COMPARISON OF CARBON FOOTPRINTS OF DIGITAL CURRENCY (BITCOIN) AND GOLD: DETERMINATION OF THE CRITICAL EXCHANGE RATE

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1st IAEE ONLINE CONFERENCE
JUNE 2021
OUTLINE

- Motivation
- Methodology
  - LCA
- Results and Implications
  - Carbon footprints of Bitcoin and gold production
  - Critical exchange rate
- Questions and Answers
Cryptocurrency market

Reference: https://doi.org/10.1016/j.physrep.2020.10.005
Why did we choose to study Bitcoin?

Cryptocurrency - Share in Global Trading Volume

- Bitcoin (BTC): 29.6%
- Tether (USDT): 15.6%
- Ethereum (ETH): 13.8%
- Other: 41.0%

Reference: https://bitrazzi.com/3-biggest-cryptocurrencies/
Concerns about Bitcoin’s environmental impact

The Graphic Truth

Crypto-mining sucks up lots of power

Electricity usage (TWh, annualized)

Global rank

24. Poland 153 TWh
25. Egypt 151
26. Malaysia 147
27. Sweden 132
28. Ukraine 129
29. Bitcoin 126
30. Argentina 125
31. Norway 124
32. Pakistan 121
33. UAE 119
34. Netherlands 111

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Source: Cambridge Bitcoin Electricity Consumption Index, EIA country data, 2019 est. (or most recent available year), CNBC/Digiconomist
Then Elon Musk further stirred things up…

Tesla & Bitcoin

Bitcoin. We are concerned about rapidly increasing use of fossil fuels for Bitcoin mining and transactions, especially coal, which has the worst emissions of any fuel.

Cryptocurrency is a good idea on many levels and we believe it has a promising future, but this cannot come at great cost to the environment.

Tesla will not be selling any Bitcoin and we intend to use it for transactions as soon as mining transitions to more sustainable energy. We are also looking at other cryptocurrencies that use <1% of Bitcoin's energy/transaction.
Not everyone thinks Bitcoin is impactful

Global annual consumption of power

- Bitcoin mining: 8.27 TWh
- Production of fiat currencies: 11 TWh
- Gold mining: 132 TWh

Reference: https://twitter.com/kuriharan/status/940239505914826752/photo/1
There is only one question really…. What is the functional unit?
How would you compare these two?
What is a ‘functional unit’?

- A functional unit is a quantified description of the function of a product that serves as the reference basis for all calculations regarding impact assessment.

- A function may be based on different features of the product under study, such as performance, aesthetics, technical quality, additional services, costs, etc.
So, what did we do then?

- There is only one function of digital currency: its purchasing value.

- Thus, we compared the environmental impacts of Bitcoin and gold per unit value ($) to see which one is more impactful.
Why not include printed currency?

When it comes to environmental impact,
LIFE CYCLE ASSESSMENT

• Life-cycle assessment or LCA (also known as life-cycle analysis) is a methodology for assessing environmental (and if desired, economic and social) impacts associated with all the stages of the life-cycle of a commercial product, process, or service.
• The following stages are usually taken into account:
  • Raw material acquisition
  • Production
  • Storage (if applicable)
  • Use (operation)
  • End-of-life-treatment
LIFE CYCLE ASSESSMENT

CCaLC Software
LIFE CYCLE ASSESSMENT

• We considered the following inputs:
  • Electronic components for Bitcoin mining
  • Electricity required for Bitcoin mining
  • Material and energy input for gold mining
  • Transportation of gold

• Four different locations were studied:
  • Turkey (where this paper was written)
  • Poland (relies heavily on coal)
  • Denmark (high share of renewables)
  • France (nuclear is by far the biggest energy source)
RESULTS – Comparison of locations

- Bitcoin mining in TR: 7,538 kg CO₂eq. of $1,000,000 worth of asset
- Bitcoin mining in PL: 15,447 kg CO₂eq. of $1,000,000 worth of asset
- Bitcoin mining in FR: 1,728 kg CO₂eq. of $1,000,000 worth of asset
- Bitcoin mining in DK: 8,103 kg CO₂eq. of $1,000,000 worth of asset
- Gold production via photovoltaic panels: 1,206 kg CO₂eq. of $1,000,000 worth of asset
- Gold production: 316 kg CO₂eq. of $1,000,000 worth of asset
RESULTS – Critical Exchange Rates

value ($) of Bitcoin so that gold and Bitcoin would have equal CF

<table>
<thead>
<tr>
<th>Country</th>
<th>Value ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TR</td>
<td>1,225,285</td>
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<tr>
<td>PL</td>
<td>2,510,726</td>
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<td>FR</td>
<td>280,834</td>
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<td>DK</td>
<td>1,317,102</td>
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<tr>
<td>Photovoltaic</td>
<td>195,982</td>
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</tbody>
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DISCUSSION

• Even if the entire energy for mining comes from photovoltaic panels, the value of a single Bitcoin should be around $196,000 so that gold and Bitcoin would have equal carbon footprints.

• The highest ever price of Bitcoin was around $60,000.

• Therefore, BITCOIN IS INDEED ENVIRONMENTALLY HAZARDOUS
WHAT TO DO ABOUT IT?

• Bitcoin transactions should be subject to a carbon tax.

OR

• Companies should stop accepting Bitcoin as a valid means of financial transaction.
How to improve this work?

- More locations could have been studied (lack of data)

- Quantifying the environmental impacts of gold mining only in terms of its carbon footprint might be interpreted as missing the big picture. The following impacts could have been taken into account:
  - land transformation as a result of deforestation due to mining activities
  - human toxicity potential due to the use of cyanide for leaching
  - photochemical smog formation due to the transportation of gold via internal combustion engine-powered means of transportation
• Thank you for listening!

• Any questions?