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FIELD GRAND CHALLENGE
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A Blockchain Grand Challenge: Smart Financial Derivatives

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Blockchain and distributed ledger technology (DLT) research encompasses use cases ranging from social innovation to banking, and technical developments ranging from cryptography to semantics of legal text. Research in both academia and industry is highly interdisciplinary across domains such as computer science, linguistics, law, cryptography, banking, economics, and social sciences. The growing complexity of blockchain science and use cases, coupled with the interdisciplinary nature of the research, poses new challenges to our community.

Research publication plays a key role in supporting this highly interdisciplinary work: supporting the need for rapid and reliable dissemination of preliminary and final results, and the need for longevity of results beyond the end of financial or management support for a research project. Industry teams rarely have subscriptions to academic journals, and an open access journal adds substantial value in supporting the research community.

The field is young, with many research challenges to be addressed. One "grand challenge" for our research community is the implementation of high-value, long-lived, financial derivatives transactions running as smart contracts on DLT ("smart financial derivatives"). This is currently being explored by academia, banking practitioners, trade associations and technology vendors, and is driving research across a wide range of research groups, each focusing on a different aspect. What makes this a "grand" challenge is the need for a large number of diverse research problems to be solved simultaneously. The following outlines a few of the major research questions being investigated: some of these are general research problems that affect blockchain/DLT development broadly, whereas others are very specific to financial derivatives, but all of these aspects must be solved, and their solutions combined effectively, to provide efficient and resilient solutions to the grand challenge.

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PRIVACY

What are the drivers of privacy requirements for wholesale banking, and how viable are privacy guarantees, whether based in cryptography, information theory, or other science (De Filippi, 2016; Halpin and Piekarska, 2017)? What are the tradeoffs between ensuring data privacy and increasing

integrity and resilience? Privacy is of course a generic issue of interest to very many blockchain/DLT systems; however, wholesale banking is subject to additional regulatory constraints on data holding, data processing, and data privacy.

INTER-CHAIN TRANSACTIONS

There might initially be a separate DLT/blockchain for each country to support domestic derivatives transactions. To support cross-border transactions, how could members of one such chain link across to trade with a member of a different chain? How would inter-chain communication and interoperability work and what issues arise (Hsu, 2017; Interledger, 2018)? This is a broad research problem with particular relevance for cross-border derivatives transactions, including for example how to minimize the use of rent-seeking intermediaries and how to ensure that counterparty risk is eliminated.

PAYMENTS

What issues arise with an effective DLT payments system that preserves privacy, provides settlement finality similar to central bank money, is fast and scalable, and integrates with legacy infrastructure (Mills et al., 2016)? Avoidance of double-spending is crucial to trust—what is the most effective and least expensive way to achieve this aim? Although on-chain payments are abroad research area, there are specific issues in a wholesale banking context that need to be addressed, such as the need for settlement in central bank money, regulatory constraints, compliance reporting, and liquidity saving mechanisms.

PLATFORM AND LONGEVITY

Smart contract code is created using different programming languages for different DLT platforms. This variety is likely to continue with many new developments—how can banks be insulated from variety and flux? The generic problem of standardization is particularly problematic for banks due to the very high governance load associated with technical changes and proliferation of technology platforms. Perhaps a common language for smart contract code on any platform? And what issues arise in deploying a platform that is guaranteed to function reliably for smart derivatives contracts that run for several decades? (Hanada et al., 2018)

SEMANTICS AND VALIDATION

Derivatives trades are defined by their underlying legal agreements, and the behavior of smart contract code must be verified and validated against the legal rights and obligations (Al Khalil et al., 2017; Magazzeni et al., 2017; Clack, 2018). Can formal methods be deployed to obtain and match the semantic descriptions of contract and code? Is it possible to "codify prose" (Hazard and Haapio, 2017), or to reimagine legal drafting to become more programmatic, with more straightforward semantics (Legalese, 2017)?

WORKFLOW

Each derivatives agreement is separately negotiated (typically based on industry templates), and testing validation and certification of smart contract code will be time consuming. Can a methodology of code templates be established to match the established workflow of legal agreement templates and to streamline the verification and validation process (Clack et al., 2016)?

PARTIAL AUTONOMY

Smart derivatives must not be entirely autonomous—they can run for many decades and changes in law might make their actions illegal. Code must be stoppable and modifiable, and at times human discretion must also be applied. How could "ask a human" states be best coded, and what issues arise? (Marino and Juels, 2016).

LEGACY INTEGRATION

Smart financial derivatives will be deployed incrementally, and DLT platforms must integrate with institutional legacy infrastructure. What issues arise in achieving this integration? Might the short-comings of the legacy systems stifle the benefits of the DLT platform?

COMMON DATA AND PROCESSES

To accrue the greatest benefit to banking, data and processes must be standardized across products in an extensible way (International Swaps and Derivatives Association, 2017). Would a virtual machine (VM) for derivatives processing facilitate a "plug and play" environment for DLT technology below the VM and business processes above the VM?

CONCLUSION

Progress will depend critically on interaction and communication between research groups and disciplines. Frontiers in Blockchain aspires to be the premier medium for blockchain and distributed ledger open-access publication and to foster a collaborative and open research spirit within which to address this and other grand challenges.

AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and has approved it for publication.

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