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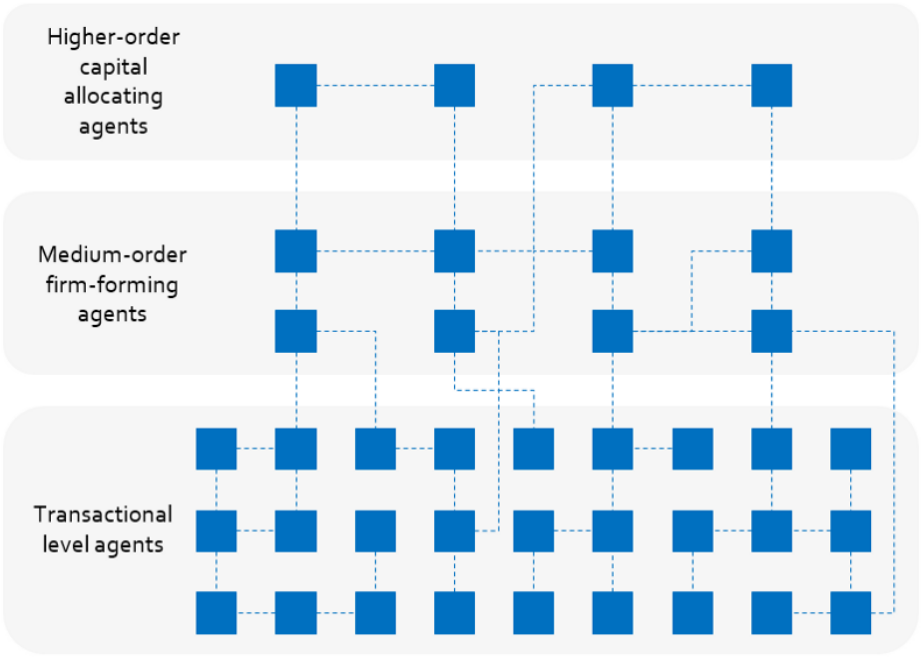
How crypto-enabled AI will transform our economy and what policymakers should do today



What a web of interconnected agents might look like

Summary

Long term ~20–70 years

If AI continues to develop exponentially it will offer significant productivity gains for all sectors of the economy.

Crypto offers AI significant advantages versus traditional sources of data for reasons I explain below; and as such, one of the most impactful ways AI will affect our economy will be when it is deployed on top of cryptographic 'rails' that define everything from capital raising through

to underlying economic activity at the transactional level. Crypto will effectively become the protocol for AI to talk to other AI.

Capital will follow where data is abundant and trusted.

This will have profound effects on the functioning of capital markets and the theory of the firm over the course of this century.

Fiat currency will ultimately be displaced as the primary mechanism for the exchange of value.

Immediate term

Crypto offers much promise but to this day still offers little use except for exchanging value outside the existing financial system.

A balanced and global view is needed when regulating crypto:

- On the one hand: there need to be stricter controls to combat illicit activity and money laundering; and governments need to work out how to define and tax these assets otherwise risk erosion of their ability to govern in the long run.
- However, on the other hand: the potential upside productivity gains should not be hampered; and given the trend for the eradication of cash, there will be a need for anonymous payment systems to combat the threat of authoritarianism as more economic activity moves online.

Definition of crypto

I'm calling these "cryptos" or "cryptographic networks" as an umbrella word to encompass DLT, blockchain, and cryptographically secured distributed databases. Even this definition isn't very good as it's too broad, e.g. SWIFT could be considered to be a cryptographic network, however I think the other terms are also too narrow so I'm sticking with crypto.

Long term vision ~20–70 years

Development of Artificial Intelligence

The course of AI development is often defined in three stages:

- **Artificial Narrow Intelligence (ANI):** Today's AI is good in only narrow fields - such as recognising cat pictures or playing chess. A single AI today doesn't have a general intelligence that can learn across multiple fields -they can only be programmed to achieve singular, discrete objectives.
- **Artificial General Intelligence (AGI):** It won't be long however until the disparate narrow intelligences that are being developed start blurring and form more general intelligences that can bridge multiple fields. A survey conducted by Nick Bostrom in 2013 indicated that most experts believe there is a 50% likelihood of us having developed AGI by 2040, and a 90% likelihood by 2075.
- **Artificial Super Intelligence (ASI):** Following the development of AGI, the natural corollary is for those AGI to then surpass human levels of intelligence due to recursive self-improvement, and ASI is likely to follow shortly thereafter.

If this is to be believed, AI will have a transformative effect upon all aspects of society and economic activity over the course of this century. Individuals, organisations and nation-states that develop the best AI will have an economic advantage over those that don't.

Development of Cryptographic Networks

In parallel, I envisage there being a web of thousands of interconnected cryptographic networks each with their own unique architectures fine-tuned to serve different use cases. Some will be tailored for wholesale trading of tokens that represent real world assets, some will be for consumer payments, some will be for IoT, and some will be to support decentralised organisations and applications e.g. through decentralised governance protocols and smart contracts.

- Side note: These are unlikely to be blockchains given their inherent scaling issues. I see Bitcoin, at best, being a digital gold, or more likely, being just an antique collectible.

The vast majority of transactions operating across these networks—and by transaction I include all forms of data sharing and processing, not just the exchange of tokens of value—will be driven by artificially intelligent agents that crawl, index, analyse, and then execute transactions on those networks on behalf of the organisations and individuals that control them.

- For example: if in the future many homes have solar panels on their roofs—there will be a need for the smart-home of the future to optimise when to buy, store, or sell electricity into the grid. This will unlikely be over existing payment systems e.g. debit card. Instead, I see a highly scalable cryptographic network being the best mechanism through which the agents, which represent each individual homes' electricity needs; share data with one another, and optimise when they buy, store or sell that electricity. Individuals will then shop for the best software agents to run their smart-home.

Use of cryptographic networks as the 'rails' upon which AI participates in our economy

Cryptographic networks will become the 'rails' upon which Artificially Intelligent Agents execute economic activity with one another —'natively'. There will be immense advantages to having AI being able to do so.

Why AI can't fully participate in today's economic systems:

At its most basic level, our economy is formed of a collection of firms that raise capital (e.g. a bank loan), purchase inputs with that capital (e.g. widgets), do something with those inputs (i.e. with capital or labour), and then sell those outputs at a margin that can repay the cost of capital.

The mechanisms through which our existing economic system operates is not designed to allow AI to operate natively, due to manual breakers

within that process that make navigating our economy far too complex.

These breakers include:

- **Natural Language Processing (NLP):** In order for an agent to participate in today's economy, they would have to speak with humans to raise capital (e.g. agree a contract for a loan with a bank manager), speak to other humans and agree contracts (e.g. with suppliers of inputs, or to hire labour), and then sell those outputs to other human agents. For an AI agent to participate in today's economy end to end, a large a large number of problems associated AI's ability to process and interpret language would need to be solved.
- **Legal certainty:** In addition, those legal contracts would be subject to interpretation and uncertainty if a dispute were to arise. An AI agent would not be able to navigate our legal systems, go to court, and the outcome of the legal process would be uncertain as it would be reliant on the whims and judgments of humans.
- **Trusted data:** Data used in today's economy to drive decisionmaking cannot be trusted or validated automatically. The trust in that data is reliant on human relationships - e.g. boards rely on the data provided to them because they trust their management team; capital allocation relies on the trust derived through audit. There are currently few data sources where trust can be placed on that data automatically.

The permutations of possible actions, and thus complexity, involved in navigating our existing economic systems are therefore many orders of magnitude too high for today's AI to operate in.

Whilst we are seeing the capital markets industry move more and more towards algorithmic investment and trading strategies, those algorithms are still only useful for specific use cases, such as informing humans to aid their investment strategies, or to automate high-frequency trading.

Today's world is therefore too complex for ANI to be able to make and execute autonomous economic decisions. Only an AI that is approaching AGI levels could do so.

Crypto solves these problems because:

- **Natural Language Processing (NLP):** In a crypto environment, agents would not need to be able to speak and interpret human language in order to raise capital, purchase inputs, and sell outputs, because the ability to do so is defined in code through smart contracts, not human language. For example an ANI could crawl the various crypto networks, submit requests for capital, and start organising that capital into outputs, without the need for any NLP. Humans or other agents could then respond and then provide that capital automatically. This would allow for firms to be formed automatically, which could also potentially be far smaller and specialised than existing firms as they would not need the manual apparatus that traditional firms would need e.g. registration with the government, or to be at least large enough to support a sole trader. A significant layer of complexity is thus removed.

- **Legal certainty:** In the case of a dispute, because the contracts are defined in code, collateral could be seized automatically if the terms of a contract are not met. Given certain criteria, the outcome of a dispute would also be known in advance, removing uncertainty in legal outcomes, and therefore allowing for better predictive models and decision making. A significant layer of complexity is thus removed.

- **Trusted data:** Cryptographic networks would eliminate the need for relationships in order to trust the data that is provided as this is achieved through cryptographic signing. For example, when goods and services are delivered, the receipt of this would be verified by the receiving party through cryptography. Conversely, the payment for those goods and services would also be delivered automatically across the network, rather than done through manual invoicing and payment through a separate means. A significant layer of complexity is thus removed.

Artificially Intelligent agents operating across a cryptographic environment would therefore face a significantly reduced number of

permutations to analyse and act on, as compared to an agent that has to navigate our existing real life economic systems.

This is because a cryptographic environment would be bounded by constraints and rules formed in code that the agent can more easily navigate. This is a far simpler environment for an AI agent to operate in by several orders of magnitude, hence my term 'rails'.

- For example: AI can easily beat the best humans at Chess or Go, but fails when the constraints become too wide, such as competing with humans in the real world. Crypto therefore becomes the 'playing board' for ANI to add value within our economic system within the next 10–30 years, rather than having to wait until AGI can participate in our existing economic system as a human would.

With time, a web of intelligent agents operating across a web of cryptographically defined economic environments would surpass humans at allocating capital, and at designing and operating the firm. There would therefore be inherent economic advantages for those organisations and economies that embrace this.

Effect of this upon capital markets and the theory of the firm

If crypto enabled AI does indeed have inherent advantages over our existing mechanisms for the allocation of capital and labour, this will disrupt the structure of both capital markets and firms.

The impact of tokenisation on capital markets reporting

Those organisations that can tokenise aspects of economic activity (i.e. create digital tokens that represent real world assets or activity)—down to the micro-transaction level such as internal firm processes—will be able to transparently report, in a trusted manner, what's going on within each part of the organisation in real time.

- For example: each time an employee in a business unit calls the IT helpdesk, the effort associated with this could be tokenised and costs allocated to that business unit as part of a smart contract. While this could still be done today with traditional systems—the

ability for this data to be trusted as it aggregates up to a capital market level would not be possible, without cryptographic signing and security.

This would allow for capital markets AI to make better decisions as hitherto invisible signals could be identified and responded to more quickly. i.e. because trusted micro-transaction level reporting would be a far richer dataset than consolidated financial statements, and real time reporting is better than quarterly.

Institutional investors (hedge funds, PE, pension funds, etc) will thus be drawn to investing capital in those organisations that can provide this level of granular and trusted data.

- Side note: There will also be convergence between hedge funds and VCs as they each become more like one another. Hedge funds will be able to invest in a collection of firms that are earlier in their lifecycle due to data being trusted and available earlier on, and where ownership of a bespoke index of those firms could be executed automatically through smart contracts i.e. macro level strategies can be applied to whole industries/geographies more easily due to tokenisation. Conversely, VCs will be able to become more like hedge funds as the data, combined with their understanding of tech, will enable them to start taking more macro level investment strategies.

The impact of decentralised governance protocols on the structure of the firm

At some point in the distant future, the structure of firms themselves will also be disrupted due to decentralised governance structures and smart contracts.

Today's firms are large, monolithic and often duplicate economic activity with one another i.e. they each have functions that more or less do the same thing as other firms. There are therefore many inefficiencies in our existing economic systems and there is great potential to better optimise how firms are structured, what they do, and what parts should or shouldn't receive capital. Today's markets attempt to do this through

M&A activity, however, due to imperfect data, this process itself is not optimal.

With the trusted micro-transaction level reporting I describe above, capital allocating agents will be able to better optimise M&A activity as the data is far richer and trusted.

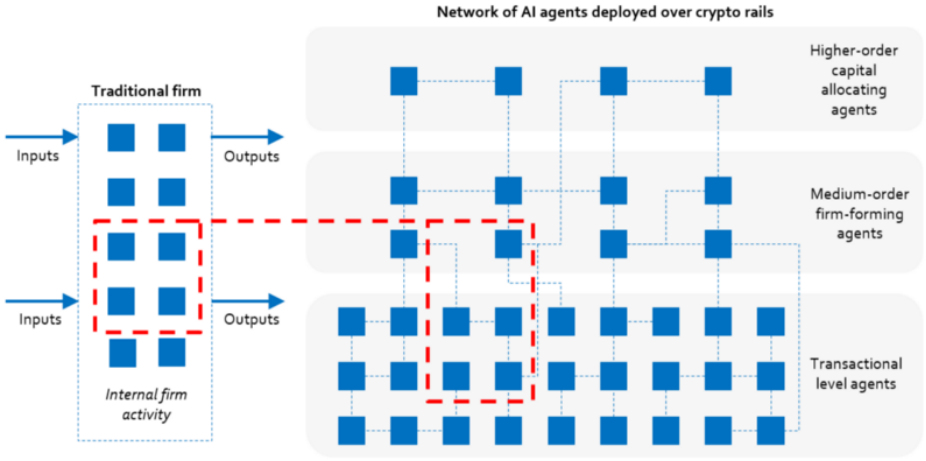
In addition, decentralised governance protocols will allow for firms to become far smaller than today because smart contracts would allow for firms, represented by an agent, to be formed automatically. This would allow for firms to be far more specialised, and allow for AI to restructure and splice existing firm activity in far smaller chunks than today, and in whatever way ultimately supports the objective of optimising capital allocation.

- Side note: Those highly specialised agents would effectively outsource everything that they are not specialist in, which is enabled by the trust and finality of legal outcomes as a result of smart contracts.

The extent to which this happens will depend on whether AI at the capital markets level spot signals that means that it is more optimal to break up a firm and replace it with a network of specialised agents, than to keep it together.

With time, firms will be broken up more and more as AI continues to seek the most optimal way to structure our firms and economy.

At some point, our economy will then look more like a highly enmeshed network of specialised agents transacting autonomously with one another and sharing resources where it is more efficient to, rather than a few large firms that are vertically or horizontally integrated.



How the internal activity of traditional firms will be carved up and replaced by autonomous agents on the basis that the underlying transactional data indicates that it is more optimal to do so

The model above describes how the structure of such a system may look. This would include:

- Higher-order agents that specialise at a capital markets level at deciding which lower level agents or entire economic sectors receive capital;
- Medium-order firm-forming agents that decide which transactional agents to use to buy inputs, do something with those inputs, and then sell outputs (i.e. what would traditionally be performed internally within a firm); and
- Many more transactional level agents that are specialised in the low level tasks that actually create goods and services, that can then be leveraged by as many firm-forming agents as wish to transact with them.

To conclude, trusted real time data at the transactional level that runs natively for AI will provide inherent advantages versus our existing models of reporting which at best are quarterly, opaque, aggregated, and to an extent, incomparable between organisations. Crypto native organisations will provide AI with a far richer dataset in which to optimise economic activity, and hence will receive capital in turn. With this data, and with smart contracts enabling decentralised organisations formed of a collection of autonomous micro-entities, firms will then be broken down by optimisation algorithms into a plethora of small but

specialist agents that overall are more efficient at executing economic activity than our traditional firms today.

Immediate future — Bitcoin and other cryptos

So far my arguments might appear somewhat fanciful, although I do strongly believe that at least some, if not most, of this will pan out so long as AI develops at an exponential rate and that crypto scaling issues can be resolved.

Crypto today and value of anonymous payment systems

In the immediate term, the only real use case for crypto today is as a hedge against inflation and the next financial crisis; as well as an exchange of value outside of the traditional financial system, which brings concerns over money laundering and the financing of illicit activity.

However, whilst this is the case, so does cash. And cash serves an absolutely integral role within society as there is a need to have anonymous payment systems to guard against potential authoritarian rule. See the global war on cash that is particularly evident in places such as Venezuela, India, and China.

If you take away all ability for individuals to exchange value outside of the watchful eye of the state, you take away the ability of the individual to challenge state rule. This is why I believe that anonymous payment systems should still exist even if they allow illicit activity, as the potential downside in my view is worse than allowing some illicit activity to take place.

What should be done

This is not to say that we shouldn't combat illicit activity however, and I think far more needs to be done to regulate the burgeoning crypto market.

Given the geographically agnostic nature of crypto, global regulation should be drafted and agreed to by most major financial centres to harmonise the regulation of cryptocurrencies. This would include:

- Legal definition of what cryptocurrencies are i.e. are they a currency, commodity, or something different entirely.
- Legal definition of what a cryptocurrency exchange is—creation of a global register of such exchanges—and enforcement of KYC, AML and sanctions standards upon such exchanges.
- Potentially the requirement for exchanges to ban the trading of the truly anonymous cryptos such as Monero or Zcash.
- Global regulatory agencies should also invest in better monitoring of public blockchains for suspicious activity.
- Global regulatory agencies should also coordinate and draft new standards regarding tax of capital gains as well as the economic activity that operates across these networks. If more activity moves onto them, this could potentially erode the power of the state as tax revenues are diminished.

I do not believe it would be wise, or even possible, to ban cryptocurrencies outright. Firstly, this wouldn't be possible due to the distributed nature of the networks themselves; and secondly, due to my arguments above, I think the economic forces that will be unleashed due to the marriage of AI and crypto over the next 70 years will infer advantages on those economies and firms that support the development of these technologies; although this must be done in a responsible and sustainable way.

In conclusion, the right balance needs to be found between harnessing the potential productivity gains; ensuring that there is still some leeway to challenge government through the allowance of some forms of anonymous payment; while making sure that illicit activity does not take place and to allow for governments to continue to raise taxes.

How will this affect banks and trust in capital markets?

From a bank's perspective

- Given crypto represents a brand new paradigm that threatens to disrupt their business model over the long term, I can definitely understand why there would be resistance. However, as articulated before—it will not be possible to shut these networks down. Nor do I think it wise to do so.
- In response, corporates should not and I think cannot battle this for the same reasons that Kodak, despite inventing the digital camera, should not have purposely held down that technology. They should instead collaborate with government regarding the regulation of cryptos, but also ensure that they are innovating with respect to being part of the vision I articulate above.

From an auditor's perspective

- I see capital markets—and the trust in information that those capital markets require—changing too.
- If my vision plays out, there will not be as much need for direct validation of financial information given this will be automated and aggregated through the tokenisation of economic activity. Rather, I see the role of auditors transforming into providing assuring that the 'tokens' that represent assets and economic activity in the virtual world do indeed represent actual economic activity in the real world. E.g. with the example I provided earlier whereby the economic cost of calling the IT service desk had been tokenised, the role of an auditor would be to validate that those tokens did indeed represent someone actually calling the service desk.

Concluding thoughts

The above is predicated on three key assumptions: (1) that AI continues to develop at an exponential rate; (2) that crypto becomes the 'rails' upon which AI integrates with our economic system; and (3) that the combination of these two technologies offers a competitive advantage over our existing capital markets and what it means to be a firm. If these

three assumptions are proven to be correct, I can only imagine a world where fiat currency is displaced in part, or all, by crypto at some point in the future. This will have profound implications for all sectors of the economy.

How we manage this transition through to the end of this century will therefore be one of the defining questions affecting economic policymakers and corporate leaders. Given technological convergence, the answer will be tightly interwoven with how we manage the rise and growth of AI in a responsible and sustainable way, including the biggest question of all: how we govern and control the transition to ASI.