Expert's Commentary:
The Digital Currency Problem

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Introduction

We don't often consider how we pay one another, even as we use various payment systems built around different currencies to participate in the economy every day. The payment infrastructure—like any infrastructure—is something that we rely on deeply, but tend to notice only when something goes awry.

Payment systems are unevenly adopted, which we might suddenly notice when the restaurant where we've been eating at mentions that they don't accept credit cards. Even modern payment systems involve considerable friction, which we might notice when a transfer takes several days to reach our bank account. Currencies also fluctuate in value, as we might discover when a landlord decides to raise the rent. We tend to notice instances of fraud when a payment card issuer blocks use of our card.

While currency fluctuations and security concerns are an occasional nuisance to individuals, they are taken quite seriously at the national level. Banks and other payment processors report billions in fraudulent transactions every year, and identifying money laundering is a top concern for law enforcement agencies. Central banks tend to consider maintaining monetary stability to be their main role, although how they go about that varies from country to country.

But even at the national and global levels, currency issues rarely make the news unless there is a major problem. For instance, both the Zimbabwean dollar and the Venezuela bolívar have experienced hyperinflation in the 21st century. Fears of deflation in the Eurozone have affected both monetary policy by the European Central Bank and international relations among European countries for much of the last decade.

In recent years, on the other hand, payment infrastructure has come into the spotlight for another reason. In 2009, an entity calling themselves Satoshi Nakamoto issued a novel decentralized digital currency: Bitcoin. The source code underlying the set of decentralized cryptographic accounting protocols was also published, allowing others to set up their own system as well. The price of Bitcoin rose unsteadily in the years that followed, and alternative cryptocurrencies proliferated.

The idea of a universal decentralized digital currency captured the public imagination sometime in 2017, leading to large increases in the prices of many of the more established cryptocurrencies. While the bubble did burst, the idea itself may be here to stay. Bitcoin brought clear novelty to the staid world of payment infrastructure and revealed how much we do not yet understand about our monetary systems.

Formulation and Intent of the Problem

This year's ICM™ problem invited students to consider our global monetary system and model a particular change: introducing a universal, decentralized, digital currency. Teams were asked to identify the viability and effects of introducing such a global digital payment system. They were asked to submit a solution of no more than 20 pages, a summary, and a short policy recommendation for national leaders.

The details of the introduced currency, and how to model the system as a whole, were left up to the teams. Instead of any particular tasks, students were introduced to a range of aspects of the problem that they could consider: growth, access, security, and stability of this new digital currency. Teams were encouraged to take neither the current system of national currencies, nor a techno-optimistic future, for granted.

Solutions were evaluated based on the team's understanding of the problem, the soundness of their modeling approach, and to what extent their policy statements reflected their mathematical model.

Solving the Problem

What makes this problem difficult (and studying money so fascinating) is that there is no established model of monetary systems that considers individual, national, and global dynamics together. The adoption of new payment methods, the impact of digital currencies, international monetary policy, financial inclusion, and countering illicit financial activity are largely studied separately. Modeling the introduction of a new digital currency involves pulling several of these strands together.

As a triage judge and final judge, I was impressed by the ambition and variety in modeling approaches taken by teams. Some teams built

sophisticated models of the adoption of the currency by individuals, and other teams focused on the official recognition of the currency by nations. The most successful teams were able to define and model how the new policies would affect the economy. I was excited to see teams extend the Mundell-Fleming trilemma[1], which describes inherent limitations on monetary policy by central banks, to apply also to a global decentralized currency and inform their policy recommendations. I was even more excited to see sound approaches that I had not considered, such as defining currency choice as a matching process and calibrating its equilibrium using real-world data.

Participating teams took on a highly complex, interdisciplinary, and impactful modeling problem, with no right answer; and all who submitted a solution are to be commended. I hope this year's ICM participants learned as much from preparing their solutions to the problem as I did from reading and judging them.

Reference

Majaski, Christina. 2019. Trilemma definition. `https://www.investopedia.com/terms/t/trilemma.asp`.

About the Author

Carolina Mattsson is a Ph.D. candidate in Network Science at Northeastern University. She is an NSF Graduate Research Fellow using her dissertation to develop network analysis tools and modeling frameworks for payment systems. She works extensively with collaborators in industry to apply her methods towards improving mobile money systems. Carolina holds a B.S. in Physics and a B.A. in International Relations from Lehigh University.

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[1]An economy cannot simultaneously maintain a fixed exchange rate, free capital movement, and an independent monetary policy. See Majaski [2019]