

# Research Statement

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We are in the midst of a historical period where advances in information technologies challenge virtually all aspects of business in traditional financial markets and create new markets altogether. While technology creates opportunities to dramatically reduce allocative frictions, to improve liquidity and informativeness, and to broaden people’s access to financial products, it also forces authorities and regulators to rethink the institutions and infrastructure over which markets are built. An integral mission of my research is *understanding how technological advances and institutional developments interplay in asset markets, how they affect their performance, liquidity, and society’s welfare.*

TABLE 1  
Summary of my papers by research area

Research Area	Paper (short title)	Technological Developments	Institutional Developments	Approach	Status (Nov 2020)
The infrastructure and industrial organization of financial markets	Competing on Speed	*Ultra-high-speed networks * Algorithmic trading	* Reg NMS, ATS (US) * Mifid I & II (Europe)	Theory, MQA	Published at <i>Econometrica</i>
	Speed, Fragmentation, and Asset Prices	* Dark pools, smart routing systems		Theory, MQA	Rej.&R at the <i>Journal of Finance</i>
	Central Clearing and Price Volatility	* new CCPs, SEFs	* Dodd-Frank, EMIR * G20 mandate	Causal Inference, Panel data	R&R at the <i>Journal of Financial Economics</i>
Privately informed trading in modern asset markets: strategies, identification, regulation	Chasing Private Information	*Big data * machine learning * FINRA’s SONAR	* Dodd-Frank * SEC’s CAT	Textual analysis, Event Studies, Panel data	Published at <i>Review of Financial Studies</i>
	Becker Meets Kyle: Insider Trading and Legal Risk		* SEC’s Whistleblower Reward Program * Newman’s ruling	Textual analysis, Causal Inference, Theory	R&R at the <i>Journal of Finance</i>
	Information and Liquidity Trading at Optimal Frequencies	* Transition floor to CLOB trading * Sophisticated retail trading platforms	* Reg NMS, ATS	Theory, MQA, Nonparametric inference	Working Paper
Decentralized payment systems, permissioned/less blockchains	Decentralizing Money: Bitcoin Prices and Blockchain Security	* Decentralized consensus protocols * Bitcoin, Ethereum mining * Ripple, Libra * Lightning	* Bitcoin network * G20 coordination * SEC/CFTC regulation * Government crypto proposals (e.g., China)	Theory, MQA	Published at <i>Review of Financial Studies</i>
	Equilibrium Valuation of Bitcoin and DN Assets			Theory, MQA	Working Paper

Notes MQA: Model-based quantitative assessment (calibration, data fit, simulation experiments). Reg NMS: Reg National Market System. Reg ATS: Reg Alternative Trading Systems. Mifid: Markets in financial instruments directive CAT: Consolidated Audit Trail, CLOB: central limit-order book, EMIR: European Market Infrastructure Regulation.

Motivated by this goal, my research program contributes to three distinct but related areas, as sum-

marized in the included table. Methodologically, most of my research papers share a two-fold approach. First, developing general equilibrium models of frictional financial exchange where trading protocols, technologies, and institutional rules are explicitly modeled. Second, empirically identifying and quantifying the key frictions and their societal impact.

## 1 Infrastructure and Industrial Organization of Financial Markets

**Fragmentation and high-speed trading.** The securities exchange industry has changed profoundly over the past decade. The entry of new venues has led to the fragmentation of trading, particularly in the United States and in Europe. Trading speed has increased a lot in some markets (equities and standardized derivatives in particular), but much trading still relies on human inputs. As a result, we now observe significant heterogeneity in trading across venues and asset classes. These evolutions have triggered heated debates in academic and policy circles. Why do trading venues invest so heavily in speed? Is there a connection between speed and fragmentation? What are the welfare consequences of these changes? What are the appropriate regulations?

In "[Competing on Speed](#)," I (with Philippon) develop a theoretical general equilibrium framework of exchange competition—a market for markets—that allows one to study these questions. In the model, trading venues decide whether to enter, subsequently make speed-related investments, and compete for investors who choose where to trade based on available speeds and fees. Once the market structure is in place, investors dynamically trade an asset due to liquidity or preference shocks. We characterize the equilibrium and derive several positive and normative implications. Faster venues charge higher fees and attract speed-sensitive investors. Competition among venues increases investor participation, trading volume, and allocative efficiency, but entry and fragmentation can be excessive, and speeds are generically inefficient. These results are broadly consistent with European and U.S. markets' experience since the implementation of Mifid I and Reg NMS. We provide regulators with specific guidance for optimal interventions. For example, we find that regulations that protect transaction prices (e.g., SEC trade-through rule) lead to greater venue fragmentation. We show that lower technological costs can dramatically increase trading speed and volume, but the associated welfare gains are small. However, when trading protocols do not favor order front-running, contrary to common wisdom, welfare gains from enforcing a minimum speed can be significant.

Do the transformations above in secondary asset markets enhance liquidity? What are the consequences for asset prices? I investigate these questions in "[Speed, Fragmentation, and Asset Prices](#)" (solo-authored). Competition among venues fragment trading but reduces average trading delays and increases volume. Liquidity improves vis-à-vis a consolidated market, provided thick market externalities are not strong. However, the equilibrium effect on asset prices could, surprisingly, have the opposite sign. Competition between venues, while leaving tradable assets to market participants unaltered, results in lower market access fees and thus increases the fraction of participating

investors. Because of type sorting, as this fraction increases, the market average gains from trade decrease and so does the marginal investor (the one that clears the market) valuation. When the asset supply is not too large, the marginal investor's valuation decreases, and fragmentation can lower asset prices. The analysis, therefore, highlights situations where prices can be poor proxies for market liquidity. In general, I show that participation frictions can increase the price volatility of supply shocks. I collect stock market data and use the model to quantify the effect of speed-related and participation frictions on asset prices.

**Clearing.** A second recent evolution regards the post-trading infrastructure, i.e., clearing and settlement. In the aftermath of the GFC, a growing consensus has emerged on the fragility of bilateral clearing designs and the benefits of a central clearing counterparty (CCP). Both the Dodd-Frank Act in the US and the European Market Infrastructure Regulation (EMIR), for example, mandate the central clearing of broad classes of derivatives products. The arguments in favor of the macro benefits of a CCP usually relate to reducing the likelihood of crises and other infrequent tail risks. However, it is less clear what the micro consequences are for the stability of asset prices at frequencies such as a day or a month more closely related to investors' decision horizon.

In "[Does Central Clearing Affect Price Stability? Evidence from Nordic Equity Markets](#)" (with Menkveld and Zoican), we aim to provide causal evidence of the effects of the introduction of a CCP on price stability. For that, we adopt as an experimental construct the 2009 clearing reform in three Nordic equity markets. We find that the daily price volatility of the affected equities experiences an economically significant decline of 8.8% relative to pre-reform levels. The decrease in volatility is more pronounced for stocks with a higher margin cost impact, consistent with dynamic asset pricing models' predictions. We also find that the reform induces a sharp decline of 9.8% in trade volume but no deterioration in market quality as captured by trading costs and information measures. Overall, our results suggest that the adoption of central clearing enhances price stability.

**What lies ahead?** There are further important issues that I would like to investigate next. In "[Secondary Market Frictions and Primary Financing Costs](#)," (solo-authored), I am currently investigating the connections between market frictions in secondary markets and firms' financing costs in primary markets. For that, I enlarge the endogenous market structure framework I have developed with an asset issuance stage (the corporate finance stage). This allows evaluating whether, as suggested by many, the current market design in secondary markets is responsible for the lack of IPOs and other equity issuance forms. I am also interested in further investigating the determinants of the transition of asset trading from over-the-counter to centralized exchange venues.

## 2 Privately Informed Trading: Strategies, Identification, and Regulation

**The empirical identification of informed traders.** Asymmetric information is ubiquitous in financial markets, because investors have unequal knowledge of firms' fundamentals. Economists widely accept that the presence of informed agents affects outcomes such as capital formation, efficiency, and welfare. Despite this strong consensus, the empirical testing of such links poses formidable identification challenges, since information sets are virtually never observable. Therefore, most tests rely on asymmetric information proxies under the assumption that these proxies bear a systematic relation with the unobserved presence of informed traders. Common examples of model-based proxies include bid-ask spreads (Glosten Milgrom tradition), trade price impact (Kyle tradition), and order imbalances (Easley O'Hara PIN tradition). Naturally, the interpretation of results suffers from the joint hypothesis problem.

In “[Chasing Private Information](#)” (with Kacperczyk), we address this identification challenge by building a unique hand-collected sample of over 450 insider trading investigations by the U.S. SEC and DoJ that document in detail how certain individuals trade on nonpublic and material information. We characterize over 5,000 such unique trades in 615 firms spanning two decades. Our first result is that AIPs largely display abnormal behavior on days with informed trading. Moreover, AIPs exhibit stronger reactions on days with a large proportion of informed trades. Second, AIPs that originate in option markets are valuable. Relative to stock-based AIPs, these AIPs tend to be more sensitive to the presence of informed traders. Third, across stock and option markets, we observe consistent patterns in the direction of market response: volatility and abnormal volume increase, whereas, contrary to conventional wisdom, illiquidity levels decrease. For example, bid-ask spread decreases by about 10% in stock markets and by 20% in option markets when informed traders are present. We provide empirical evidence and model simulation results supporting three explanations for the puzzling relation between informed trading and illiquidity: the timing of trades, the use of limit orders, and the multivariate learning process of the market makers.

**The deterring power of insider trading regulations and market efficiency.** The debate on whether and under what circumstances insider trading should be illegal has a long tradition. Arguably, no issue in securities law has garnered more attention from legal and economics scholars and the public alike. The dominant view that promotes enforcement actions highlights their potential to reduce firms' costs of capital and to increase investment and welfare. Such potential benefits provide a rationale for the social investment of significant monetary and human resources in the battle against this activity; ignoring the judicial branch and the Department of Justice, the SEC Division of Enforcement alone employs over 1,300 skilled individuals and received federal resources of over \$4.6 billion in the last decade. Ultimately, since regulators cannot stop insiders in real time, whether that social investment can be justified depends on its deterring power.

Instead of taking such deterring effects for granted, in “[Becker Meets Kyle: Legal Risk and Insider Trading](#)” (with Kacperczyk), we address the critical question of whether illegal insiders internalize legal risk. Using hand-collected data from SEC investigations and exploiting two plausibly exogenous shocks to expected penalties, we provide an affirmative answer. We show that insiders trade less aggressively and earlier and concentrate on tips of greater value when facing higher risk. The results match the predictions of a model where we allow the insider to internalize the impact of trades on prices and the likelihood of prosecution and where the insider anticipates penalties in proportion to trade profits. Our findings lend support to the effectiveness of U.S. regulations’ deterrence and the long-standing hypothesis that insider trading enforcement can hamper price informativeness. More broadly, they support the existence of a *genuine* social trade-off regarding the optimality of insider trading laws: absent deterring effects, the burden of investigative and enforcement efforts would amount to a net social loss.

**Liquidity provision and information transmission in modern asset markets.** In modern markets working via electronic limit order books, all participants can act as liquidity providers and decide when to trade. These features are in contrast with traditional market microstructure analyses. In “[Information and Liquidity Trading at Optimal Frequencies](#)” (solo-authored), I develop a continuous-time model that captures these two salient features and where, notably, private information and agents are long-lived. I find that, in equilibrium, both informed and uninformed investors demand and supply liquidity simultaneously, following distinctive time-varying patterns previously found in experiments. As private information is reflected in prices, informed investors rely more heavily on liquidity provision, making limit order quotes relatively more informative near information announcements. Uninformed traders display an opposite pattern, supplying relatively less liquidity as information aggregates. I provide evidence from a proprietary NYSE data provides that supports such implied liquidity provision behavior. The model offers rich structural connections that one can use to evaluate adverse selection risk for uninformed participants.

### **What lies ahead?**

I am interested in developing empirical methods to better regulators’ detection of suspicious informed trade activity and portfolio managers’ real-time assessment of adverse selection risk. With that end, in “[Information Spillovers](#)” my co-author and I are combining proprietary databases on informed stock and options trades with tick-level commercial market data. I am also expanding on the links between law and informed trading by addressing regulators’ incentives more closely. In “[Regulators’ Incentives and the Prosecution of Insider Trading](#)” together with M. Kacperczyk and Natasha Sarin, we are interested in better understanding the consequences of one important Dodd-Frank Act feature that allows the SEC to seek civil penalties against non-regulated persons. Previously, the SEC could only launch administrative enforcement actions against those registered with the SEC. With that goal, we are currently building a more comprehensive insider trading

database that includes all administrative procedure actions, which number sharply increased since 2014. Overall, I believe that the investigation of informed traders' actions and regulating agencies' methods can offer unique perspectives on market performance and enhanced institutions.

### 3 Decentralized Finance: Bitcoin and other Digital Currencies

In the view of many, the bitcoin network is one of the most disruptive economic innovation in recent decades. Its rapid growth over the last ten years has sparked heated debates. The issue of bitcoin price determination and price volatility is particularly elusive. On the one hand, in investment and entrepreneurial circles, it is often argued that the price reflects fundamental factors such as the growth in the number of network participants and the quality of the underpinning technology. A prominent view in the academic and policy communities, on the other hand, is that bitcoins are just a bubble that will eventually burst and, therefore, bitcoin prices are meaningless. While there can be truth in both views, reaching a consensus is challenged by the fact that traditional monetary and asset pricing models were not designed around a decentralized network, such as Bitcoin, but a centralized network run by an institution such as a central bank, government, or a corporation.

In “[An Equilibrium Valuation of Bitcoin and Decentralized Network Assets](#)” (with Buraschi), we formalize the critical economic innovation in the system designed by Nakamoto as a noncooperative game among miners that seek to obtain block rewards. The demand side from the perspective of a utility token where users of the network can get a service flow and can benefit from the associated network effects. To the best of my knowledge, our equilibrium asset pricing analysis is the first in which prices affect miners incentives and, at the same time, mining activity influence valuations. Among many valuable insights, we find that the embedded miners' incentive mechanism generates excess price volatility for bitcoin.

In “[Decentralizing Money: Bitcoin Prices and Blockchain Security](#)” (solo authored), I study the general equilibrium of an economy where bitcoins act as a means of exchange (intrinsically useless money). In the model, users forecast the transactional and resale value of holdings, pricing the risk of malicious systemic attacks. Miners contribute resources to protect against attackers, competing for block rewards. I show that Bitcoin's design leads to multiple equilibria. In contrast to conventional wisdom, arguing that blockchains yield secure ledgers, I show that the same technology and fundamentals are consistent with sharply different price and security levels. I also characterize optimal monetary policies and show that Bitcoin's protocol-driven policy can lead to welfare losses and deviations from quantity theory. Regarding price fluctuations, I find that Bitcoin's security model embeds the amplification of price volatility: price–security feedback amplifies fundamental shocks' volatility impact and leads to boom–busts not driven by fundamentals. Finally, I characterize how Bitcoin's viability versus fiat currency depends on relative acceptability and inflation protection.

**What lies ahead?** I envision that the new area of decentralized financial/payment networks will be one of the most exciting and fertile grounds for finance and interdisciplinary research in the

coming years. I briefly comment on two work-in-progress projects in which I am collaborating with other leaders in this field. In “[Bitcoin versus Central Bank Digital Currencies](#)” (with Guillaume Rocheteau), we develop a currency competition model featuring a central bank and bitcoin. Our approach recognizes that, first, fiat currency and bitcoin and cryptocurrencies are not perfect substitutes, and second, the central bank does not behave as a passive observer: survival against the decentralized competitor can become a policy objective. Together with Jiasun Li, we are working on the critical issue of bitcoin scalability for commerce. In “[Scaling Blockchains Through Lightning](#),” we develop a model for bitcoins’ second layer, the Lightning network, which allows for off-chain reliable transactions with short delays periodic on-chain netting.

## 4 Academic and Broad Impact

My research work is regularly presented at prestigious academic conferences in economics and finance, as well as in policy making institutions and industry forums. I include a selected list by research area in the table below.

TABLE 2  
Selected Presentations and Distinctions

Research Area	Refereed Academic Conferences	Policy institutions	Industry	Distinctions
The infrastructure and industrial organization of financial markets:	<ul style="list-style-type: none"> <li>* Western Finance Association</li> <li>* American Economic Association</li> <li>* American Financial Association</li> <li>* Finance Theory Group</li> <li>* SFS Cavalcade</li> <li>* NYU Stern Microstructure (prev. NBER microstructure)</li> <li>* Econometric Society</li> <li>* Cowles Foundation</li> </ul>	<ul style="list-style-type: none"> <li>* Bank of England</li> <li>* Federal Reserve Bank of New York</li> <li>* Federal Reserve Bank of Philadelphia</li> <li>* Federal Reserve Bank of Chicago</li> </ul>	<ul style="list-style-type: none"> <li>* Chicago Quantitative Analysis/Society of Quantitative Analysis</li> <li>* Euronext Hedge Fund Conf.</li> <li>* Brevan Howard conf. HFT</li> </ul>	<ul style="list-style-type: none"> <li>* Grant from the Smith Richardson Foundation</li> <li>* CQA/SQA Annual academic speaker</li> <li>* Publication request for special issue on Fragmentation, Rev. of Econ. Dynamics</li> </ul>
Privately informed trading in modern asset markets: strategies, identification, regulation	<ul style="list-style-type: none"> <li>* American Financial Association</li> <li>* Western Finance Association</li> <li>* European Financial Association</li> <li>* NBER Asset Pricing</li> <li>* NBER Long-Term Asset Mgmt</li> <li>* NBER Economics of Crime</li> <li>* CEPR Conf.</li> <li>* FIRS Conf.</li> <li>* SFS Cavalcade</li> <li>* UNC Asset Pricing</li> </ul>	<ul style="list-style-type: none"> <li>* Federal Reserve Board of Gov.</li> <li>* Financial Conduct Authority</li> </ul>	<ul style="list-style-type: none"> <li>* AQR Hedge Fund</li> <li>* SAC Capital Hedge Fund</li> <li>* Buyside Liquidity Conf.</li> <li>* The World Federation of Exchanges</li> </ul>	<ul style="list-style-type: none"> <li>* QSRI award to organize “Frictions in Finance: Theory and Evidence”</li> </ul>
Decentralized payment systems, permissioned/less blockchains	<ul style="list-style-type: none"> <li>* NBER Asset Pricing</li> <li>* American Economic Association (2019, 2010)</li> <li>* Western Finance Association</li> <li>* American Financial Association</li> <li>* European Financial Association</li> <li>* Finance Theory Group</li> <li>* FIRS Conf.</li> <li>* Finance Theory Group</li> <li>* Toronto Fintech Conference</li> <li>* Nova SBE Fintech Conference</li> </ul>	<ul style="list-style-type: none"> <li>* Bank of Canada</li> <li>* Central Bank Research Association</li> </ul>	<ul style="list-style-type: none"> <li>* Bloomberg Annual Crypto Summit</li> <li>* Blockchain Economic Forum at Davos and London</li> </ul>	<ul style="list-style-type: none"> <li>* Best Crypto Economics Paper Award, Toronto Fintech Conference</li> <li>* Featured by Bloomberg as the first bitcoin valuation framework</li> <li>* #1 paper on SSRN, April 2018</li> </ul>