Karl Marx and the blockchain

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Thanks

Thanks for inviting me to speak.

This talk draws from a book chapter Karl Marx and the blockchain (fulltext) coauthored with Devraj Basu, and from an article in the Times Higher Education (permalink).

Map of the talk:

1. Marx in context: some dates.
2. What's a blockchain?
3. What was Karl Marx's commentary on capitalism?
4. What does blockchain look like, from the point of view of Marx's theories?
5. Historical context: why crypto hit a nerve.
6. The future.

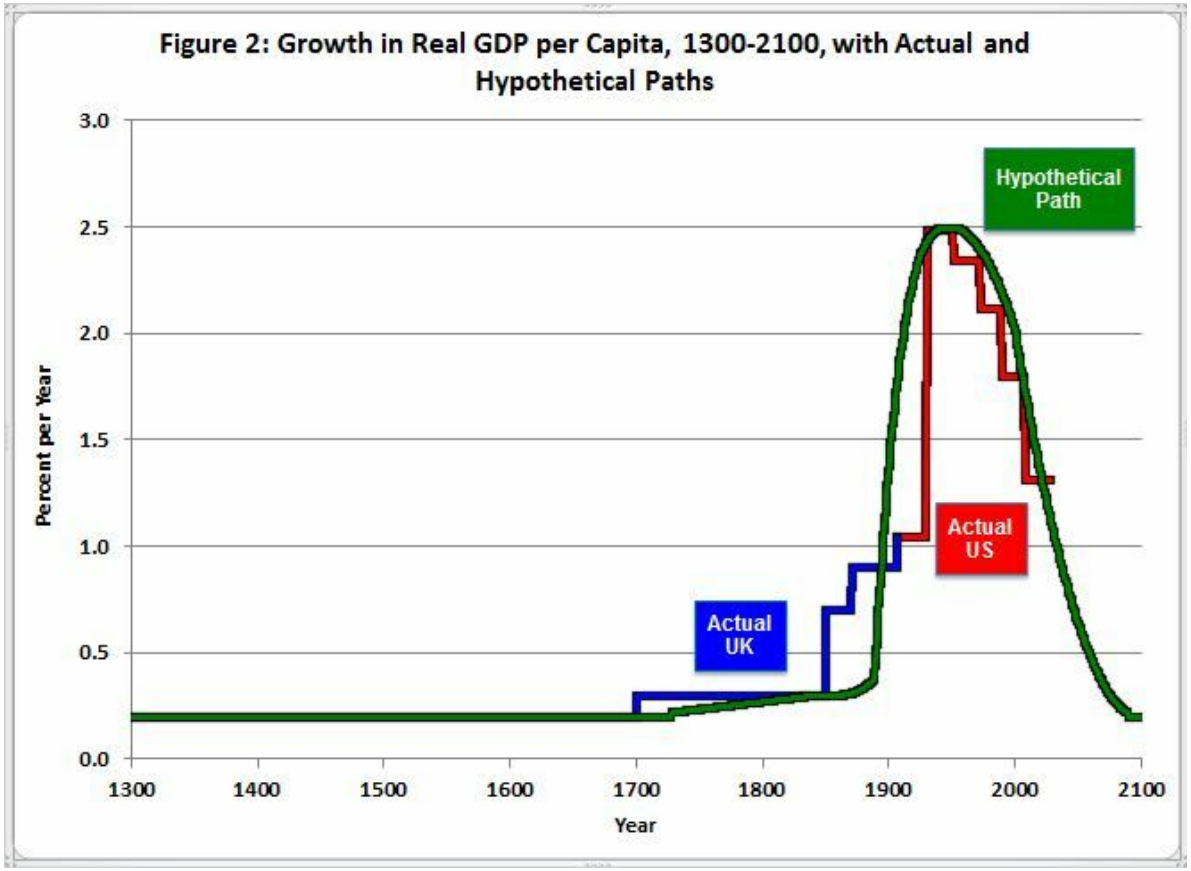
Marx in context: some dates

- 1867. Marx publishes Das Kapital. (In other news that year: *USA purchases Alaska from Russia!*)
- 1876. Graham Bell patents the telephone.
- 1879. Practical incandescent lightbulb invented.
- 1886. Benz patents the *Motorwagen* (see picture.)
- 1910. Mass production allows Ford to produce 1 Model T car (introduced 1908) every three minutes.

When Marx wrote his famous book, he was living in London, earning money as a freelance writer for the New York Tribune and other papers — i.e. doing gigs — and working in the reading room of the British Museum. There were no lightbulbs, telephones, cars, or mass production — and TV, internet, modern logic and CS, and blockchain were far, far in the future.

At the time, the wealthiest 10% owned 90% of the property in Britain. This was a very unequal society.

In the 1860s a massive surge in productivity growth was just getting started. In retrospect, what was coming is what we now know as the modern world.[1]



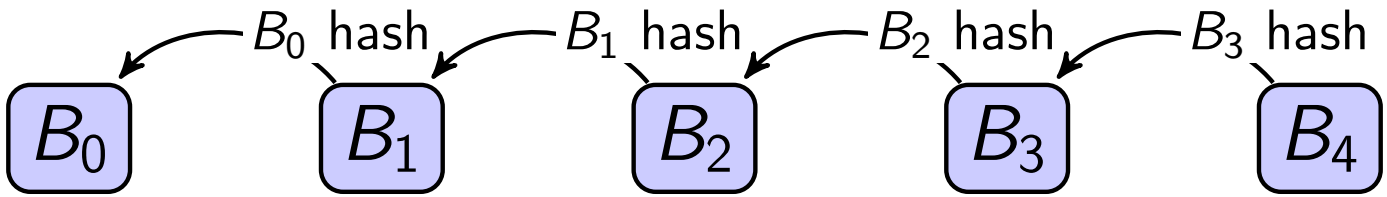
Context: steam power (1750–1830); ICE & electricity (1870–1900); computers (1970–present); distributed computing systems (1999–present), including blockchain (2008–present) ...

[1] (Image: Robert Gordon (w18315).)

Blockchain = hash trees + consensus + crypto

A blockchain is a distributed database in which each block B_{t+1} (i.e. a *state update*), is signed with a cryptographic hash of the preceding block B_t.

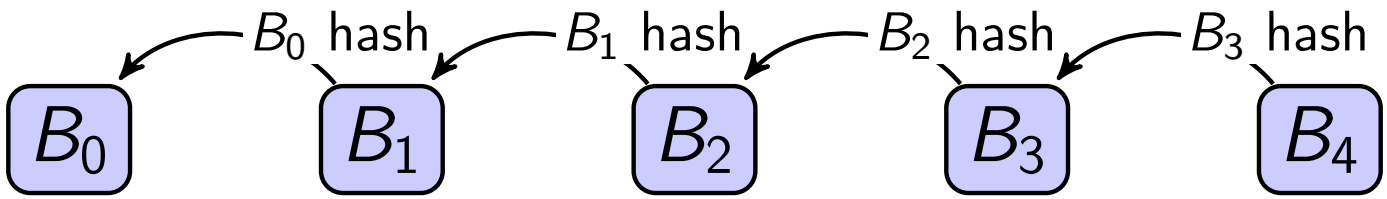
So: a *blockchain* is a block-chain in which each block, representing an update to the state of the database, cryptographically points to its predecessor:



This data structure is based on Merkle trees/hash trees (Wikipedia ref), which predate cryptocurrencies: e.g. git (introduced 2005, used in the production of these slides) uses hash trees to organise its commits (webpage; search for *tree objects*).

Blockchain = hash trees + consensus + crypto

A *blockchain* in the modern sense adds a distributed consensus protocol for adding blocks.



Say we're at block B_4 at time t=4. To progress the system, we create and agree on a suitable block B_5 as follows:

- Users propose transactions (e.g. *transfer n tokens from X to Y*) to a queue.
- Validators validate and parcel these up into candidates B_5, B_5', B_5'' at e.g. 1500 transactions per candidate.
- Validators then vote on which candidate B_5 to add.

Blockchain = hash trees + consensus + crypto

Making blockchain work in practice is a huge field (much of it researched here in Edinburgh). For this talk, let's focus on the transactions.

Transactions are likely secured by cryptographic keys, so that Validators will only validate transactions that are suitably cryptographically signed — think: each transaction on the blockchain is passworded, and you can only interact with it if you know that password.

This is how you can 'own' a Bitcoin: you — and only you — have a cryptographic secret associated to the asset's most recent transaction on the blockchain.

(If you mine a Bitcoin, it gets added in a transaction that you can sign with your own cryptographic secret.)

Blockchain = hash trees + consensus + crypto

This combination of hash trees + consensus + crypto, when applied to a store of value or means of exchange — a so-called *token* — means that:

- Ownership of capital is secured (at least in principle) by code and cryptography, not by a nation state.
- Production of capital is (at least in principle) democratised to all, without requiring a central bank.

This was a revolutionary idea. The designer(s) of Bitcoin certainly thought so.

To be fair, there was another *earlier* revolutionary idea of a similar type ...

Napster and peer-to-peer

Napster did for data, circa 1999–2002, what Bitcoin did for money, by showing that data could be stored and transmitted without requiring a central copyright-holding authority.

This was revolutionary.

Streaming services moved in to bury filesharing, or at least obscure it by offering a more convenient (commercial) alternative — but the technology was in place and the idea could not be un-learned, as Bitcoin then demonstrated.

(An aside: coding ethics)

Bitcoin, Napster, and many other software systems, have changed the world for better or for worse.

Coding is not a value-neutral activity! It is also not an economically neutral activity!

The code that we teach students to write *matters*. It matters to how we make a living. It matters to how we live.

We should teach ethics in Computer Science undergraduate courses. Perhaps some macroeconomics would be useful too. My students are universally ignorant of this, aside from issues of copyright & plagiarism (cue story of trading app student).

Some economics: factors of production

Factors of production are defined as inputs required for adding economic value by creating a good or service. For example:

- Labour.
  That's work, by workers: e.g. childcare, bricklaying, digging ditches, delivering parcels, preparing lectures and setting and marking coursework, etc.
- Capital.
  That's the assets that make work possible and productive: e.g. factories, offices, computers, mobile data infrastructure, lecture theatres, homes, money, etc.
- Further examples include land (e.g. for agriculture), and more: think of innovation, or data, or compute.

Factors of production

I would add to the definition of a factor of production that it should be 'clumpy'; display network effects, and self-organise into politically active oligopolies.

Contrast:

- Land (clumpy) vs. air (non-clumpy);
- Big Data (clumpy) vs. data (non-clumpy);
- Cloud Compute (clumpy) vs an in-house supercomputer (non-clumpy).

The 'big two' factors of production are: Labour and Capital.

Labour vs. Capital

Labour and Capital tend to stand in opposition:

1. Labour wants labour to be expensive and capital to be cheap (so that value accrues to workers).
2. Capital wants labour to be cheap and capital to be expensive (so value accrues to people who own stuff).

This tension needs to be creatively and constructively in balance, such that labour and capital both earn enough to prosper (e.g. people can raise families, and buildings can be built and maintained). Rule of thumb:

- if Labour has the upper hand then wages rise and asset prices stagnate;
- if Capital has the upper hand then asset prices rise and wages stagnate.

Marx's critique of capitalism from 1867

1. Capitalism rewards efficiency, including efficient use of labour.
2. Up to a point, increased labour productivity leads to better quality of life — but taken to its logical conclusion, labourers become redundant and the value of labour collapses.
3. If the value of an economic input like (say) bird guano collapses, that's not a big deal. But Labour is a special kind of economic input: it is made of *people*, and people are what gives all other assets value. If *people* lose economic value, then so does the capital required to support them.
4. The value of capital will then collapse, because the people that need it can't pay.
5. Capitalism implodes. Work doesn't pay, people can't earn a living, capital assets lose their value, investment stalls, government can't function because there's nothing to tax, and society collapses. (Sound familiar?)

Marx's critique of capitalism

Thus Marx predicted that capitalism will:

1. increase labour productivity,
2. destroy the value of labour,
3. destroy the value of capital,
4. and then implode.

Note that the argument here isn't that capitalism is evil and doesn't work.

The argument is much more penetrating: that capitalism *could* work — and that's a problem because it's logically inconsistent.

As a mathematician, I like this proof by contradiction.

Was Marx right?

Let's give Marx credit for being far-thinking: Das Kapital was published in 1867. This was at the very start of a huge realignment in the relationship between labour and capital.

Was he right that capitalism is inherently contradictory and must collapse?

Perhaps.

On the one hand, capitalism hasn't imploded in the 156 years 1867–2023, and we can be grateful for the material progress made in this time.

On the other hand, the system has certainly wobbled, and there is a case to answer here and we have no reason to be smug.

This matters to you, here and now

You'll know about the current strikes.

Think of all those medical professionals (and academics!) who aren't payed a living wage nowadays. That's capitalism in action: driving efficiency to a point beyond which the system defeats its own purpose and can no longer sustain the very workers without whom it cannot function.

I suspect that the nurses who vaccinated my family may have saved my wife's life, and perhaps mine too. Why can't we pay them? Why are we working them to burnout?

This seems consistent with Marx's warning. It will be interesting to see how it plays out in the coming months and years.

Historical context

Let's crudely divide the last century into three eras:

1. Era 1, 1945–1979: End of the Second World War to the elections of Margaret Thatcher (1979-1990) and Ronald Regan (1981-1989).
   I was born in the mid-70s: Era 1 was my parent's world.
2. Era 2, 1979–2008: From the Thatcher/Regan era and the corollary administrations which followed, through to the 2008 financial crisis.
   My childhood and young adulthood: a student born in the middle of Era 2 (the Berlin Wall fell in 1989) would have had time to graduate and apply for a job in time for 2008.
3. Era 3, 2008–today:
   This is the world that our current students know.

Historical context

Era 1 was the time of Labour. Labour was scarce and there was a lot of rebuilding to do. Wages rose, productivity increased. If you could work, you could make money and put food on the table. This seemed to hit a wall sometime around the late 70's.

Era 2 was the time of Capital. If you could own things (think: property), you could do well. This fell off a cliff in the 2007-2008 financial crisis. (Excellent and very watchable films on this topic include The Big Short and Margin Call.)

So it's 2008. The promise *"Work and prosper"* faltered; the promise *"Buy a house and prosper"* faltered. This was more than a financial crash: there was a smell of existential dread in the air, that we might (in Marx's terms) have reached that point where the system consumes itself. Where do we go from here?

Aside: academia

We can observe a generally parallel evolution in UK academia:

UK universities transitioned from skills-based institutions focussed on investing in research and education (cf. Era 1), to capital-based institutions focussed on investing in infrastructure — often on borrowed money! — to maximise student numbers & fee income. 'Efficencies' were 'gained' by stagnating wages, shedding pension liabilities, and substituting certification for education (cf. Era 2).

The consequences of this are *all over* the lived lives of practicing academics.

Aside: academia

I see this as a moral and economic dead end, which poorly serves a genuine need for social development and for investing in the creation of skilled and competitive workers, and of educated citizens. More on this in the THE article.

(We can also be critical of business, which generally speaking has left education to the state as a public good. But, to be fair, it is.)

Historical context

Back to 2008. Into Era 3 came Crypto. We can see why it would be appealing.

- Cryptocurrencies promise a medium of exchange and/or a store of value that is independent of the state and cannot be inflated away by a central bank.
- Cryptocurrencies promise to put the creation of capital into the hands of labour (think: Bitcoin mining). No need to apply for a travel grant — just mine some tokens!

This is not self-evidently bad. The problems of Era 3 are real, and at least cryptocurrencies' claim to address them is innovative and forward-looking.

Such innovation is not clearly worse than the magical thinking, populism, nationalism, and imperialism that's in the news, and ...

Some thoughts

. . . blockchain is just code: we can make of it what we will. You want inflation? Try a stablecoin. Ownership of physical assets? Use an NFT!

These are perfectly reasonable things to try out . . . in a suitably prudent, sober, and well-regulated manner.

Crypto sometimes come with a dose of anarchism and libertarianism. Boosters claim(ed) that cryptocurrencies could stand apart from (and remake? reform? render obsolete?) law, society, and indeed human nature.

Such claims are as false, but irrational exuberance about novelties is hardly unprecedented. There have been many exuberances and there will be more — why act surprised?

Other topics

To discuss, time permitting:

1. DAO hack and Ethereum fork.
2. FTX scandal.
3. Importance of regulation & integration of blockchain into existing legal and business structures.

The future

- Bitcoin was a genuine technical innovation — the cryptocurrency — which had an outsize social impact.
- It's based on legitimate and interesting technologies, including: hash trees, distributed consensus, and some cryptography.
- These technologies are themselves of their time and taken from a basket of powerful techniques powering modern computing systems.

Bitcoin was a proof-of-concept that hit a nerve. I'm no tech booster, but to be fair: the code makes some good points, and what has become of it is not entirely the fault of the underlying ideas.

The challenge is to regulate and refine these innovations so they can be harnessed to drive stable productivity and jobs. This is no different than any other technical innovation.

The future

I am generally optimistic. Creating and managing modern distributed computing systems is *skilled* and *labour-intensive*.

Furthermore, blockchain in particular promises to put labour to work constructing entirely new forms of capital!

That's pretty neat, and you need armies of highly-qualified and specialised programmers and mathematicians and managers and business development consultants and lawyers and marketers and technical writers and formal methods experts and smart contract developers and cryptographers and software engineers and developers and more, to create and maintain a lead in this game.

This nicely reflects the creative tension which Marx observed.

The future

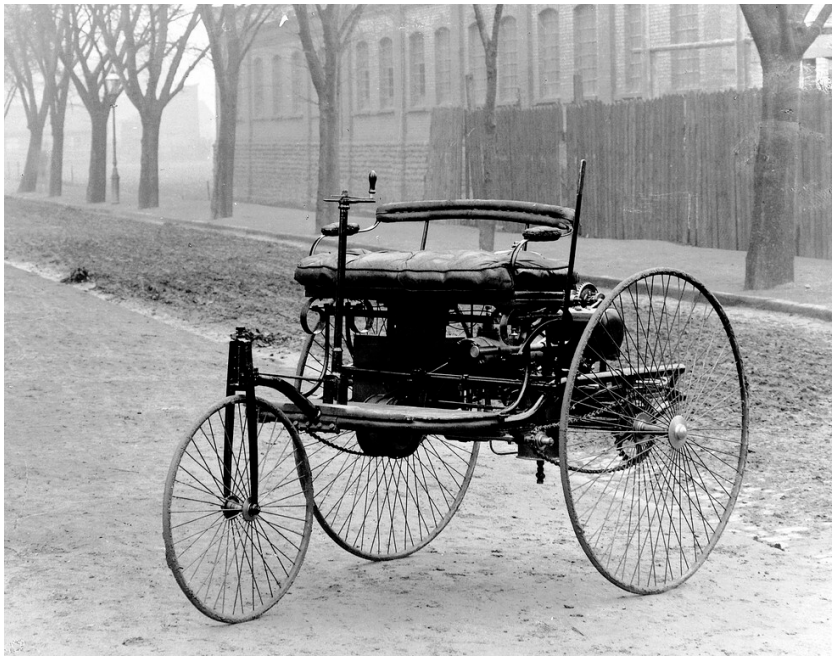
Blockchain, understood broadly, is compatible with labour and capital working together to create value. That's good and how it should be.

For all the recent news of tech layoffs, the underlying trend is up: companies can't hire talent quickly enough.

Marx might say that this is just a reprieve that does not address the claimed underlying paradox of capitalism.

Perhaps, but a reprieve is still a reprieve, and from the available choices we could do worse than a technology that seems structurally likely to create both jobs and capital.

The pace of change: 1885–1925 (Wikipedia)





An 1885 Benz Motorwagen vs. a 1925 Model T Ford touring.

Note the sheer speed with which, in this case, capitalism drove technical evolution, lowered costs, and optimised.

Das Kapital was published in 1867; twenty years before the leftmost object was created.