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Connected Account of Research

My research studies financial crises and significant mispricings due to institutional frictions, strategic considerations, and behavioral trading. My current, past and future work can be grouped into three closely related lines of research: (i) research on asset price bubbles, (ii) studies on liquidity crises and (iii) work on behavioral economics.

Asset Price Bubbles

A bubble is said to exist if the price of an asset substantially exceeds its fundamental value. Notorious examples of bubbles include the Dutch tulip mania of the 1630's, the South Sea bubble of 1719-1720, the Japanese real estate bubble of late 1980's, and more recently the Internet bubble which peaked in March 2000.

My research on bubbles started with my book **"Asymmetric Information: Bubbles, Crashes, Technical Analysis and Herding"** (Oxford University Press, 2001). The book surveys and critiques the literature on bubbles and herding in settings in which different investors hold different information. One conclusion of the book is that it is difficult to obtain bubbles in models in which all market participants are fully rational.

While even proponents of the "efficient market hypothesis"[1] admit that not all market participants are fully rational, they argue that bubbles can not persist since well-informed sophisticated investors will undo the price impact of behavioral traders. That is, rational investors should have an incentive to go against the bubble even before it emerges. The work on limits to arbitrage challenges this view. My theoretical research **"Bubbles and Crashes"** (Econometrica, 2003) with Dilip Abreu offers a new mechanism for why rational traders might prefer to ride the bubble rather than attack it. We argue that timing the bubble is a difficult task. Since a single trader alone cannot burst the bubble, he faces the following trade-off: if he attacks the bubble too early, he forgoes profits from the subsequent run-up caused by momentum traders; if he attacks too late, he will suffer from the subsequent crash. Thus, rational traders have to coordinate their actions over time. Each trader tries to forecast when other rational traders will go against the bubble. Timing other traders' moves is difficult in our model because traders become sequentially aware of the bubble and they do not know where in the queue they are. Because of this "sequential awareness", it is never common knowledge that a bubble has emerged. That is, it might be the case that everybody knows of it and that everybody knows that everybody knows it and so on but this "knowledge iteration" can never be made infinitely often. It is this lack of common knowledge which removes the bite of the standard backwards induction argument. Hence, in equilibrium, all traders ride the bubble for a number of periods, even though they know that the price exceeds the fundamental value.

The second important message of our work is that relatively insignificant news events can trigger large price movements. While this phenomenon is empirically well documented, it was up to now not well understood. This phenomenon occurs quite naturally in our model because even unimportant news events allow traders to

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[1] The semi-strong form of the efficient market hypothesis asserts that asset prices fully and correctly reflect all pertinent information in the public domain.

synchronize their sell strategies. Of course, large price drops are themselves significant synchronizing events and hence can trigger a whole price cascade.

My article **"Hedge Funds and the Technology Bubble"** (Journal of Finance, 2004) empirically examines the response of top hedge funds to the growth of the technology bubble using previously unexplored data on hedge fund stock holdings. We find that hedge funds, which probably come closest to the ideal of unconstrained rational traders, did not exert a correcting force on stock prices during the technology bubble. Instead, they were heavily invested in technology stocks and were riding the bubble rather than shorting these stocks. Hedge funds understood that prices would eventually deflate: they captured the upturn, but skillfully avoided much of the downturn by reducing their long exposure on a stock-by-stock basis when prices were about to decline. These empirical findings question the efficient markets notion that rational speculators always immediately stabilize prices by shorting overpriced assets. The study also reveals that short-sales constraints, emphasized in recent work on the technology bubble, are not sufficient to explain the failure of rational speculative activity to contain the technology bubble. Short-sale constraints and arbitrage risks alone can rationalize reluctance to take short positions, but do not explain why sophisticated investors would buy into the overpriced technology sector.

While in "Bubbles and Crashes" behavioral momentum traders continuously push up the price until the bubble bursts, both price and fundamentals follow a random walk in **"Synchronization Risk and Delayed Arbitrage"** (Journal of Financial Economics, 2002) with Dilip Abreu. Assets can be over- or underpriced. Price corrections are significantly delayed because of synchronization risk (each trader is uncertain when other traders will trade against the mispricing) and because traders incur holding costs for non-balanced positions. This framework has many applications. For example, it can explain the persistence of mispricing and sudden price adjustments in the bond market and the foreign exchange (FX) market. Currently, I am pursuing an empirical project with Gabriele Galati that verifies our theory using proprietary high frequency data on FX carry trades. Investors are willing to "carry" an overvalued currency if it yields a higher interest rate even though it might collapse as soon as a synchronizing event occurs. Going against this currency is costly since one foregoes the interest differential. We cover episodes like the previously unexplained 10% dollar-yen collapse on October 7th and 8th, 1998 that occurred without a corresponding shift in fundamentals.

The contributions of the working paper **"Clock Games: Theory and Experiments"** (with John Morgan) are twofold. First, it introduces the notion of clock games. Clock games are timing games in which the timing of other key players' moves is random and depends on de-synchronized clocks. We consider games with a finite number of strategic players, vary the observability of opponents' moves and consider a setting with information clustering. By doing so, we are able to study a rich class of situations in which players' timing decisions are crucial and each player neither wants to be the first nor the last to move. Potential cross-disciplinary applications range from asset price bubbles to the introduction of new products to the starting of revolutions. Second, the paper tests the empirical predictions of this model in the laboratory environment with a novel experimental design. Our main finding in the experiments is that the key comparative static properties of the model are largely borne out in the choice behavior of the subjects. Most notably, strategic delays increase with the uncertainty about other players' timing; and subjects immediately follow the first mover when moves are observable.

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Starting from the late 1990s we have experienced sharp run-ups in housing prices in almost all major countries. My recent working paper **"Housing Prices and Inflation: What Fuels Housing Bubbles?"** with Christian Julliard provides a possible explanation for the recent frenzy in the housing market. Unlike in the stock market, in the real estate market it is obvious that rational traders cannot undo the price impact of behavioral investors. In this paper we study whether the behavioral bias of "money illusion" can explain housing price movements. Agents that suffer from money illusion do not properly take into account the fact that a decline in nominal interest rates due to a drop in inflation does not reduce future real mortgage payments. This leads to a non-linear increase in their evaluation of housing. After empirically decomposing the price-rent ratio into a rational component and an implied mispricing component, we find that inflation and the nominal interest rate explain a large share of the time-series variation of the mispricing. We also find that the run-up in the housing prices starting in the late 1990s is reconcilable with the contemporaneous reduction in inflation and nominal interest rates. Moreover, we reject the currently predominant view that inflation effects are due to the so-called tilt effect.[2]

Liquidity Crises – Market Microstructure

While bubbles can persist because traders are reluctant to sell overvalued shares, liquidity crises occur when prices drop and nobody wants to step in to buy shares. A prominent example was the liquidity crisis during August and September 1998 which was triggered by the financial difficulties of the hedge fund Long Term Capital Management (LTCM). Market liquidity dried up exactly when LTCM was forced to liquidate its positions. In our article **"Predatory Trading"** (Journal of Finance, 2005), Lasse Pedersen and I argue that this lack of market liquidity was not a coincidence but was due to predatory trading by other strategic traders. If one trader needs to sell, others also sell and only subsequently buy back the asset. This induces endogenous time-variations in liquidity, leads to price overshooting, and a reduced liquidation value for the distressed trader. Hence, the market is illiquid when liquidity is most needed. Even worse, predatory trading can also trigger another trader's crisis, and the crisis can spill over across traders and across markets leading to systemic risk. Our model provides a new framework for studying the strategic interaction among large traders and has important implications for risk management and for financial regulators. It advocates for "dealer exit stress tests" and argues in favor of coordinated actions by regulators, bailouts and granularity in disclosure rules for asset holdings of large hedge funds.

Our working paper **"Market Liquidity and Funding Liquidity"** shows the interplay between a security's market liquidity – i.e., the ease of trading it – and traders' funding liquidity – i.e., their availability of funds. Traders provide market liquidity and their ability to do so depends on their funding, that is, their capital and the margins charged by their financiers. In times of crisis, reductions in market liquidity and funding liquidity are mutually reinforcing, leading to a liquidity spiral. Our model provides a natural and cohesive explanation for several empirically well documented features of market liquidity, such as why it (i) can suddenly dry up and trigger a liquidity crisis, (ii) has

[2] The tilt effect arises for mortgages with a fixed nominal repayment schedule. In a high inflation environment the repayment schedule is, in real terms, tilted towards early repayments. This constrains the size of mortgages and hence, reduces housing demand.

commonality across securities, (iii) is related to volatility, (iv) experiences "flight to liquidity" events, and (v) comoves with the market. Finally, the model shows how the Fed can improve current market liquidity by committing to improve funding in the event of a future crisis.

Two of my earlier papers touch upon liquidity, in the sense that asymmetric information and market regulation affect liquidity and market efficiency.

Figuring out the correct price impact of a public news announcement is difficult. This is specially the case if some of the news might have leaked beforehand to some insiders. In this case, an unknown part of the information content is already reflected in the pre-announcement price. My paper **"Information Leakage and Market Efficiency"** (Review of Financial Studies, 2005) models such a situation (with sequential signal arrival) and derives the optimal trading strategy for traders who receive some information early. It also shows that even though information leakage enhances informational efficiency in the very short-run, it lowers it in the long run. The analysis provides support for Regulation Fair Disclosure which was recently promulgated by the Securities and Exchange Commission.

My paper **"Disclosure Requirements and Stock Exchange Listing Choice in an International Context"** with Steven Huddart and John Hughes (Journal of Accounting and Economics, 1999) studies competition among exchanges in listing standards. Exchanges require listed firms to regularly disclose company information. Some argue that competition among exchanges leads to a "race to the bottom" in disclosure standards. Our paper argues to the contrary. Exchanges have no incentive to undercut listing standards since this would scare uninformed liquidity traders away and with it corporate insiders who benefit from trading with them.

Behavioral Finance – Economics and Psychology

My research on bubbles primarily focused on mechanisms that explain why rational sophisticated agents do not undo the price impact of behavioral agents. The next logical step – taken in my third line of research – is to model the behavioral distortions directly, ideally without sacrificing the useful advances made in economics. The neoclassical framework in economics assumes that all agents maximize a well defined objective function (utility function), aggregate outcomes are described by an equilibrium, and expectations are rational.

The **"Optimal Expectations"** framework (American Economic Review, 2005), jointly developed with Jonathan Parker, proposes a departure from the rational expectations paradigm that all agents' beliefs always coincide with the true objective probability distribution. Optimal expectations provide a structural model of belief distortions that can explain many experimental findings documented in the economics and psychology literature. Optimal belief biases in our model are driven by the desire to look forward with optimism, and are limited by the cost of impaired decision making. Unlike much of the previous literature, beliefs are derived endogenously. This not only imposes discipline but also avoids the outcome that agents with biased beliefs can be exploited without limits by rational agents. Our framework provides a parsimonious explanation for previously ill-understood phenomena such as why (i) agents facing an investment problem are overoptimistic and exhibit risk-loving behavior for lottery-type (skewed)

payoffs; (ii) agents bet against each other in an asset pricing setting; and (iii) observed consumption profiles are concavely downward sloping even though agents' expected profiles are not.

Jonathan Parker and I plan to extend this line of research to study other behavioral biases. In particular, we envision the following three projects: a paper on "The Planning Fallacy" with Filippos Papakonstantinou which addresses the phenomenon that people systematically underestimate the time required to complete a task. This paper also studies how deadlines are set optimally. In a joint project with Christian Gollier we plan to extend the asset pricing implications of our optimal expectations framework in general equilibrium. Finally, in a joint project with Chris Harris we study the confirmatory bias, which loosely speaking refers to the tendency that people are reluctant to correct their first impressions.

Another way of departing from the neoclassical framework is to assume a different objective function for the economic agents. Prospect theory does exactly this. My note **"Learning to Re-optimize Consumption at New Income Levels: A Rationale for Prospect Theory"** (JEEA, 2004) provides a rationale for three elements of prospect theory.

One can also deviate from the canonical utility function by making it state dependent, e.g. by introducing preferences which depend on past consumption habits. If agents' habit preferences are additive, then a positive (negative) wealth shock leads to a transitory decrease (increase) in agents' relative risk aversion. Such preferences have been proposed for models with a single representative agent. These models are generally viewed as a "rational" explanation of the equity premium puzzle and the predictability puzzle of stock returns. My working paper with Stefan Nagel **"Do Wealth Fluctuations Generate Time-varying Risk Aversion? Micro-Evidence on Individuals' Asset Allocation"** investigates whether there is micro-level evidence in support of this proposed (negative) relationship between wealth shocks and relative risk aversion. To this end, we analyze two decades of panel data on household asset allocation from the PSID and CEX surveys. Using a variety of specifications, we find that the share of financial assets that households invest in risky assets is unaffected by shocks to their wealth. Our findings are important because they show – contrary to common belief – that the assumed time-varying risk aversion of the representative agent is not simply a reflection of the same preferences at the microlevel. Hence, a different microfoundation is needed.

My ongoing research project **"Neurofinance: Neurological Foundations of Investor Behavior and Financial Market Outcomes"** joint with Joshua Coval uses behavioral and neuroimaging methods to study subjects in an experimental timing game. In this project we intend to use functional magnetic resonance imaging to study the interaction between cognitive and emotional brain processes. We are particularly interested in studying how professional traders' versus inexperienced subjects' timing decisions are affected by adverse emotional shocks.