under three aspects. First, a treatment is introduced where only half of all market participants received tournament incentives (the remaining traders received linear incentives); second, a two-period asset-life security is opposed to the original 15 period life asset; finally, the tournament contract is modified to provide traders with a penalty conditional on underperformance. Isaac and James (2003) found that i) reducing the number of traders being paid through a tournament contract (by half the market) eliminated the original distortive effect on asset prices, ii) the modified version of the tournament contract did not produce any improvements on market performance, iii) convergence paths in two-period asset-life markets were similar to Anderson et al. (1991).

Cheung and Coleman (2014), study the effect of relative performance incentives on (i) decreasing intrinsic value markets where bubbles are very likely but diminish across replications (i.e. markets *à la* Smith et al., 1988) and (ii) constant intrinsic value markets where mispricing is sporadic and mostly occurring in early rounds (i.e. markets *à la* Noussair et al., 2001). If in the latter market configuration there is no much potential for beating the market, in the former markets, professionals being paid for relative performance may be tempted to ride the bubble, since premature "sell out" may cause them to lose short term performance with respect to their competitors. While in markets *à la* Smith et al., (1988) prior results[14] are confirmed without tournament incentives, Cheung and Coleman (2014) show that (i) mispricing is higher in presence of relative performance payment schemes and, more interestingly, (ii) mispricing is impaired with experience. Similarly, in markets *à la* Noussair et al. (2001), while original findings[15] are supported, the authors find a small but significant tournament incentives effect. It is, hence, quite surprising how relative performance incentives may play a role even in situations where there is less potential for tracking prices other than the intrinsic value.

Holmen et al. (2014) compare option-like incentives (i.e. convex incentives) with linear incentives in terms of traders' behavior and market dynamics. They find that option-like incentives are responsible for overvalued trade prices and induce higher risk taking in market participants. Interestingly, the authors underline that these findings (trading at

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[14] Widespread pricing at levels above the fundamental value but intrinsic value tracking improved by subjects' experience.

[15] Slight mispricing in inexperienced markets but high efficiency in later periods.

overvalued prices and taking excessive risk) do not have to be interpreted as a form of irrational behavior but they are perfectly rational for traders with convex incentives. Indeed, because of the convexity structure of the compensation scheme, trading at the observed prices would increase the expected value of subjects' payout. This result is in line with the claim of Rajan (2006).

Kleinlercher et al. (2014) contribute to extend the work of Holmen et al. (2014) in two relevant features: (i) including alternative payment schemes, like penalty and bonus with cap; (ii) introducing a second security with a different level of risk. As a general result, the authors find that subjects respond rationally to the different types of incentives. More particularly, Kleinlercher et al. (2014) find that markets where traders face bonus incentives show the highest prices, while those with penalty incentives exhibit the lowest. Furthermore, bonus incentives stimulate riskier investment behaviour, inducing traders' preference for the risky asset. By contrast, subjects facing penalty incentives exhibit more conservative investment behaviour and prefer holding cash.

Finally, Baghenstanian et al. (2016), extend the previous studies by endogenizing liquidity provision within the principal/agent relationship. Different schemes (unlimited liability with and without capping bonuses; limited liability with and without capping bonuses) are implemented in a framework where investors can decide the amount of their initial cash to entrust theirs traders with. The experimental results are pretty divergent from the theoretical predictions[16]. Baghenstanian et al. (2016) find that investors enhance liquidity provision under limited liability and, as a consequence, greater asset bubbles are observed. Bonus caps are found not to be effective in mitigating price bubbles. These results innovate the previous literature in a crucial way. Indeed, while the works of Holmen et al., (2014) and Kleinlercher et al. (2014) indicate excessive risk taking by traders as the main driver for bubbles, Baghenstanian et al. (2016) show that endogenous liquidity provision is likely to increase trading at higher prices. This occurs because investors do not cut their liquidity provision to prevent traders from trading at too high prices. Then, investors seem to be willing to "ride the bubble" as well.

As it emerges from the reviewed works, the impact of non-linear incentives on market performance has been a growing experimental research strand in recent years.

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[16] Theoretically speaking, limited liability should induce investors to decrease liquidity provision in order to make traders willing to trade at lower prices (since limited liability causes traders to evaluate the asset more than investors). On the opposite, liquidity provision is expected to be incentivized by bonus caps (since they make traders evaluate the asset less than investors), and trading at higher prices is expected.

Interesting policy implications come for policy makers and regulators. In the light of the fact that pricing reflecting the asset intrinsic value is desirable, the reviewed research has highlighted the tremendous detrimental effect that non-linear incentives cause in terms of market efficiency. Then, regulations[17] that aim at averting substantial mispricing and excessive risk taking by financial professionals should keep these findings into account. This point is especially relevant since risk-taking incentives may increase the probability of misalignments between traders' incentives and investors' interests, resulting in both pricing distortions and in a deterioration of the principal/agent relationship. In this sense, a further implication would consist of forcing traders to share losses with investors, since, as it has been showed, it would imply lower asset price bubbles. In any case, to date, further research is still needed to provide specific insights about how the optimal compensation contract should be designed.

8. Conclusion

This work has provided a review of the main advances from use of experimental procedures to study financial market performance. The included works perform the task to provide readers with a picture of the prevailing research strands and the relative state of art. As visible, due to the advantage of making relevant variables observable, the use of a laboratory framework to address financial markets studies has been widely adopted in the last decades. This makes experimental methodologies a complementary tool to both theoretical and empirical investigation on asset markets. Many insights come from the reviewed research. We learn that information distribution affects market efficiency, and that the presence of informationally advantaged traders stimulates markets efficiency when their presence is common knowledge among market participants (Keser and Markstädter, 2014; Barreda et al., 2016a; Lux et al., 2016). Concurrently, when the latter condition misses, markets fail to properly aggregate the dispersed information and widespread information mirages might have severe implications in terms financial contagion (Noussair and Xu, 2015). We also learn that properly designed market institutions can limit the occurrence of information mirages (Morone and Nuzzo, 2015) as well as mitigating the occurrence of bubbles (Lugovskyy et al., 2011). The markets propensity to generate bubbles is well established and also sensitive to several factors like the lack of common

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[17] For instance, bonus caps have already been implemented in EU through the directive 2013/36/EU.

knowledge of traders' rationality (Lei, Noussair and Plott, (2001), traders' cognitive biases (Michailova and Schmidt, 2016), cash inflow and fundamental value patterns (Kirchler, Huber and Stöckl, 2012; Kirchler et al. 2015; Noussair and Tucker, 2016) and traders' emotions (Breaban and Noussair, 2015; Andrade et al., 2016; Kocher et al., 2016). On the other hand, it has been documented that tools like training (Cheung et al., 2014), passive market participation (Cason and Samek, 2015) and asset-holdings caps (Lugovskyy et al., 2014) sort a positive effect in reducing bubbles magnitude. Furthermore, the introduction of public information is not free from counter indications, mainly coming from the evidence that the crowding out effect induced by public news on costly acquired private information might have a detrimental effect on market efficiency when public information is incorrect and private information is poor (Alfarano, et al. 2015; Ferri and Morone, 2014). Finally, in the light of the latest financial crisis, very recent research has shown that non-linear payment schemes induce great mispricing (Cheung and Coleman, 2014; Kleinlercher et al., 2014; Holmen at al., 2014; Baghenstanian et al., 2016). Despite the several experimental evidence provided so far, some topics still demand further research. Some of the newest contributions are providing evidence that markets with asymmetrically informed traders bring about higher market efficiency. This result might be due to an attention shift by informationally disadvantage traders. According to this conjecture, these traders might feel more concerned with extracting information from market exchanges rather than focusing on their poor private information. Anyway, to date, asserting that informational asymmetries are beneficial for market performance may not be very cautious, especially because the achievement of higher market efficiency is based on the expense of "outsiders". Indeed, mostly in early periods, insiders still manage to make very profitable trades by exchanging with "outsiders". In this sense, more research is needed to ascertain the benefit-cost ratio associated to information asymmetries. As Haruvy and Noussair (2016) point out, careful investigation is still deserved by the relationship between market regulations and bubbles. In particular, the positive effect of short selling in reducing positive bubbles – by introducing pessimistic expectations in the market – presents the shortcoming of overcompensating positive bubbles, thus leading prices even below the fundamental value. To conclude, if on one hand the recent studies on non-linear incentives have provided a prominent explanation for excessive risk taking by financial professionals, on the other hand, such payment schemes have been widely adopted so far because of their efficacy to fix the moral hazard issue underlying the investor\manager

relationship. In this sense, more research is welcome to eventually reconcile these two strands and to shed light on the characteristics of the optimal compensation scheme.

References

Ackert, L. F., Charupat, N., Church, B. K., and Deaves, R. (2006). Margin, short selling, and lotteries in experimental asset markets. *Southern Economic Journal*, 419-436.

Ackert, L. F., Church, B. K., and Zhang, P. (2002). Market behavior in the presence of divergent and imperfect private information: experimental evidence from Canada, China, and the United States. *Journal of economic behavior and organization*, *47*(4), 435-450.

Alfarano, S., Camacho, E., and Morone, A. (2011). The role of public and private information in a laboratory financial market. IVIE.

Alfarano, S., Camacho, E., and Morone, A. (2015). Do investors rely too much on public information to be justified by its accuracy? An experimental study (No. 30*). Collaborative EU Project FinMaP-Financial Distortions and Macroeconomic Performance: Expectations, Constraints and Interaction of Agents.*

Anderson, S., Johnston, D., Walker, J., and Williams, A. (1991). The efficiency of experimental asset markets: Empirical robustness and subject sophistication. *Research in Experimental Economics, The Journal of Economic Education, transferred in,(Fall 1993)*, 107-190.

Andrade, E. B., Odean, T., and Lin, S. (2016). Bubbling with Excitement: An Experiment. *Review of Finance*, 20, 2: 447-466.

Arato, H., and Nakamura, T. (2011). The benefit of mixing private noise into public information in beauty contest games. *The BE Journal of Theoretical Economics*, 11(1).

Arifovic, J., and Gencay, R. (2000). Statistical properties of genetic learning in a model of exchange rate. *Journal of Economic Dynamics and Control*, *24*(5), 981-1005.

Arthur, W. B., J. H. Holland, B. LeBaron, R. Palmer, and P. Tayler. (1997). Asset Pricing Under Endogenous Expectations in an Artificial Stock Market. In W. B. Arthur, S. N. Durlauf, and D. A. Lane (eds.), The Economy as an Evolving Complex System II, Reading, Mass.: Addison-Wesley, 15-44.

Baghestanian, S., Gortner, P. and Massenot, B. (2016). Compensation schemes, liquidity provision, and asset prices: an experimental analysis. *Experimental Economics,* first online, 1-25, 10.1007/s10683-016-9493-0

Baghestanian, S., and Walker, T. B. (2014). Thar she blows again: reducing anchoring rekindles bubbles (No. 54). *Research Center SAFE-Sustainable Architecture for Finance in Europe, Goethe University Frankfurt.*

Banerjee, A. V. (1992). A simple model of herd behavior. *The Quarterly Journal of Economics*, 797-817.

Barreda-Tarrazona, I., Grimalda, G., Morone, A., Nuzzo, S., and Teglio, A., (2016a). Centralizing information increases market efficiency more than sharing information: results from experimental asset markets. *Mimeo.*

Barreda-Tarrazona, I., Grimalda, G., Morone, A., Nuzzo, S., and Teglio, A., (2016b). Does Co-operation Pay off in Financial Markets? An Experimental Analysis. *Mimeo.* Baumeister, R. F., Bratslavsky, E., Muraven, M., and Tice, D. M. (1998). Ego depletion: is the active self a limited resource?. *Journal of personality and social psychology*, *74*(5), 1252.

Bebchuk, L. A., Cohen, A., and Spamann, H. (2010). Wages of Failure: Executive Compensation at Bear Stearns and Lehman 2000-2008, The. *Yale J. on Reg.*, *27*, 257.

Beja, A., and Goldman, M. B. (1980). On the dynamic behavior of prices in disequilibrium. *The Journal of Finance*, *35*(2), 235-248.

Bikhchandani, S., Hirshleifer, D., and Welch, I. (1992). A theory of fads, fashion, custom, and cultural change as informational cascades. *Journal of political Economy*, 992-1026.

Bloomfield, R., O'hara, M., and Saar, G. (2009). How noise trading affects markets: An experimental analysis. *Review of Financial Studies*, *22*(6), 2275-2302.

Brandouy, O., Pascal B., and Lawrence A. L. (2000). Insider trading, imitative behaviour and price formulation in a stimulated double-auction stock market. *Loughborough University Institutional Repository, Economic Research Paper No. 00/01.*

Breaban, A., and Noussair, C. N., (2015). Trader characteristics and fundamental value trajectories in an asset market experiment. *Journal of Behavioral and Experimental Economics*, 8, 1-17.

Brock, W. A., and Hommes, C. H. (1998). Heterogeneous beliefs and routes to chaos in a simple asset pricing model. *Journal of Economic dynamics and Control*, *22*(8), 1235-1274.

Cadsby C. B. and Maynes, E., (1998). Laboratory Experiments in Corporate and Investment Finance: A Survey. *Managerial and Decision Economics*, Vol. 19, No. 4/5, Laboratory Methods in Economics (Jun. - Aug., 1998), pp. 277-298.

Camerer, C., and Weigelt, K. (1991). Information mirages in experimental asset markets. *Journal of Business*, 463-493.

Cason, T. N., and Friedman, D. (1996). Price formation in double auction markets. *Journal of Economic Dynamics and Control*, *20*(8), 1307-1337.

Cason, T. N., and Samek, A. (2015). Learning through passive participation in asset market bubbles. *Journal of the Economic Science Association*, *1*(2), 170-181.

Chamberlin, E. H. (1948). An experimental imperfect market. *The Journal of Political Economy*, 95-108.

Chen, H., De, P., Hu, Y. J., and Hwang, B. H. (2014). Wisdom of crowds: The value of stock opinions transmitted through social media. *Review of Financial Studies*, *27*(5), 1367-1403.

Chen, J., Hong, H., and Stein, J. C. (2001). Forecasting crashes: Trading volume, past returns, and conditional skewness in stock prices. *Journal of financial Economics*, *61*(3), 345-381.

Cheung, S. L., and Coleman, A. (2014). Relative performance incentives and price bubbles in experimental asset markets. *Southern Economic Journal*, *81*(2), 345-363.

Cheung, S. L., Hedegaard, M., and Palan, S. (2014). To see is to believe: Common expectations in experimental asset markets. *European Economic Review*, *66*, 84-96.

Cipriani, M., and Guarino, A. (2008). Herd behavior and contagion in financial markets. *The BE Journal of Theoretical Economics*, *8*(1).

Colombo, L., and Femminis, G. (2008). The social value of public information with costly information acquisition. *Economics Letters*, *100*(2), 196-199.

Copeland, T. E., and Friedman, D. (1992). The market value of information: Some experimental results. *Journal of Business*, 241-266.

Cornand, C., and Heinemann, F. (2008). Optimal degree of public information dissemination. *The Economic Journal*, *118*(528), 718-742.

Davis, D. D., and Holt, C. A. (1993). Experimental economics. *Princeton university press*.

Day, R. H., and Huang, W. (1990). Bulls, bears and market sheep. *Journal of Economic Behavior and Organization*, *14*(3), 299-329.

Duxbury, D. (2015a). Behavioral finance: insights from experiments I: theory and financial markets. *Review of Behavioral Finance*, *7*(1), 78-96.

Duxbury, D. (2015b). Behavioral finance: insights from experiments II: biases, moods and emotions. *Review of Behavioral Finance*, *7*(2), 151-175.

Duxbury, D. (1995). Experimental asset markets within finance. *Journal of Economic Surveys*, *9*(4), 331-371.

Enke, B., and Zimmermann, F. (2013). Correlation Neglect in Belief Formation (November 29, 2013). CESifo Working Paper Series No. 4483. Available at SSRN: https://ssrn.com/abstract=2363834

Farmer, J. D., and Joshi, S. (2002). The price dynamics of common trading strategies. *Journal of Economic Behavior and Organization*, *49*(2), 149-171.

Ferri, G., and Morone A. (2014). The effect of rating agencies on herd behaviour. *Journal of Economic Interaction and Coordination* 9.1: 107-127.

Fisher, E. O. N., and Kelly, F. S. (2000). Experimental foreign exchange markets. *Pacific Economic Review*, *5*(3), 365-387.

Friedman, D. (1993a). How trading institutions affect financial market performance: some laboratory evidence. *Economic Inquiry*, *31*(3), 410-435.

Gaunersdorfer, A., and Hommes C. (2005). A non linear structured model for volatility clustering. In: *G. Teyssiere and A. Kirman (eds.), Long Memory in Economics, Springer-Verlag.*

Gaunersdorfer, A., Hommes, C. H., and Wagener, F. O. (2008). Bifurcation routes to volatility clustering under evolutionary learning. *Journal of Economic Behavior and Organization*, *67*(1), 27-47.

Georges, C. (2006). Learning with misspecification in an artificial currency market. *Journal of Economic Behavior and Organization, 60(1),* 70-84.

Hanke, M., Huber, J., Kirchler, M., and Sutter, M. (2010). The economic consequences of a Tobin tax—an experimental analysis. *Journal of Economic Behavior and Organization*, *74*(1), 58-71.

Haruvy, E., and Noussair, C. N. (2006). The effect of short selling on bubbles and crashes in experimental spot asset markets. *The Journal of Finance*, *61*(3), 1119-1157.

Hey, J. D., and Morone, A. (2004). Do markets drive out lemmings—or vice versa?. *Economica*, *71*(284), 637-659.

Hinterleitner, G., Leopold-Wildburger, U., Mestel, R., and Palan, S. (2015). A Good Beginning Makes a Good Market: The Effect of Different Market Opening Structures on Market Quality. *The Scientific World Journal*, *2015*.

Hirshleifer, D., and Shumway, T. (2003). Good day sunshine: Stock returns and the weather. *The Journal of Finance*, *58*(3), 1009-1032.

Holmen, M., Kirchler, M., and Kleinlercher, D. (2014). Do option-like incentives induce overvaluation? Evidence from experimental asset markets. *Journal of Economic Dynamics and Control*, *40*, 179-194.

Holt, C. A. (1995). Industrial organization: A survey of laboratory research. In *HANDBOOK OF EXPERIMENTAL ECONOMICS, J. KAGEL AND A. ROTH.*

Hommes, C. H. (2002). Modeling the stylized facts in finance through simple nonlinear adaptive systems. *Proceedings of the National Academy of Sciences*, *99*(suppl 3), 7221-7228.

Huber, J., Kirchler, M., and Sutter, M. (2008). Is more information always better?: Experimental financial markets with cumulative information. *Journal of Economic Behavior and Organization*, *65*(1), 86-104.

Iori, G. (2002). A microsimulation of traders activity in the stock market: the role of heterogeneity, agents' interactions and trade frictions. *Journal of Economic Behavior and Organization*, *49*(2), 269-285.

Isaac, R. M., and James, D. (2003). Boundaries of the tournament pricing effect in asset markets: Evidence from experimental markets. *Southern Economic Journal*, 936-951.

James, D., and Isaac, R. M. (2000). Asset markets: How they are affected by tournament incentives for individuals. *American Economic Review*, *90*(4), 995-1004.

Kagel, J. H., Roth, A. E., and Hey, J. D. (1995). *The handbook of experimental economics* (pp. 501-85). Princeton: Princeton university press.

Kamstra, M. J., Kramer, L. A., and Levi, M. D. (2003). Winter blues: A SAD stock market cycle. *The American Economic Review*, *93*(1), 324-343.

Keser, C., and Markstädter, A. (2014). Informational asymmetries in laboratory asset markets with state-dependent fundamentals. *CIRANO-Scientific Publications 2014s-30*.

King, R., Smith, V. L., Williams, A. W, and Van Boening M. (1993). The robustness of bubbles and crashes in experimental stock markets. In *Nonlinear Dynamics and*

Evolutionary Economics, edited by R. Day and P. Chen, 183-200. Oxford: Oxford University Press.

Kirchler, M., Bonn, C., Huber, J., and Razen, M. (2015). The "Inflow-Effect"–Trader Inflow and Bubble Formation in Asset Markets. *European Economic Review*. *77*, 1-19.

Kirchler, M., and Huber, J. (2007). Fat tails and volatility clustering in experimental asset markets. *Journal of Economic Dynamics and Control*, *31*(6), 1844-1874.

Kirchler, M., Huber, J., and Kleinlercher, D. (2011). Market microstructure matters when imposing a Tobin tax—Evidence from the lab. *Journal of economic behavior and organization*, *80*(3), 586-602.

Kirchler, M., Huber, J., and Stöckl, T. (2012). Thar she bursts: Reducing confusion reduces bubbles. *The American Economic Review*, *102*(2), 865-883.

Kleinlercher, D., Huber, J., and Kirchler, M. (2014). The impact of different incentive schemes on asset prices. *European Economic Review*, *68*, 137-150.

Kocher, M. G., Lucks, K. E., and Schindler, D. (2016). Unleashing Animal Spirits–Self-Control and Bubbles in Experimental Asset Markets. *Online at http://epub.ub.uni-muenchen.de/27572/*

Kool, C., Middeldorp, M., and Rosenkranz, S. (2011). Central bank transparency and the crowding out of private information in financial markets. *Journal of Money, credit and Banking*, *43*(4), 765-774.

Kyle, A. S. (1985). Continuous auctions and insider trading. *Econometrica: Journal of the Econometric Society*, 1315-1335.

Lahav, Y., and Meer, S. (2010). The effect of induced mood on prices in experimental asset markets. *Unpublished working paper, Emory University*.

LeBaron, B. (2000). Agent-based computational finance: Suggested readings and early research. *Journal of Economic Dynamics and Control*, *24*(5), 679-702.

Lei, V., Noussair, C. N., and Plott, C. R. (2002). Asset bubbles and rationality: additional evidence from capital gains tax experiments. Social Science Working Paper, 1137. California Institute of Technology, Pasadena, CA.

Lei, V., Noussair, C. N., and Plott, C. R. (2001). Nonspeculative bubbles in experimental asset markets: Lack of common knowledge of rationality vs. actual irrationality. *Econometrica*, *69*(4), 831-859.

Lugovskyy, V., Puzzello, D., and Tucker, S. (2011). An experimental study of bubble formation in asset markets using the tâtonnement trading institution. *Department of Economics and Finance, College of Business and Economics, University of Canterbury.*

Lugovskyy, V., Puzzello, D., Tucker, S., and Williams, A. (2014). Asset-holdings caps and bubbles in experimental asset markets. *Journal of Economic Behavior and Organization*, 107, 781-797.

Lux, T. (1995). Herd behaviour, bubbles and crashes. *The economic journal*, 881-896.

Lux, T. (1998). The socio-economic dynamics of speculative markets: interacting agents, chaos, and the fat tails of return distributions. *Journal of Economic Behavior and Organization*, *33*(2), 143-165.

Lux, T., and Marchesi, M. (1999). Scaling and criticality in a stochastic multi-agent model of a financial market. *Nature*, *397*(6719), 498-500.

Lux, T., and Marchesi, M. (2000). Volatility clustering in financial markets: a microsimulation of interacting agents. *International journal of theoretical and applied finance*, *3*(04), 675-702.

Lux, T., Morone A., and Nuzzo S. (2016). The role of information distribution in financial markets. *Mimeo*.

Merlo, A., and Schotter, A. (2003). Learning by not doing: an experimental investigation of observational learning. *Games and Economic Behavior*, *42*(1), 116-136.

Michailova J., and Schmidt, U., (2016). Overconfidence and bubbles in experimental asset markets. *Journal of Behavioral Finance,* published online, 280-292, 10.1080/15427560.2016.1203325

Morone, A. (2008). Financial markets in the laboratory: an experimental analysis of some stylized facts. *Quantitative Finance*, *8*(5), 513-532.

Morone, A., and Nuzzo, S. (2016). Do Markets (Institutions) Drive Out Lemmings or Vice Versa?. *EconStor Preprints 146917, ZBW - German National Library of Economics.*

Morone, A., and Nuzzo, S. (2015). Market Efficiency, Trading Institutions and Information Mirages: evidence from an experimental asset market. EERI Research Paper Series EERI RP 2016/17, Economics and Econometrics Research Institute (EERI), Brussels.

Morris, S., and Shin, H. S. (2002). Social value of public information. *The American Economic Review*, *92*(5), 1521-1534.

Noussair, C. N., and Powell, O. (2010). Peaks and valleys: Price discovery in experimental asset markets with non-monotonic fundamentals. *Journal of Economic Studies*, *37*(2), 152-180.

Noussair, C., Robin, S., and Ruffieux, B. (2001). Price bubbles in laboratory asset markets with constant fundamental values. *Experimental Economics*, *4*(1), 87-105.

Noussair, C. N., and Tucker, S. (2016). Cash inflows and bubbles in asset markets with constant fundamental values. *Economic Inquiry*.

Noussair, C. N., and Tucker, S. (2013). Experimental research on asset pricing. *Journal of Economic Surveys*, *27*(3), 554-569.

Noussair, C., and Xu, Y. (2015). Information mirages and financial contagion in an asset market experiment. *Journal of Economic Studies*, *42*(6), 1029-1055.

Palan, S. (2013). A review of bubbles and crashes in experimental asset markets. *Journal of Economic Surveys*, *27*(3), 570-588.

Plott, C. R. (1982). Industrial organization theory and experimental economics. *Journal of Economic Literature*, *20*(4), 1485-1527.

Plott, C. R., and Sunder, S. (1982). Efficiency of experimental security markets with insider information: An application of rational-expectations models. *The Journal of Political Economy*, 663-698.

Porter, D. P., and Smith, V. L. (1995). Futures contracting and dividend uncertainty in experimental asset markets. *Journal of Business*, 509-541.

Powell, O., and Shestakova, N. (2016). Experimental asset markets: a survey of recent developments. *Journal of Behavioral and Experimental Finance*, published online, 14-22, 10.1016/j.jbef.2016.08.003

Raberto, M., Cincotti, S., Focardi, S. M., and Marchesi, M. (2001). Agent-based simulation of a financial market. *Physica A: Statistical Mechanics and its Applications*, *299*(1), 319-327.

Rajan, R. G. (2006). Has finance made the world riskier?. *European Financial Management*, *12*(4), 499-533.

Schnitzlein, C. R. (1996). Call and continuous trading mechanisms under asymmetric information: An experimental investigation. *the Journal of Finance*, *51*(2), 613-636.

Schnitzlein, C. R. (2002). Price formation and market quality when the number and presence of insiders is unknown. *Review of Financial Studies*, *15*(4), 1077-1109.

Smith, V. L., Suchanek, G. L., and Williams, A. W. (1988). Bubbles, crashes, and endogenous expectations in experimental spot asset markets. *Econometrica: Journal of the Econometric Society*, 1119-1151.

Smith, V. L., Williams, A. W., Bratton, W. K., and Vannoni, M. G. (1982). Competitive market institutions: Double auctions vs. sealed bid-offer auctions. *The American Economic Review*, *72*(1), 58-77.

Sunder S. (1995). Experimental Asset Markets: A Survey, in *The Handbook of Experimental Economics, J. Kagel and A. Roth, eds, Princeton University Press.*

Svensson, L. E. (2005). Social value of public information: Morris and Shin (2002) is actually pro transparency, not con (No. w11537). *National Bureau of Economic Research.*

Theissen, E. (2000). Market structure, informational efficiency and liquidity: An experimental comparison of auction and dealer markets. *Journal of financial markets*, *3*(4), 333-363.

Van Boening, M. V., Williams, A. W., and LaMaster, S. (1993). Price bubbles and crashes in experimental call markets. *Economics Letters*, *41*(2), 179-185.

Wagner, W. (2013). Performance evaluation and financial market runs. *Review of Finance*, *17*(2), 597-624.