

Getting to grips with blockchain

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FULL TEXT

Banks have suddenly cottoned on to the power of the blockchain technology beneath Bitcoin. Inside their own treasuries and innovation labs, and increasingly in collaboration, banks are testing uses for rebranded distributed ledgers to replace their costly, proprietary systems. Enthusiasts see banks creating a new fabric for payments transfer and financial markets, an internet of money. Doubters sense it's all hype. Big challenges remain, but markets from private equity and syndicated loans to corporate bonds and derivatives may go on private blockchains within months.

It's mid 2015 and Euromoney has been talking to the head of markets at one of the largest global banks about the changing structure of fixed income trading. As the meeting ends and we head to the lifts Euromoney asks what news from the OTC interest rate derivatives desks, now transitioning onto swap-execution facilities.

"The derivatives markets? Oh, they're all going OBC," says the banker. Euromoney makes that quizzical face we all learn in journalist training school. They're doing what? "They're going on blockchain," the banker grins; the lift doors close and he ascends. In the days after, Euromoney tries to follow up but, unusually for him, the banker goes strangely silent.

A couple of months later and the blockchain is all you hear from the banks. It is as if the entire industry has decided that the whole of finance is going on blockchain and all that remains to be decided is just how and when. Blockchain is the technological infrastructure underpinning bitcoin, and its association with the cryptocurrency has delayed appreciation among mainstream banks of the transformative power, elegance of design and genius of the mechanism for value exchange it embodies.

At its heart, the blockchain is a series of incentives and limits for the creation, validation and secure maintenance of an open, shared, transparent and immutable ledger of record for all transactions and shifts in ownership in an asset: in the original case, the asset being bitcoins.

Participants in the bitcoin marketplace can spend their bitcoins - transfer them to other parties in payment for goods or services - knowing that other participants in the network will recognize and validate that exchange or payment and record it in a system-wide ledger that no one central source owns or controls.

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The so-called miners that perform this validation must show proof of work - in electricity consumed and computing power used - and are themselves paid in new bitcoins. They confirm each other's work by consensus before a new page - or block - of the ledger is established, so ensuring that an owner of bitcoins cannot spend the same coins twice and that the receiver will not subsequently find his ownership of those transferred bitcoins challenged or his payment reneged on.

That's a lot of weird sounding concepts. What does it all mean?

It means a peer-to-peer payment network where Mike in Mexico City can transfer payment to Sam in Singapore directly and securely in about 10 minutes flat, without any 'help' from a bank in the middle that may take days to process the same transaction through its correspondent banking network and charge a fat fee for the privilege of

inserting its inefficiencies into the process. The blockchain takes out the middleman.

Indeed it removes the need for middlemen by replacing the key trust element that has kept banks at the heart of the payment system for centuries. Mike and Sam may not think much of their banks' systems, but they do trust their banks. Mike may never have met Sam, but if he wants to buy something from him, he knows that if he puts \$500 in his bank and asks his bank to pay it to Sam's bank, all of that will eventually happen, even if it takes days and costs a hefty percentage of the transaction. Mike knows that, eventually, Sam will be able to take out that \$500 from his own bank.

Blockchain technology uses encryption and a balance of incentives and checks such that the system as a whole can be trusted to work without any of the individual participants within it necessarily trusting each other - or even knowing each other beyond the lines-of-code pseudonyms that act as identifiers of individuals on the network. Banks are used to sitting on vast databases of proprietary data protected at the perimeter by password access. Blockchains embed encryption into every transaction and interaction between users and the ledger. Users have their own encrypted keys.

The final genius of the bitcoin Blockchain is this. Enough malign forces acting together could subvert it - perhaps a handful of users pretending to be many more by using multiple pseudonyms - if they together accounted for just over half the computing power on the network. But by the time they got to that point, these forces would have amassed so much bitcoin wealth, that destroying trust in the network and thus in the value of bitcoins - which goes up the more they are used - would be utterly self-defeating. The system colonizes its own would-be invaders. The bitcoin Blockchain has been attacked but it has never been hacked.

Mike and Sam become their own banks.

The banks can see where this is all going, of course, and they don't particularly like it. So in a classic case of the incumbents feasting on the disrupters, they have now jumped on the blockchain technology.

"My role has flipped in a matter of months," says Simon Taylor, vice-president of blockchain research and development at Barclays, "from trying to interest people here in thinking differently about the potential of the blockchain to struggling to contain their expectations. It isn't the answer to all banks' problems. But in the next five to 10 years and longer it has the potential to be transformative and it will find uses that we can't even imagine today."

If this is year zero in the internet of money, banks know they have been slow and that bitcoin, established in 2009, has gained a potentially threatening lead in proving the blockchain concept.

Euromoney talks to a fintech entrepreneur. "My family in Latin America recently transferred me some money to help start this business in Europe. It took a week for the banks to clear and I couldn't believe how much they charged. It made me think how often my family has transferred money over the decades and how much the banks have taken. Well, that's over. I will never again use a bank to do that."

More and more small businesses and some sizeable ones are accepting payment in bitcoins. Like all great innovations it is spawning many more. You may not be able to spend bitcoins on Amazon but you can use them to buy digital gift cards and spend those on Amazon instead.

How important is the blockchain to the future of banking and finance? a) It will transform banking fundamentally b) It will be an important way of improving efficiency but will not transform banking c) It is just one technical innovation among many d) It is mostly hype and won't actually change much at all Participate in our questionnaire to see if you agree with other financial players

The banks are now gripped by fear of missing out.

The banks also know, however, that bitcoin has, to put it mildly, got a bit of an image problem thanks to its association with Silk Road, the dark web and online criminality. Banks are now working to rebrand the blockchain as the distributed - sometimes the shared - ledger. They want to separate the blockchain from the bitcoin and set up their own private blockchains with only approved participants given permission to join them.

Daniel Marovitz is president for Europe at Earthport, a new cross-border payments service built to fill a gap left by the banks and to provide lost-cost and efficient cross-border service in high volumes of low-value payments, low

being \$50,000 or so. Its customers are corporate pay-roll departments, national pension schemes sending payments to retirees overseas and the like. Japan Post Bank, the world's 10th largest bank by assets, is a newly signed up user.

Marovitz claims that Earthport offers a pragmatic solution to solving cross-border payments, using existing global automated clearing-house infrastructure that banks already trust and understand. It also believes in the blockchain. Earthport has teamed up with Ripple Labs, whose Ripple protocol is a new variant of blockchain technology designed to work with existing fiat currencies and to allow for even faster settlement than the bitcoin Blockchain, in seconds rather than minutes.

Marovitz says: "The typical conversation you have with a senior banker now about this technology goes the same way. The banker will tell you: 'Bitcoin bad, blockchain good'. And you know that somewhere there is a compliance officer watching this conversation on CCTV, wiping his brow in relief that his man has said what he has been told to say. The banker will then confirm that somewhere in one of the bank's innovation labs it has some coders with beards and interesting tattoos working on potential use cases for the blockchain. Then when you ask him when these are likely to come into production as commercial applications, he'll pause, look at you and say: 'Bitcoin bad, blockchain good'."

Banks are just at the start of this. They want to prevent the blockchain from making them redundant by capturing it, adopting it, as an already pre-tested new technology, to make them much more efficient and reduce costs. And the banks are now doing this en masse.

At the end of September, R3, the fintech firm, announced that 13 global banks had joined nine original members of its shared-ledger initiative that seeks to develop commercial applications across the financial services industry for this technology and establish consistent standards and protocols to facilitate broader adoption of the shared ledger and gain a network effect.

It's worth recording that the first nine banks to join were Barclays, BBVA, Commonwealth Bank of Australia, Credit Suisse, Goldman Sachs, JPMorgan, Royal Bank of Scotland, State Street and UBS. Just two weeks after the venture first went public in mid September, Bank of America Merrill Lynch, Bank of New York Mellon, Mitsubishi UFJ Financial Group, Citi, Commerzbank, Deutsche Bank, HSBC, Morgan Stanley, National Australia Bank, Royal Bank of Canada, SEB, Societe Generale and Toronto-Dominion Bank all joined.

So it is quite the who's who of global banking.

Now is the time for banks, if they believe the shared ledger could form the basis of trade, transfer of value and reconciliation for decades to come, to think very deeply about the technology they're going to deploy to support that David Rutter, R3

"Fortunately for R3 we had recognized the potential of the blockchain about 18 months ago, when a lot of the banks were still focusing on bitcoin and what that meant for them," David Rutter, chief executive of R3, tells Euromoney. "What has happened since is that enough work has been done to prove the potential of the shared ledger at a very high level. And now is the time for banks, if they believe the shared ledger could form the basis of trade, transfer of value and reconciliation for decades to come, to think very deeply about the technology they're going to deploy to support that."

He adds: "Remember that today many banks are still stuck at a point where their own trade finance systems can't talk to their payments systems without layers of translation APIs bolted on, their credit systems can't confirm a swap. So, together we need to build a base layer for all these systems to talk to each other, before then moving more rapidly into ways of building valuable applications on top of this shared ledger."

Rutter adds: "Banks need to agree, for example, common identifiers where these don't yet exist before they can move their own systems of record outside their firewalls and onto a market-level system of record via a shared ledger, with all the attributes required for that to operate robustly at an industrial scale and in compliance with regulation to ensure it will stand the test of time."

Teppo Paavola, chief development officer and general manager of new digital businesses at BBVA, one of the global banks that has mostly fully embraced the power of new technology, is less gung ho than some about the

speed at which the blockchain will transform banking and capital markets. "It makes more sense to trial this technology first in smaller, niche markets. I'm thinking, for example, of Everledger, which emerged from our OpenTalent competition and uses blockchain technology to register valuables such as diamonds. These are registered as soon as they are mined and then Everledger provides a transparent, secure and immutable ledger as they are bought and sold to track their provenance. It's useful for insurers as well as for dealers and buyers, especially with the concern over blood diamonds."

Paavola says: "Right now we have no commercial banking product based on the blockchain, though like every other bank we are all trialing ideas in our labs. There are lots of good ideas but a key question is how do you build them into a network. The fax machine was a fantastic invention, but it wasn't much use if you were the only bank that had one. Right now, I can understand the interest in money transfer, but maybe more revolutionary could be the whole world of smart contracts on the blockchain."

Which types of blockchain are banks most likely to use in the next one to three years ? a) Mainly private blockchains for internal use between different entities in the same banking organisation b) The open, public Blockchain c) Permissioned blockchains with controlled, regulated entities participating Participate in our questionnaire to see if you agree with other financial players

It's conceptually easy to see the power of the shared, immutable ledger of record in any marketplace. Much discussion has centred on the potential to disintermediate banks from trade finance. If Mark in Mexico is an importer and Sam in Singapore an exporter, they can exchange payment directly with each other. But this, according to Taylor at Barclays, is to focus on the trees and miss the forest.

"If you look at the volume, complexity and interdependencies of the many paper-based workflows around trade finance, the payment component is not particularly the problem. Is there a better, more efficient, cheaper way of exchanging the payment than by Swift messaging? Maybe. But the real issues around trust in the trade finance workflow come before the financial transaction. Has the exporter actually delivered the goods to the port? Can the importer be sure that they have been loaded onto the ship and are in transit? A lot of this is still done, even today, by paperwork and paper sometimes gets lost. Bills of lading can be forged."

Taylor adds: "Banks in trade finance essentially intermediate a lot of this operational risk for their customers. But think if there was an immutable, digital ledger where the port authority could register, using an encrypted signature, that goods had indeed been delivered and had been loaded into transport, and the importer could see this in real time. That digital ledger would take out a lot of the operational risk exposure."

Taylor says it's a mistake to think of the blockchain just as a payments technology. "Yes, you can do payments on it, but it is a technology that can be applied to so much more. Right now, the banks have reached consensus that the distributed ledger is a good thing and we're all looking at internal uses, at uses between a few partners, at uses in larger consortia and even on open platforms. But we're still in the chaos period, which is the one that forges creativity. The definition of best-use cases varies between banks depending on their starting points. What might be a great help for one bank might badly hurt another. So it won't be clear for some time yet what commercial applications will emerge. The most interesting and valuable use cases probably haven't even been thought up yet."

There are lots of good ideas, but a key question is how do you build them into a network. The fax machine was a fantastic invention, but it wasn't much use if you were the only bank that had one Teppo Paavola, BBVA Alex Batlin heads up the so-called Crypto 2.0 pathfinder programme for UBS inside the Level39 fintech accelerator in Canary Wharf, tasked with exploring uses for the blockchain. He tells Euromoney: "I see this not so much as building single-uses cases for particular asset classes or financial instruments, rather it is about creating a new financial fabric - new rails for payments, new rails for clearing and settlement."

There are a few big carrots and sticks at work here, forcing banks into experiments with the shared ledger that is so utterly different to their established ways of working off fiercely guarded proprietary data and stand-alone operating systems.

Marovitz spent 11 years at Deutsche Bank, serving variously as chief information officer at the global banking and

markets division and head of product management of the global transaction bank. He has a good sense of the strain now being exerted on many banks' antiquated systems.

He says: "According to the World Bank, between 2011 and 2014 the number of unbanked people in the world actually fell by 700 million. In 2013 the growth rate of e-commerce was something like 60% and cross-border payments are growing at around 11% annually, which is way ahead of world economic growth. Something like 82% of small and medium-size enterprises in OECD countries transact cross-border today."

Marovitz says that has changed since the financial crisis. "Regulators have forced banks to become more local, to disengage from far-flung geographies, and this just as many more customers are connecting and transacting commercially across borders and need payments to match. In the years leading up to the crisis the banks were making so much money off structured products and the like that they didn't really bother to invest in their IT systems."

Banks have also had other, more pressing issues to deal with. "In the seven years since the crisis, they've had much less money and been spending most of it on regulatory compliance. So it's 15 years since the last time these banks invested much in their systems, many of which were turned on in the 1980s and some in the 1970s. A person can sit in New Zealand today and stream gigabytes of data to watch Breaking Bad from the US in real time, but sending the money to pay to receive it can take four days. So a lot of the banks are thinking: 'My systems are creaking, I have limited budget to invest. Maybe the blockchain is the answer.'"

When is your institution likely to launch its first commercial application of blockchain technology? a) We already have b) In the next three months c) In the next 12-18 months d) This is five years away Participate in our questionnaire to see if you agree with other financial players

If the blockchain is the answer, plenty of bright minds see the fortunes to be made if they can fit it to the right question.

Lawrence Wintermeyer, chairman of Innovate Finance, the umbrella body for fintech firms in London, points out: "The shared ledger has come into focus at a time when a very large amount of capital has been raised by fintech entrepreneurs and there is huge attention on financial technology. Hundreds of companies are looking at potential commercial applications on the blockchain. And while many fintech start-ups have focused on payments, remittances, peer-to-peer lending and investing - all activities that run on the banking system's traditional rails - the concept of moving away from those creaking legacy banking systems that are under constant siege by hackers and onto something more secure and shared has captured enormous interest, not least among regulators. "There are thousands of banks in Europe that bear significant expenses meeting the same regulatory requirements around know-your-customer and anti-money laundering. There are big benefits for regulators and enormous savings for banks from doing that on a shared distributed ledger."

There are thousands of banks in Europe that bear significant expenses meeting the same regulatory requirements around know-your-customer and anti-money laundering. There are big benefits for regulators and enormous savings for banks from doing that on a shared distributed ledger Lawrence Wintermeyer, Innovate Finance But hold on a minute. Is the idea that the underlying fabric of the financial system will move onto blockchain any more than just hype?

One vendor admits to Euromoney: "By the middle of last year we calculate that \$300 million of venture capital money had been raised for businesses around bitcoin, most of that when its use was growing exponentially. It is still growing but no longer exponentially. If you see the number of bitcoin users plateau at a few million rather than grow to several hundred million, all those investors in bitcoin related technology will be searching for a new market. That's why they now hope to sell it to the incumbent financial system."

Rhomaio Ram, global head of product for global transaction banking at Deutsche Bank, came back from the Sibos meeting in Singapore last month astonished by the heightened state of excitement and expectation that the blockchain will transform banking speedily.

"Many of us agreed in Sibos that we are now at peak hype on the blockchain. That's not to say I'm sceptical because I believe that it will have wide applicability across banking and finance. But we are still in the R&D phase.

And the first way this gets used is as a computer science innovation relating to maintaining a database in multiple locations all in sync with each other. That's been a tough nut to crack for banks that run multiple ledgers across the different entities inside their own organizations."

He says: "It may be that smart contracts, for example in bonds, eventually become a good-use case. You have bonds that may have 360 different terms and conditions that enter a bank's systems and then get broken down into separate payments processes for coupons, amortizations, contingent liabilities. The shared ledger could be a way to retain a complete view internally."

The question becomes: when do such internal-use cases become networks? In some ways the blockchain is like a social network - Facebook or Twitter - that needs users to come on it first, use it and only then figure out what it's actually any good for much later. But banking isn't a great environment for experimentation like that, which borders on messing around.

If you look outside the bank at the securities markets as a whole, there are so many participants that mostly focus on post-trade. If you moved securities onto the blockchain some of them would no longer be needed and you could speed up clearing and settlement and become much more efficient Rhomaïos Ram, Deutsche Bank

Ram says: "If you look outside the bank at the securities markets as a whole, there are so many participants - broker dealers, CSDs, clearing houses, custodians, sub-custodians - that mostly focus on post-trade. If you moved securities onto the blockchain, some of them would no longer be needed and you could speed up clearing and settlement and become much more efficient."

The debate around shifting financial markets onto the shared ledger and the potential development of private and semi-private blockchains, for the moment, remains quite conceptual. Banks are discussing networks where none yet exist. They certainly can't move onto the bitcoin Blockchain where the identities of users are hidden behind electronic pseudonyms because that is irreconcilable with banks' know-your-customer and anti-money laundering obligations. The banks ignore those at their peril. Yet many banks are already testing the blockchain internally through their treasury departments, looking, for now, at the use of shared ledger to record transfers between their own branches or subsidiaries in different countries, while experimenting with wider network applications.

And if the distributed ledger takes off beyond that, the rewards will come in vastly reduced operating costs. The dirty secret of banking was that for years banks themselves benefited from inefficiencies in the systems they offered customers: trapped cash was a free good. But that has changed thanks to new regulations.

On an IIF panel in Lima at the IMF/World Bank meetings last month, Gary Cohn, president and chief operating officer of Goldman Sachs, almost admitted as much. "Think about the way we settle: T+2 - that was the 1920s/30s/40s - you were literally, manually moving money. We don't send telexes anymore, we do it all electronically. In the situation that always makes me cringe the most - the dollar/yen transaction - you deliver dollars 19 hours later, and I have that sitting on my balance sheet, which I have to capitalize as an intraday credit exposure: whereas blockchain technology settles that in real time. It frees up the credit risk, my regulatory capital, everything else."

Cohn sets the message from the top: "It's imperative we get this done. We have made an investment in a blockchain company because we think it is where we are going - not only for ourselves and efficiency - but also for our clients and getting them instantaneous access."

If you can settle in two hours instead of two days you can turn over balance sheet in the same activity 24 times - just imagine the profitability that this will bring Axel Weber, UBS

Sitting on the same panel, Axel Weber, chairman of UBS, said: "With these blockchain technologies, if you can settle in two hours instead of two days, you can turn over balance sheet in the same activity 24 times - just imagine the profitability that this will bring to financial institutions that are payment and transaction focused - this is a huge opportunity." He admits: "It is true there are many non banks who drive this, and the choice is to innovate or die.

"We choose to innovate."

On a panel discussion at the Bloomberg Most Influential conference last month, Oliver Bussmann, chief

information officer at UBS, who joined the bank in 2013 from SAP and has become one of the banking industry's most noted cheerleaders for the blockchain, explains how the shift in thinking came about at the bank.

"It was driven by an entrepreneur talking to [UBS CEO] Sergio Ermotti about doing trade settlement condensed into a few minutes rather than two days. We studied this last year and came to the conclusion it was indeed possible. We built a team focusing on the blockchain and potential use cases at the Level39 accelerator in Canary Wharf." Bussmann says that the members of the financial services innovation group at the World Economic Forum have analyzed 11 separate areas of innovation in fintech and come to the conclusion that the blockchain is the most important. "It's an efficiency play and it's a risk-reduction play," he says. At Sibos in Singapore, on a panel discussing the blockchain he went further and declared: "This is massive. Banking processes that have been in place for 100 years plus will be massively disrupted."

The potential for the blockchain to transform payments, clearing and settlement, seems obvious. Instead of each bank having its own ledger and devoting vast resource to maintaining it while checking its records against those of other banks - managing confirmations, breaks and errors - the whole market having one shared ledger, immutable due to embedded encryption and uncontested, would be a game changer.

For regulators, too, it would be a boon: a means of procuring the undisputed authoritative tape record for any market agreed among multiple firms and, potentially, a means to reduce systemic risk across financial markets as well. "If regulators are also on the blockchain for a market, then they would get to see everything that banks get to see in real time rather than having to request and then analyze reports submitted from many banks after the event," says Batlin at UBS. "Regulatory reporting would become an automated by-product of being in a business for banks."

These are all the things the regulators have aimed to achieve by pushing OTC markets such as derivatives onto exchanges and central clearing counterparties.

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Gary Cohn,
Goldman Sachs

In a report published in October, entitled 'Innovation in payments: the future is Fintech', Bank of New York Mellon concluded: "Were the challenges of making blockchain technology a tangible concept overcome, banks and fintech companies could radically transform global payments. Not only would systems have far more capabilities, developing countries would have greater access to financial services, therefore benefitting society as a whole. Indeed, by leveraging such technology to make cross-border payments immediate, cost-effective, completely transparent and risk free from a regulatory perspective, payments will become truly revolutionized. Blockchain technology has the potential to unleash this new payments world."

For now, there are almost as many opinions as to the best way forward on the blockchain as there are banks struggling with it and vendors pushing it. At Sibos in Singapore last month, the hottest ticket in town was to the Inntribe discussion 'New Kids on the Block(chain)'. The new kids, in this case, are the banks.

Preston Byrne, co-founder and chief operating officer of Eris Industries - Eris is free software that allows anyone to build their own secure, low-cost, run-anywhere data infrastructure using blockchain and smart contract technology - argued: "The biggest risk is that the banks chase down the wrong use cases. I disagree with most of the banks on clearing. Clearing may be the worst possible use case for the blockchain. Blockchains are transparency engines that don't do privacy well and I don't think that disclosing sensitive data on all market participants' exposures to everybody is where it will get much traction."

Rather, he argues: "Business process automation within banks - addressing the slowest process element, often human intervention - is where it will have most impact. The blockchain is about eliminating people."

Gideon Greenspan is founder and chief executive of Coin Sciences, a company set up to build private blockchains. He tells Euromoney: "There is one spanner in the works for the adoption of private blockchains, which is that by

default, everything that takes place on the chain is visible to all participants. If we look at the role of a conventional central counterparty or custodian, as well as confirming changes of ownership of assets, it also acts as a Chinese wall between the players in a marketplace.

In what areas of banking and finance will the best uses cases for the shared ledger emerge? a) Payments b) Post-trade, securities clearing and settlement c) Origination, distribution and trading of securities as smart contracts d) All of the above e) None of the above f) Different uses cases Participate in our questionnaire to see if you agree with other financial players

"So the key question becomes: can you operate a private blockchain so that participants can mine and verify the blocks while also hiding some of the data, in ways that match the underlying business logic for the market in question? Can advanced cryptography like confidential transactions enable miners to validate the exchange of ownership of assets without also seeing their precise amounts or value? If not, it may be that the main use for blockchains will be in confirming changes of ownership in instruments where quantity and value are not sensitive data, such as letters of credit, for example, which are not fungible or divisible."

Leda Glyptis, head of the EMEA innovation centre at Bank of New York Mellon, and so representing one of the new kids on the same panel as Byrne at Sibos, sees an existential question looming for banks. She says: "A lot of what we do as banks is package absence of trust. So we have agency arrangements, middlemen and tri-party agreements all because of lack of trust. This [blockchain] technology will take that away. The blockchain forces banks to rethink our entire value chain in ways we have never done before. Whatever the final answer is as to what goes on the blockchain remains to be seen. But we have to think: 'What are we for, as banks?'"

The challenges for the banking industry are thus threefold: first, to avoid being disintermediated, a risk that has risen because of their initial disdain for bitcoin and failure to spot the importance of the blockchain underneath it; second to take the technology that has worked for bitcoin and develop new versions for the banks themselves to transact securely, at industrial scale and in compliance with regulation - handling not tens of low-value transactions per second, but rather hundreds of thousands of often high-value transactions per second; third, to work out where else in banking beyond payments the blockchain might be transformational.

It doesn't take long for any conversation about the blockchain to shift to smart contracts: financial products where payment or conversion or other contingencies are triggered at certain times and by certain events written into the underlying legal contracts. Many of the core wholesale financial markets consist of such contracts: bonds, loans, derivatives, certain classes of equity and all equity-linked securities.

Batlin at UBS says: "We weren't particularly interested in bitcoin but we were interested in bonds, a very large market in instruments with quite complex features and life cycles. At first we thought that while we could shift transfer of ownership of bonds onto the blockchain, everything else in a bond's life cycle would still have to be done off the chain. Now, however, with platforms like Ethereum developing the next generation blockchain for smart contracts, we have the first set of capabilities to model the entire life cycle of an instrument - and manage bond coupon payments, maturity payments, derivatives and cash all on the same chain."

Batlin points out: "One of the constraints of the bitcoin Blockchain, which has no central governance, is validators producing proof of work prior to achieving consensus, all of which requires 10 minutes between blocks. Ethereum takes that to just 12 seconds. We think it could eventually go to sub seconds, though never to nano seconds because even on private blockchains with different governance models to the bitcoin Blockchain, there is still a need to achieve consensus - which requires exchanging multiple messages between validators. So the blockchain may not be good for high frequency, low latency trading environments. But for everything else it may become the new fabric, especially for everything post-trade."

Euromoney talks to firms that aim to be in at the start of putting all manner of financial markets on the blockchain, changing not just settlement in secondary trading markets but primary markets too. One of these is Symbiont, a fintech company cofounded by Mark Smith, an early pioneer of ECNs (electronic communication networks) in the 1990s who has been talking to investment banks about doing corporate bonds on the blockchain.

It started this August with something else, publishing several of its own private equity investments - including the

founders' shares and convertible notes in Symbiont itself - onto the bitcoin Blockchain, in a format trademarked as smart securities that means the stakes will for ever be part of that public record, allowing dividend payments or stock-option conversions to happen automatically.

Others, too, have cottoned on to the notion that most of the equity in the world's companies is private and therefore rarely traded. Shared ledger technology that immutably verifies a beneficial entity's entitlement to claim ownership of equity stakes in private companies - and that records transfer of ownership in an uncontested register and automates actions such as conversion of equity-linked instruments into common stock - might just eliminate the distinction between private equity and public equity traded on an exchange. By enabling more efficient and secure transfer and trading in such unlisted investments, the blockchain might encourage greater inflows of institutional capital into the ownership of private companies. It may not be suitable for high-frequency stock trading but it could still transform the equity markets.

The entities at risk of being disintermediated here would not be the banks but rather the stock exchanges and the central clearing counterparties. Nasdaq is already working with the shared ledger in its private market division, mindful of the danger of being disrupted.

Syndicated loans are a \$4 trillion market that still runs on faxes, email and excel spread sheets. We have turned paper syndicated loans into smart contracts where the terms and conditions of the loans are programmed and embedded algorithmically in a digital format issued from the borrower Mark Smith, Symbiont

But listing its founders' shares was just a first step. Smith, also chief executive of Symbiont, tells Euromoney: "There are other areas where smart contracts could work on the bitcoin Blockchain where it is not essential to restrict to regulated entities, for example crowdfunding of under \$50 million through RegA+. But we are also working on smart securities on a permissioned, distributed ledger where access is limited to regulated entities and their customers that have gone through AML and KYC checks. This allows those participants to use it without the worry of potential regulatory exposure to an anonymous miner that may be on the Office of Foreign Assets Control list or in a sovereign jurisdiction that has banking and money transfer restrictions. With our solution, all the regulated entities on our permissioned ledger come to consensus on a block by block basis."

Smith says that the bank will put this to work in the first quarter of 2016 in two markets: corporate bonds and syndicated loans.

It's perhaps a bit of a surprise that such an old-fashioned market as syndicated loans should be a text case for this gee-whiz new technology, but it is precisely because it is so old-fashioned that it is a suitable market to show the cost-savings and efficiency the shared ledger can bring.

Smith says: "Syndicated loans are a \$4 trillion market that still runs on faxes, email and excel spread sheets. We have talked to banks whose syndicated loan teams processed 2 million-plus faxes in 2014, each of which can be 30 pages long, and they employ 50 people whose sole job is just to stack those pages up and deliver them. We have turned paper syndicated loans into smart contracts where the terms and conditions of the loans, including payment features, are programmed and embedded algorithmically in a digital format issued from the borrower to a syndicate of lenders across a shared ledger."

If the loan is originated as a smart contract, terms can be agreed by all participants, for example agreeing upon the source for the variable interest rate, like Libor, which drives the cash flow payments, then the atomic clock will trigger payments automatically from the borrower to the lenders' wallets in proxy tokens exchangeable into dollars, yen, euros, sterling or whichever fiat currency. Smith says: "The platform not only automates functions it also restricts transfer based on the terms of the loan. In most cases syndicated loans cannot be traded in the secondary market without borrower consent. The borrower can approve secondary-market trades via their cryptographic private key or automate the function by using a pre-approved whitelist of lenders."

Smith says that Symbiont expects one of its customers to do the first syndicated loan as a smart contract on its permissioned shared ledger by the end of the first quarter of next year and he thinks this will change the syndicated loan market very significantly by the end of 2016.

Smith says: "It's a matter of much greater efficiency across the whole life cycle of a financial process. A lot of

people are talking about the shared ledger impacting securities clearing and settlement. We think it is better to step back and look at the entire process from end to end, starting with the corporate banker originating a transaction. The whole process from originating to completing a syndicated loan takes on average 27 days. That could come down very quickly to two or three days if the market moves to smart contracts on our permissioned shared ledger."

He adds: "We also have an agreement with a leading investment bank to do the first \$100 million corporate bond issuance for a Fortune 100 company as a smart security on our permissioned shared ledger in the first quarter of next year. We think that smart contracts are the killer app for the blockchain and that adoption will be a lot faster than people expect."

Ram at Deutsche Bank is one of the more measured in his assessment of the blockchain. "Will the whole of finance have moved on the blockchain in 18 months time and we all look back and ask: 'What did we do before this?' Probably not. But three, five, 10 banks, by then, might well be using some form of blockchain technology in commercial applications."

At this stage, it's as well to remind ourselves of the limits. "I see two issues with all the discussion around smart contracts," says Greenspan at Coin Sciences. "First, where actions are triggered by any external event, such as options that depend on a move in a currency exchange rate or the weather, you still need a centralized external authority to sign and deliver a message to the smart contract. Second and more simply, if a borrower issues a bond as a smart contract, the private blockchain cannot help if the borrower runs out of money to make coupon payments. It can note that a payment has been missed but it cannot seize any real-world assets in response. The general principle is that, if a bank's existing proprietary database can't perform a certain action, a private blockchain or shared database cannot do it either."

How engaged are are your clients/you as a client in discussions around the blockchain? a) Very engaged in development of potential commercial applications b) Quite interested but in wait and see mode c) Not very interested d) We haven't asked them Participate in our questionnaire to see if you agree with other financial players

For all that, it looks like a reasonable assumption that the blockchain will change much more than just the global payments business. It will transform non-financial markets as well, becoming a registry for validation of ownership and change of ownership of assets such as land, property, commodities and - current flavour of the month, in one of the most interesting test cases - diamonds. The endgame is for the blockchain - or perhaps more likely for an interlocking series of private, semi-private and public blockchains - to do all that and become the infrastructure for exchanging payments in fiat as well as cryptocurrency for exchange of those assets.

The key concern for banks as they seek to deploy blockchain technology to reduce operating costs, fully automate the management of financial instruments through their life cycle, reduce settlement times and associated capital consumption, is that they mustn't replace the spaghetti of their legacy systems with a new jumble of multiple blockchains.

Debra Brackeen is managing director and global head of the innovation network at Citi Ventures, where the bank is doing most of its experimentation with the distributed ledger. "The blockchain is a really exciting new technology," she declares. "We are exploring across all three types of blockchain - the open and public, the private, and also the permissioned or federated blockchain. From our perspective, the opportunities blockchain offers to create efficiencies, reduce costs and enhance the customer experience give us a lot of reason to explore all sorts of use-cases, notably across payments, securities clearing and settlement, while also looking at its application to identity, smart contracts, micro-payments and the internet of things."

Brackeen is honest enough to admit: "At this stage, we have more questions than answers. We are all trying to understand blockchain and its potential value. Fundamentally, it is a network technology and partnerships are vitally important. Banks are challenged with legacy systems, and a key issue that must be thought through for all the use cases is the inter-operability of systems across different partners. We collectively recognize that there's a lot of potential here and a lot to explore collaboratively."

Citi's own internal experiments with e-cash led it to develop the so-called Citicoin as a token to exchange internally. "It's a name that someone here came up with last year that has just stuck. It's still a prototype in our labs but we have no intention to issue it," says Brackeen.

Brackeen joined Citi from HP where she worked in corporate ventures, and the bank has taken a similar approach, mentoring start-ups, investing in outside firms and operating its own labs from Silicon Valley to Tel Aviv. "We are investing in a portfolio of proofs of concept," she says, "across a range of areas and potential applications."

Euromoney tries to press her. In looking at permissioned, federated blockchains in partnership with other banks, who would take on the role equivalent to miners in the bitcoin Blockchain as validators of the shared ledger? And how would they be incentivized?

Brackeen dodges this one. "It's a key question to explore and understand but maybe too early to answer. We're at the very start here of a development that will play out over many years. But we are very excited about blockchain and the distributed ledger."

Taylor at Barclays picks it up. "Who will the validators be and how will they be incentivized is a question to which there are so many good answers, yet it is one I will probably spend the rest of my life responding to. There don't necessarily have to be large numbers of unconnected ones that don't know each other, as on the bitcoin Blockchain. That arrangement fitted the world view of founders who wanted a censorship-resistant form of digital cash beyond any government's control. But shared-ledger technology can work within regulated systems and could operate with a small number of known validators at a handful of banks."

Right now it would probably be quicker and cheaper for me to hire a courier to package up this chair I'm sitting on in London and deliver it to New York than it would be for me to send the money from New York to London through the banking system to pay for it Nicolas Cary, Blockchain

Greenspan at Coin Science expands on this. "Showing proof of work is an issue in an open, public blockchain which anybody can mine. To prevent minority control of an open blockchain, creating a block has to be a laborious and expensive process. However in a private blockchain, there is a different consensus mechanism, since the set of permitted miners is defined and closed. In a private chain, miners can digitally sign the blocks they create and the chain can have rules such as: for every 10 blocks mined, no more than two can be created by the same entity. Mining becomes computationally trivial, and its cost can easily be covered by a small subscription or the basic incentive of a chain's participants to keep the system functioning. The mining process for individual blocks can be much simpler and quicker than on a public blockchain, and the incentive for miners is completely different."

If 2015 was the year banks realized they had to take the blockchain seriously, 2016 may be the year the first truly important commercial applications come into effect. Many bankers now compare this to the early days of the internet at the end of the 1990s, when everyone was amazed that they could dial up pages of data, but no one could imagine Twitter, iTunes, Facebook, Instagram or Netflix.

What happened to the media industries in the past 15 years could be about to be unleashed on the banks.

Fears of disintermediation are never far away and nor are existential questions of what banks are going to be for.

"If you look at the extreme case for banks in the bond markets," says Batlin at UBS, "you could have bonds issued as digital smart contracts by a borrower and distributed across a blockchain to investors, with regulators as a third node on that network. Banks have to think carefully about what value they bring, be it in underwriting, marketing or whatever and which intermediary functions still actually need to be performed. The blockchain is already here. Bitcoin provides a decentralized, autonomous organization that is almost a banking depositary and payments service. Banks need to think very strategically about their own decentralized, autonomous organizations across multiple use cases."

Looking on from the fringe are the disrupters that first championed bitcoin. Jon Matonis is a director at the Bitcoin Foundation, who sat on the Bloomberg panel with Oliver Bussmann last month, casting polite doubts on the banks' efforts to re-invent in private permissioned networks what already works in an open public form.

"I think it is a failure of the banks to think of bitcoin and the blockchain as something that can be usurped and brought in-house. The disrupters at bitcoin see their Blockchain with a capital B as the SMTP for email or the

TCP/IP for the internet. If the banks don't see that, they are going to spend a lot of time just recreating what already exists. I can see that R3 at least allows 22 banks to spread the cost of that effort, but if a banking consortium is the answer, why doesn't one of the existing ones do it, like Swift?

He adds: "It's interesting to see some of the banks already creating their altcoins when they realize they need a native currency on these networks. I suppose it's no bad thing to see the banks experiment with their private blockchains to get ready for bitcoin."

Will blockchain render banks redundant in core parts of their businesses? a) No, it will strengthen banks as the blockchain will allow them to offer vastly improved customer service. b) Banks are late to the party but clients will continue to prefer to deal with a few big banks to provide for all of their requirements rather than with a plethora of tech start-ups c) Yes, this is the beginning of the end for banks. Those that survive will be largely advisory houses. Participate in our questionnaire to see if you agree with other financial players

Nicolas Cary, co-founder of Blockchain, the most popular bitcoin wallet provider with 3.7 million users, and a builder of bitcoin software, spoke at a Misys Forum in London last month. He reminded banks of the danger to their core payments business. "This company spent its first two-and-a-half years unbanked because we were bootstrapped through bitcoin and did not have external capital until we raised a \$30.5 million series-A funding round recently. We are adding around 70,000 users a week and we can replicate those customers' banking experience on their phones immediately. If I want to send value anywhere in the world, I can now do it instantly, like sending an email. I can see we must be quite frightening to the banks because we are moving fast and we are not asking anyone's permission to do so."

He says: "Our vision is to completely re-imagine how the world transacts."

He reminds the banks why millions of their customers have come to bitcoin. "Right now it would probably be quicker and cheaper for me to hire a courier to package up this chair I'm sitting on in London and deliver it to New York than it would be for me to send the money from New York to London through the banking system to pay for it."

One thing on which everyone can agree: that has to change.

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