NETWORK ECONOMICS OF DECENTRALIZED DIGITAL PLATFORMS

Research proposal for a small grant in economics of digitization

Daniel Obermeier (TUM) *Hanna Halaburda (NYU Stern)*

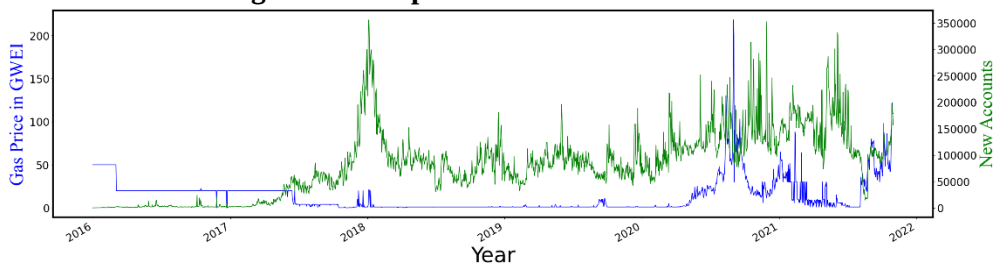
Relation between platforms and blockchains. In the 21st century, multisided platforms have risen to dominate the digital economy (Baye & Prince, 2020; Rietveld & Schilling, 2020). A crucial source for their prevalence is their ability to realize and benefit from network effects (Katz & Shapiro, 1985) which often lead to "winner-takes-it-all" dynamics and excessive market power for the platform provider (Cusumano, 2020). With blockchain technology, an alternative blueprint for such platforms has emerged that offers new sources for network effects without the requirement of a powerful platform intermediary. Blockchain-based platforms are also two-sided markets where users can interact with complements offered by other users in form of apps. Their difference to conventional platforms is that they do not need a platform intermediary to enforce and verify transactions as they rely on pre-defined, transparent, and immutable rules that are automatically enforced by "a clever mix of cryptography and economic incentives" (Catalini & Tucker, 2018: 1). These consensus rules ensure that transactions are only executed if the majority of the networked parties have verified and voted for the truthfulness of the transaction (Gans & Gandal, 2019). By design, blockchain platforms reduce the costs of verifying transactions (Catalini & Gans, 2020) and thus mitigate opportunistic behavior (Halaburda, Levina, & Min, 2019). Furthermore, blockchain platforms neither need to restrict access to their platform, collect personal information about their users, nor compromise their neutrality by censoring transactions. These properties are a powerful new source of network effects and an advantage over established platforms since, despite an existing demand for the above-mentioned features, established platforms (deliberately or not) fail to provide them (e.g., Prince & Wallsten, 2020; Rietveld, Ploog, & Nieborg, 2020). However, this potential source of network effects is opposed by a limited supply of transactions. Limiting the supply is necessary since blockchains are built on the principles of peer-to-peer communication and redundancy. This means that every transaction has to be verified, voted for, and stored by every network party and all parties have to be economically incentivized to comply with the rules of the protocol (Halaburda, Haeringer, Gans, & Gandal, 2020). Accordingly, all participants who want to conduct transactions or offer services on such a platform compete for the limited supply of transactions where only the highest biding transactions will be verified. This competition gets tougher with additional participants or complements entering the platform leading to negative network effects. For blockchain platforms, this implies that even though they have the potential to tap into new sources of positive network effects they simultaneously introduce negative network effects. A better understanding of this phenomenon is necessary to evaluate if blockchain platforms can take up the battle with prevailing centralized platforms.

Research questions. Our application to the NBER research grant is with a hope to support our empirical investigation of these competing dynamics, particularly the unprecedented competition for transactions. For our investigation, we follow prior work of scholars who have studied how platform design choices influence complement and user heterogeneity (e.g., Hagiu, 2009). Specifically, we are interested in the following two research questions: ***(1) How does the competition for transaction verification affect the usage of complements (dApps), and thus what categories of complements will be offered on a blockchain platform in the long run?*** Investigating this question is particularly interesting as there is a paucity of research on the drivers of the heterogeneity of complements even if past research has shown that the variety of products offered on a platform is decisive for participants to enter the platform (Rietveld & Schilling, 2020). ***(2) How does the competition for transaction verification influence user heterogeneity and thus the rise of a dominant platform?*** Understanding this question is interesting from an antitrust perspective because if competition for transaction verification on blockchain platforms constrains user heterogeneity, there will be more demand for diverse blockchain platforms which mitigates the risk of one monopolistic platform.

Data and preliminary insights. To investigate these research questions, we have started to compile a novel dataset. Our dataset is based on the Ethereum blockchain and comprises transaction-level data of all 1.3 billion transactions conducted on the platforms since it went live in 2016 (>736GB). We have chosen Ethereum since it is not only the second-largest blockchain network after Bitcoin, but it also allows users to deploy and run smart contracts: computer programs running on top of the blockchain (Gans, 2019) that can

be used by third-party providers to offer arbitrary platform complements in form of decentralized applications (dApps). For every transaction, our dataset contains, among other variables, information of sender/recipient, an exact timestamp, the value of the transaction, and how much transaction fees a user paid as an outcome of the first-price transaction fee auction. This data allows us to study individual transaction and transaction fee bidding behavior and thus to explore our second research question. We further have computed and added platform-level data such as the value of one Ether, the number of unique accounts transacting on the network, and variables such as the gas limit and the gas used on a given day which allows us to approximate the supply and demand of transactions. Figure 1 depicts the market price for one unit of gas and the count of new accounts on a given day.

Figure 1 - Gas price and new accounts over time



To investigate our first research question, we add off-chain data from a total of 1738 dApps. We collect this data by crawling different websites and matching this information (e.g., category of the dApp, market entry, market exit) with the addresses on which services are running on the blockchain. This step is important as transactions on a blockchain are pseudonymous which means that transactions can be traced but only become meaningful if they are augmented with further off-chain information. For example, without augmenting on-chain data with off-chain information, a direct money transfer from one to another user would be difficult to distinguish from a transaction with a dApp. Figure 2 depicts the count of daily transactions per dApp category where we find that increasing transaction activity in one category is associated with decreasing transaction activity in other categories. Figure 3 also suggests that the demand curves for dApp categories seem to differ significantly.

Figure 2 - Transaction count by category

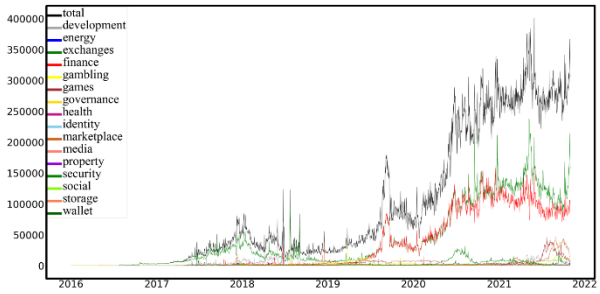
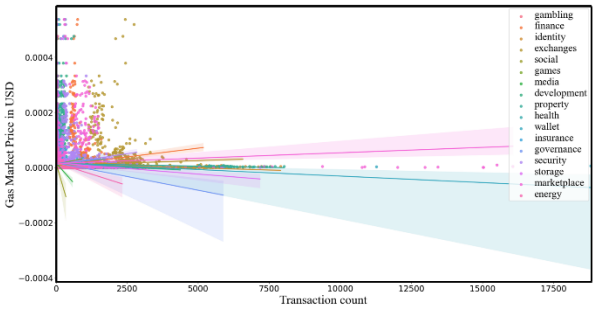


Figure 3 - Demand curve by category



Impact of the grant. With the support of the NBER research grant, we seek to improve our research in three crucial ways. First, the grant will help us to accelerate our progress. Particularly in the fast-developing blockchain environment speed matters since knowledge quickly becomes outdated and necessary policy interventions run the risk of not being implemented simply because the industry has moved on already. To this end, the research grant will not only help us to leverage powerful cloud computation services (such as Google Big Query which can query the whole Ethereum data set within minutes while a desktop computer would need days) but also to hire additional workforce that will accelerate our data collection. Speed in the data collection process is also important since some variables (e.g., pending transactions) are not archived and thus cannot be restored and collected in the future. Overall, we conjecture that this grant will speed up our project by 4-5 months. Second, the research grant will help us to collect more variables and more consistent data as it would allow us to purchase curated data from reliable sources. For example, the Etherscan.com Pro API provides us with further information on historical account balances or historical token supplies and the coinmarketcap.com API allows us to access reliable historical token and

cryptocurrency prices. Further, we could hire student assistants who could help us to identify additional variables such as important changes to the dApps in the past or if a dApp benefits from network effects itself. With the additional money, we could also hire MTurk workers who validate and refine the outcome of the current approach we use to match off-chain with on-chain data. This would allow us to match approximately an additional 20,000 smart contracts to dApps that our automated approach could not match with sufficient certainty. Omitting these contracts would lead to underestimating the real usage of dApps and thus would jeopardize the consistency of our data and all further analyses. Finally, the NBER research grant would help us to advertise and share our knowledge and data with researchers who are interested in blockchain platforms or in how platforms shape the digital economy in general but lack the technical knowledge to build their own data set from scratch. Therefore, we want to present our work at different conferences (NBER summer institute, WISE, and CIST) to specifically provide as many digitization economists as possible with a suitable entry point for their own research.

Timeline. To leverage synergies, we will conduct the data collection for both research questions simultaneously but to achieve our ambition to finish the first paper by the end of 2022, we will work conceptually on the second question only to the extent required by the data collection and focus on research question one first. Specifically, we plan to finish the data collection process in April, complete our data analysis in June, and finalize the first draft of our manuscript by the end of July to be able to discuss our findings and collect feedback at conferences and workshops. After this project, we will focus on the second research question. If no further data is required, we plan to finish our analysis in February 2023 and a first draft of the paper in April. Beyond these two projects, our data set opens also more general avenues for research. For example, our data would also allow investigating phenomena such as multihoming or long-term bidding behavior in auctions which is typically difficult to study due to the sparsity of long-term auction data. However, we will address such questions only after the first two projects have been completed.

Summary of contribution. We seek to make the following three contributions with our research project: First, by studying a new type of competition—the competition to get a transaction verified—on a platform we extent our theoretical understanding of platform design choices and their implications. Second, we contribute to a better understanding of the potential of blockchain platforms as an alternative to established centralized platform blueprints. Finally, we create and showcase the use of a novel data set which hopefully inspires and empowers other researchers to do join our work and create more empirical work that helps provide useful advice to policymakers to navigate and improve the digital economy.

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Halaburda, H., Levina, N., & Min, S. 2019. Understanding Smart Contracts as a New Option in Transaction Cost Economics. ***ICIS***.

Katz, M. L., & Shapiro, C. 1985. Network Externalities, Competition, and Compatibility. ***AER***, (75): 424–440.

Prince, J., & Wallsten, S. 2020. How Much is Privacy Worth Around the World and Across Platforms? ***SSRN***.

Rietveld, J., Ploog, J. N., & Nieborg, D. B. 2020. The Coevolution of Platform Dominance and Governance Strategies: Effects on Complementor Performance Outcomes. ***AMD***, (6): 1–45.

Rietveld, J., & Schilling, M. 2020. Platform Competition: A Systematic and Interdisciplinary Review of the Literature. ***JOM***: (in press).

Hanna Halaburda

hhalaburda@gmail.com
www.halaburda.ca
December 2021

Affiliation

2019–present	New York University, Stern School of Business *Associate Professor of Technology, Operations and Statistics* courtesy affiliation with *Economics*
2015–2019	New York University, Stern School of Business *Visiting Professor*
2012–2019	Bank of Canada *Senior Economist*
2007–2012	Harvard Business School *Assistant Professor of Business Administration*

Education

2007	PhD, Economics, Northwestern University
2001	M.A., Economics, Warsaw School of Economics
2001	M.A., Philosophy, Warsaw University

Published Papers

"The Microeconomics of Cryptocurrencies," with Guillaume Haerringer, Joshua Gans and Neil Gandal, *Journal of Economic Literature*, forthcoming

"Informational Challenges in Omnichannel Marketing: Remedies and Future Research," with Tony Haitao Cui, Anindya Ghose, Raghuram Iyengar, Koen Pauwels, S. Sriram, Catherine Tucker and Sriramanwith Venkataraman, *Journal of Marketing* 85, no. 1 (2021): 103–120

"When Permissioned Blockchains Deliver More Decentralization Than Permissionless," with Christoph Mueller-Bloch, *Communications of ACM* 64 (February 2021): 20–22

"Platform Competition with Multi-homing on Both Sides: Subsidize or Not?," with Yannis Bakos, *Management Science* 66, no. 12 (2020): 5599–5607

"Dynamic Competition with Network Externalities: Why History Matters," with Bruno Jullien and Yaron Yehezkel, *RAND Journal of Economics*, 51 (2020): 3-31

"Were Jews in Interwar Poland More Educated?" with Ran Abramitzky, *Journal of Demographic Economics* 86 , Special Issue 3: The Economics of Religion (September 2020): 291–304

"Focality Advantage in Platform Competition," with Yaron Yehezkel, *Journal of Economics & Management Strategy* 28 (2019): 49–59

"Blockchain Revolution without the Blockchain," *Communications of the ACM* 61 (July 2018): 27–29

"Competing by Restricting Choice: The Case of Search Platforms," with Mikolaj Jan Piskorski and Pinar Yildirim, *Management Science* 64 (2018): 3574–3594

"Digital Currencies: Beyond Bitcoin," *Communications & Strategies* 103 (2016): 77–92

"Can We Predict the Winner in a Market with Network Effects? Competition in the Cryptocurrency Market," with Neil Gandal, *GAMES* 7 (2016): 16–36

"Monotone Strategyproofness," with Guillaume Haeringer, *Games and Economic Behavior* 98 (2016): 68–77

"The Role of Coordination Bias in Platform Competition," with Yaron Yehezkel, *Journal of Economics & Management Strategy* 25, no. 2 (2016): 274–312

"Information and Two-Sided Platform Profits," with Andrei Hagiu, *International Journal of Industrial Organization* 34 (May 2014): 25–35

"The Limits of Scale: Companies That Get Big Fast Are Often Left Behind," with Felix Oberholzer-Gee, *Harvard Business Review* 92, no. 4 (April 2014): 95-99

"When Does a Platform Create Value by Limiting Choice?" with Ramon Casadesus-Masanell, *Journal of Economics & Management Strategy* 23, no. 2 (2014): 258–292

"Platform Competition under Asymmetric Information," with Yaron Yehezkel, *American Economic Journal: Microeconomics* 5, no. 3 (2013): 22–68

"When Smaller Menus are Better: Variability in Menu-Setting Ability," with David Goldreich, *Management Science* 59, no. 11 (2013): 2518–2535

"Unraveling in Two-Sided Matching Markets and Similarity of Preferences," *Games and Economic Behavior* 69, no. 2 (2010): 365–393

Books

Beyond Bitcoin: The Economics of Digital Currencies, with Miklos Sarvary, Palgrave Macmillan 2015

Beyond Bitcoin: The Economics of Digital Currencies and Blockchain Technologies, 2nd ed, with Miklos Sarvary and Guillaume Haeringer, Palgrave Macmillan 2021 (available at ssrn)

Book Chapters

"Some Economics of Private Digital Currency," with Joshua Gans, in *Economic Analysis of the Digital Economy*, A. Goldfarb, S. Greenstein and C. Tucker (eds), The University of Chicago Press, 2015

"Bitcoin: A Revolution?," with Guillaume Haeringer, in *Digital Economy*, J. Ganuza and G. Llobet (eds), 2018

Other Publications

"Toward a Multidimensional Conceptualization of Decentralization in Blockchain Governance: Commentary on "Two Sides of The Same Coin? Decentralized Versus Proprietary Blockchains and the Performance of Digital Currencies" by Cennamo, Marchesi, and Meyer," with Christoph Mueller-Bloch, *Academy of Management Discoveries*, 2020, Vol. 6, No. 4, 713–714

"Understanding Smart Contracts as a New Concept in Transaction Cost Economics," with Natalia Levina and Semi Min, Proceedings of the 40th International Conference on Information Systems, Munich, Germany, December 2019

"Will We Realize Blockchain's Promise of Decentralization?," with Christoph Mueller-Bloch, *Harvard Business Review*, September 2019

"Central Bank Digital Currencies: A Framework for Assessing Why and How," with Ben Fung, *Bank of Canada Staff Discussion Paper* 2016-22

"Understanding Platform-Based Digital Currencies," with Ben Fung, *Bank of Canada Review*, Spring 2014: 12–20

"When Should a Platform Give People Fewer Choices and Charge More for Them?" with Mikolaj Jan Piskorski, *The CPI Antitrust Journal* 6, no. 2 (fall 2010): 2010–2011

Working Papers

"An Economic Model of Consensus of Distributed Ledgers," with Zhiguo He and Jiasun Li, NBER working paper, November 2021

"Tradeoffs in Permissioned vs Permissionless Blockchains: Trust and Performance," with Yannis Bakos, NYU working paper, November 2021

"Blockchains, Smart Contracts and Connected Sensors: Substitutes or Complements?" with Yannis Bakos, NYU working paper, September 2021

"Funding New Ventures with Digital Tokens: Due Diligence and Token Tradability," with Yannis Bakos, NYU working paper, January 2019

"The Role of Cryptographic Tokens and ICOs in Fostering Platform Adoption," with Yannis Bakos,

NYU working paper, July 2018

"The Unfairness Trap: A Key Missing Factor in the Economic Theory of Discrimination," with Jordan Siegel and Naomi Kodama, HBS working paper, March 2013

Refereeing

The American Economic Review, Quarterly Journal of Economics, Journal of Political Economy, Management Science, The RAND Journal of Economics, Information Systems Research, Journal of Economics and Management Strategy, Journal of Economic Theory, Games and Economic Behavior, International Journal of Industrial Organization, Journal of Industrial Economics, Review of Financial Studies, Journal of Financial Stability

Editorial Functions

2018–present	*Management Science*, Associate Editor
2018–2020	*JEMS*, Co-Editor
2017–2020	ICIS, Associate Editor
2017–2020	Toronto Fintech Conference, Program Committee
2019–2020	Tokenomics (Paris & Toulouse), Program Committee
2019–2020	ACM Conference on Economics and Computation, Program Committee
2020	Cornell Fintech Conference, Program Committee
2020	NY Fed Fintech Conference, Program Committee
2021	Tokenomics (NYU), Organizer, Chair of Economics Program Committee
2022	ACM Conference on Economics and Computation, Area Editor for Blockchain

Grants and Awards

2021	U Penn Economics of Digital Services grant
2019	The Networks, Electronic Commerce and Telecommunications (NET) Institute grant
2010–2015	The Networks, Electronic Commerce and Telecommunications (NET) Institute grants
2011	Bergman Memorial Research Award
2011	US-Israeli Binational Science Foundation grant

Teaching Experience

2021	Blockchain and Cryptocurrencies: Technical and Strategic Perspective
2019 – 2021	Foundations of Fintech at NYU-Stern
2016	Game Theory (MBA and Undergraduate) at NYU-Stern
2015	Strategy at INE PAN
2014	Business Economics, Executive MBA, Queen's University at Kingston
2011–2012	Competing through Business Models (MBA elective course) at HBS
2008–2010	Strategy (MBA required course) at HBS

Curriculum Vitae - Daniel Obermeier

Contact Info

Technical University of Munich
Dr. Theo Schöller Chair of Technology and Innovation Management
Arcisstrasse 21
80333 Munich, Germany

Citizenship: German
Phone: +49 89 289 257 45
Mail: daniel.obermeier@tum.de

Education

Since 10/2017	PhD Candidate in Technology and Innovation Management, TUM School of Management Advisor: Joachim Henkel
09/2021 – 12/2021	Visiting PhD Student at New York University, Department of Technology, Operations Management, and Statistics, Host: Hanna Halaburda
01/2021 – 06/2021	Visiting PhD Student at the Chair of Technology and Innovation Management, ETH Zürich, Host: Stefano Brusoni
09/2014 – 03/2017	M.Sc. Management and Technology, TUM School of Management
09/2011 – 07/2014	B.Sc. Management and Technology, TUM School of Management

PhD Committee

Prof. Joachim Henkel, Technical University of Munich
Prof. Aija Leiponen, Cornell University
Prof. Jean-Philippe Vergne, University College London

Research Interests

Blockchain. Smart Contracts, Artificial Intelligence, Digitalization

Research Projects

Working Paper	Smart contracts on a blockchain: Transaction governance with the potential of deductive certainty (with Joachim Henkel) – under review at Organization Science
Work in Progress	A Market for Transactions and its Implications for Blockchain Technology (with Hanna Halaburda)
Work in Progress	Trust formation in decentralized applications: A smart contract-based survey

Work Experience

Since 10/2017	**Research Assistant, Technical University of Munich,** Munich
	Schöller Chair of Technology and Innovation Management
08/2015 – 03/2017	**President, 180 Degrees Consulting Munich e.V.**, Munich
05/2016 – 03/2017	**Project Lead, timetech.io UG**, Stuttgart
02/2014 – 12/2015	**Co-Founder, Vigalux – Smart Home Lighting**, Munich

Awards & Grants

SMS 2020 nominated for PhD Conference Paper Prize, 2020
Academy of Management Best Paper Proceedings, 2020
TUM Research Excellence Program, since 2019
Blockchain Research Accelerator Program, 2018
Winner of the THINK.MAKE.START price in the category "best startup potential", 2016
Participant at Google Launchpad Munich, Startup Bootcamp. 2015
Munich Leading Entrepreneurs, LMU Entrepreneurship Center Lap, Class of 2015
"The best 50 startups worldwide", Founder.org class of 2015

Publications / Conferences Contributions

Weiss, Obermeier (2021) "How Blockchain Can Enhance Trust and Transparency of Online Surveys". ICIS 2021 Proceedings. 7.https://aisel.aisnet.org/icis2021/fintech/fintech/7

Tietze, Theye, Obermeier. and Di Francesco Maesa: Introducing the Bill of IP, a novel concept for the digital IP management applied to a DLT-based smart licensing system, R&D Management Conference, July 2021, Glasgow

Obermeier, Henkel, Provable Transactions: Exploring the Boundaries of Trust in Smart Contracts on Blockchains, Strategic Management Society, October 24-27, London, 2020 (held online)

Obermeier, Henkel, Provable Transactions: Exploring the Boundaries of Trust in Smart Contracts on Blockchains, Academy of Management Conference, August 9-11, Vancouver, Canada, 2020 (held online)

Bakos, Forman, Halaburda, Henkel, Leiponen, Obermeier, Thomas, The Trust Machine? The Promise of Blockchain-based Algorithmic Governance of Exchange, Academy of Management Conference, August 9-13, Boston, Massachusetts, 2019

Selected PhD Courses

Technical Foundations of Information Systems, NYU Stern School of Business, Prof. Tuzhilin

Deep Learning DS-GA1008, NYU Center for Data Science, Prof. Yann LeCun & Alfredo Canziani

Paper Design Workshop, TUM School of Management, Prof. Alexy

8th SKEMA KTO Paper Development Workshop, SKEMA Business School, Prof. Dibiaggio, Prof. Ahuja, Prof. Cattani, Prof. Lamaanen, Prof. Tzabbar, Prof. Castellaneta, Prof. Kretschmer, Prof. Frederiksen

How to Deliver a Good Peer Review Workshop, LMU, Prof. Barczak, Prof. Griffin

Economics of Innovation and Technological Change, TUM School of Management, Prof. Bekkers, Prof. Li-Ying, Prof. Henkel, Prof. Pfotenhauer, Prof. de Rassenfosse, Prof. Hottenrott, Prof. Gaule

Advanced Econometrics, TUM School of Management, Prof. Henkel

Introduction to Applied Econometrics, TUM School of Management, Prof. Hottenrott

Introduction to Management Research, TUM School of Management, Prof. Schweißfurth

Teaching Experience

Certified Blockchain and DLT Manager Program, TUM Executive Education Center WT2019 - WT2021

Current Issues in Technology Management (M.Sc.), Adv. Seminar, TUM School of Management, WT 2018

Lead User Project (M.Sc.), Seminar, TUM School of Management, WT 2019-ST2021

Technology and Innovation Management in Practice (M.Sc.), Case Study Seminar, TUM School of Management, ST 2018

Empirical Research in Management and Economics (M.Sc.), Tutorial, TUM School of Management, WT 2017

Supervision of M.Sc./B.Sc. Thesis: Management & Technology, TUM School of Management, since WT 2017

Community service

Organizer of the **TUM Workshop on Blockchains and Smart Contracts**: Collaboration in a Decentralized World, July 2021, held online

Supported the organization of the **Munich Summer Institute**, 2021, held online

Ad-hoc reviewer for **Organization Science**

Reviewer for **Academy of Management Annual Meeting** 2021 and 2020

Organizer of the **TUM Workshop on Trust, Blockchains, and Smart Contracts**:, July 2020, held online

Member of the **Association for Information Systems**, since 2021

Member of the **Strategic Management Society**, since 2020

Member of the **Academy of Management**, since 2019

BUDGET ESTIMATE - NBER SMALL GRANT
ECONOMICS OF DIGITIZATION

last update: January 2022

Investigator 1: Daniel Obermeier (Technical University of Munich)
Investigator 2: Hanna Halaburda (New York University)
Project Name: Network Economics of Decentralized Digital Platforms

Total Budget: $12,677

Project Periods		Q1	Q2	Q3	Q4	
	Start Date	03/01/2022	04/01/2022	07/01/2022	10/01/2022	
	End Date	03/31/2022	06/31/2022	09/31/2022	12/31/2022	
Item	**Quantity**					**Total Budget**
1. Data						
API access Coinmarket Cap ($79/month)	1	79.00	237.00	237.00	237.00	**790.00**
API access Etherscan ($199/month)	1	199.00	597.00	597.00	597.00	**1,990.00**
Total Data access costs		*278.00*	*834.00*	*834.00*	*834.00*	***2,780.00***
Google Big Query (on demand queries $5/1TB)	10 TB / month	50.00	150.00	150.00	150.00	**500.00**
Google Cloud Storage (0,026 $/GB and Month)	2 TB / month	52.00	156.00	156.00	156.00	**520.00**
Total data storage and handling costs		*102.00*	*306.00*	*306.00*	*306.00*	***1,020.00***
Total data related costs		***380.00***	***1,140.00***	***1,140.00***	***1,140.00***	***3,800.00***
2. Workforce						
Research assistant 1 (graduate hourly wage of $34.91)	20h/month	698.20	2,094.60	0.00	0.00	**2,792.80**
Research assistant 2 (undergrad hourly wage of $19.58)	20h/month	391.60	1,174.80	0.00	0.00	**1,566.40**
Amazon Mechanical Turk	$0.01/annotation + 20% Mtruk fee	720.00	720.00	0.00	0.00	**1,440.00**
Total research assistant costs		*1,809.80*	*3,989.40*	*0.00*	*0.00*	***5,799.20***
3. Travels						
NBER Summer Institute 2022 - Flight (if in person)	1	0.00	0.00	600.00	0.00	600.00
mmer Institute 2022 - Accomodation (if in person; $150/night)	6	0.00	0.00	900.00	0.00	900.00
Total Travel Costs Investigator 1		*0.00*	*0.00*	*1,500.00*	*0.00*	*1,500.00*
NBER Summer Institute 2022 - Train (if in person)	1	0.00	0.00	78.00	0.00	78.00
mmer Institute 2022 - Accomodation (in in person; $150/night)	6	0.00	0.00	900.00	0.00	900.00
Total Travel Costs Investigator 2		*0.00*	*0.00*	*978.00*	*0.00*	*978.00*
Total Travel Costs		***0.00***	***0.00***	***2,478.00***	***0.00***	***2,478.00***
4. Supplies and other expenses						
Publication costs (copy editing $60/h)	10h	0.00	0.00	0.00	600.00	600.00
Total supplies and other expenses		***0.00***	***0.00***	***0.00***	***600.00***	***600.00***
	Total costs	**$2,189.80**	**$5,129.40**	**$3,618.00**	**$1,740.00**	**$12,677.20**

Justification

Standard API access to Coinmarket API to get reliable historical token price data (https://coinmarketcap.com/api/pricing/). The selected API plan allows using the data commercially.
Only the Etherscan PRO API allows accessing important Ethereum Meta Data and historical account and token balances that can only be obtained through an archival node (https://etherscan.io/apis). The selected API plan allows to use the data commercially.

Google Big Query's on-demand query services allow to flexibly scale and thus to quickly query our 700GB of data across multiple tables stored on Google Big Query.
To keep costs at a minimum we preprocess as many data sets as possible in GBQ and only store final data sets which are too large to download to a local machine

We plan to hire two research assistants (one graduate and one undergraduate student) to be able to crosscheck their findings and to collect further variables. Wages are calculated according to the NYU rates for research assistants (grad RA. $26.75/h + 30.5% fringe, undergrad. RA $15/h + 30.5% fringe)

We plan to use Mturk for more simple, repetitive annotation tasks. Specifically, we will use MTurk to manually match 120,000 smart contracts to dApps. This task involves looking up the smart contract on Etherscan and trying to find the associated dApp in our database. We conjecture that approx. 15% of these smart contracts can be manually matched to dApps.

Source of flight price: kayak.com
Source of hotel price: booking.com (middle class hotel)

Source of price: amtrak.com
Source of hotel price: booking.com (middle class hotel)

As non-native speakers, a copy editor will be necessary to assure the linguistic quality of our final manuscript.