



# Securities Services on Blockchain

A Value Analysis for Custodian Banks

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# Introduction



...“reconciliation” is the main source of inefficiency in the securities services industry. It is also the chief promise of blockchain...

“Securities settlement in particular seems ripe for innovation; a typical settlement chain can involve many intermediaries, making securities settlement comparatively slow, operational risks and costs high.”<sup>1</sup>

Post-trade securities transaction processing is often described as a “value chain.” It can be described more accurately, however, as an “extraction of a value chain,” in which a string of intermediaries charge investors for checking and storing information about securities transactions while adding data of their own to the record, and then passing it on to the next link in the chain.

The intermediaries include fund managers, brokers, custodians, cash correspondents, central securities depositories (CSDs), clearing brokers, central counterparty clearing houses (CCPs), trade repositories, fund accountants, fund distributors, and transfer agents. All extract value by standing between the buyers of securities and the sellers, especially across borders.

Each link in the chain requires the intermediary to compare data and rectify discrepancies. When a fund manager buys shares, for example, it needs to settle the details – that it was a purchase and not a sale, the number of shares bought, the price, and the charges – with both its broker and its custodian.

This process of “reconciliation” is the main source of inefficiency in the securities services industry. It is also the chief promise of blockchain – which adds “blocks” of cryptographically secure transactions consensually agreed between all network parties to a single, immutable but distributed digital ledger – to eliminate the costs of reconciliation.

In theory, blockchain will achieve this by simply allowing users to share a common database rather than maintaining proprietary databases, which have to be compared and reconciled. This collapses all of the separate links in the chain into one process on a single database. The execution, clearing, and settlement of transactions occur more or less simultaneously.

Nothing fundamental will change. Transactions that settle gross in real-time may not need pre-funding, but they will still require a consensus between the parties for buyers to deliver cash and sellers to deliver securities or funds. The consensus will be achieved by parties comparing their databases and rectifying discrepancies through sharing and approving the content of a common database.

If all parties have the same record, the need for consensus-by-reconciliation disappears. Instead of agreeing to the terms of a transaction with the previous link in the chain, adding information to it, and then passing it on to the next link in the chain, all parties will simultaneously share a single set of data in real-time.

<sup>1</sup> Mark Carney, Governor of the Bank of England, “The Promise of FinTech – Something New Under the Sun?” at the Deutsche Bundesbank G20 conference on “Digitising finance, financial inclusion and financial literacy,” Wiesbaden, 25 January 2017, page 7.

By doing so, a blockchain can disintermediate existing service providers from post-trade transaction processing. The need to maintain and reconcile multiple ledgers is no longer necessary, which allows counterparties to exchange value without relying on third parties to guarantee delivery or payment. By eliminating intermediaries, blockchain can also eradicate the costs of intermediation.

This has the potential to release substantial efficiency gains. While there are other benefits of blockchain – notably increased security and a reduced risk of fraud – these efficiency gains are the principal attraction of blockchain for the users of post-trade services provided by custodian banks.

For custodian banks, on the other hand, the prospect is far less appealing. These organizations make their living by helping buy-side clients cope with inefficiencies of the current dispensation in post-trade securities processing. For them, blockchain is an existential threat of disintermediation from the extraction of a value chain. The purpose of this paper is to assess the value that is at risk.

# The Opportunity



Placing all market participants on a **single distributed ledger would end the multiplication of databases and the duplication of technology.**

## Threats do of course create opportunities

These are obvious for new entrants to the securities services industry, which can deploy blockchain technology unencumbered by the legacy of past platforms, or the need to support existing business. However, threats can also create opportunities for incumbents – and blockchain could solve a number of problems for custodians.

With high levels of intermediation, the industry is inhibited by its inability to cut costs decisively. Even cost savings from offshoring, which custodians have used extensively, are limited by the need to reproduce existing processes offshore, and tailor services to individual client needs. Moving towards a radical new technology platform could change this equation, but existing technology budgets are devoured by the expense of maintaining current platforms and regulatory compliance.

In theory, blockchain could help custodians break out of this impasse. Placing all market participants on a single distributed ledger would end the multiplication of databases and the duplication of technology. Instead, all parties would share a common digital representation of assets in custody, and keep track of the execution, clearing, and settlement of transactions without investing in proprietary technology.

The cost of regulation could also be reduced by granting regulators access to the ledger, allowing them to supervise activities in real-time rather than by requiring custodians to report on activities after the fact. In addition, updates and alterations to regulations could automatically be put into effect through the distribution of “smart contracts” – computer programmes that trigger an investigation or enforcement action when a regulation is breached or might be breached – via a blockchain.<sup>2</sup>

Blockchain networks additionally have the ability to reduce the costs of Know Your Client (KYC), Know Your Client’s Client (KYCC), Anti-Money Laundering (AML) and sanctions screening, if the individual and corporate identities are digitised, stored, and updated on a blockchain. Custodians could access the information, obviating the need to solicit and store verified documentation in a central database.

The same approach could be used to cut the costs of sourcing the accurate reference and market data. The security identifiers (such as ISINs and CUSIPs) and counterparty identifiers (such as BICs and LEIs) needed in current reconciliation processes could become available and update automatically on a blockchain. Indeed, they would have to be integrated into the settlement process.

Regulatory and client pressure on custodians to move to name-on-register and segregated accounts can also be ameliorated by blockchain technology. Although account structures are not changed by the technology, blockchain can be used to develop links between nominee accounts and beneficial owners, as it permits multiple layers of ownership. This could obviate the industry’s need to invest in moving from its preferred omnibus account structure to individually segregated accounts.

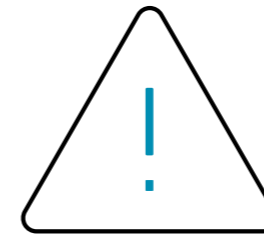
<sup>2</sup> A smart contract is a computer programme that can collect and move value autonomously provided certain conditions are met.

## The Opportunity

Blockchain can reduce the costs of improving data integrity (entry on a distributed ledger technology can only be changed by altering all previous entries), and tightening cybersecurity (a distributed database has no single point of failure, unlike a centralised one). It also provides a cheaper means of accessing securities held across borders by enabling tokenised rights of ownership to securities held in custody for trade on blockchains.

Last but not least, blockchain could reduce the cost of the capital custodians have to allocate to the operational risks that they run. By enabling transactions to settle in real-time, blockchain decreases credit and counterparty risk for custodians. This will eliminate the need for central counterparty clearing houses (CCPs) to intermediate transactions, while also cutting capital costs, and reducing the liquidity custodians maintain. At a time when regulation is increasing the expense of providing cash and securities to clients for transaction settlements, this is a substantial benefit.

## The Threat



...the ability of blockchain to **reduce the cost of the credit and liquidity risks assumed by custodians** will also reduce their revenues.

### The obverse of the cost-cutting potential of blockchain is plain

At present, the revenues of custodian banks are broadly equivalent to the costs of inefficiency incurred by their clients through the fragmentation created by the proprietary databases of fund managers, brokers, custodians and CSDs, and the lack of efficient inter-operability between them. In other words, the fee income of custodians ultimately depends on a continued requirement for reconciliation.

At present, custodians operate and maintain centralised databases that aggregate, store, update, and report information about assets and transactions in those assets. They are paid fees to reconcile these records with ones of the same assets and transactions held by brokers, fund managers, and CSDs. If the clients of custodian banks instead have access to a single record maintained on a distributed database, this function becomes unnecessary.

On a blockchain, cash and asset records are updated automatically in real-time as transactions are settled. Because trading instructions posted on a blockchain also include settlement instructions, the need for trade confirmation, affirmation, and matching services will also disappear. Settlement would merge imperceptibly with trading to become a single process in which both elements are effectively simultaneous and instantaneous. The settlement fee income of custodians could potentially disappear.

Asset servicing functions such as income collection, corporate actions, proxy voting, and tax reclaims will also be affected. By encoding smart contracts that embed information about entitlements and their value in the ledger, blockchain would allow share and bond issuers to credit the accounts of investors on the due date directly, eliminating custodial intermediation. Involuntary corporate actions, such as stock splits and redemptions, could be managed the same way.

Even elective corporate actions, such as rights issues and mergers, could be affected by blockchain technology. Though they require active choices by investors and are therefore not as simple as the automatic debiting and crediting of accounts, issuers can still use blockchains to issue notifications to investors, accept their instructions, and record the resulting elections. This can be fully automated, provided that issuers publish the information in standardised, machine-readable formats.

### Banking revenues will be adversely affected

If blockchains shift post-trade processing to simultaneous, final, and irrevocable delivery versus payment in real-time, accounts will have to be pre-funded with cash or securities. This will reduce the revenues custodians collect from lending cash and securities, and sourcing collateral for their clients. In this sense, the ability of blockchain to reduce the cost of the credit and liquidity risks assumed by custodians will also reduce their revenues.

It is unlikely, however, to fully eliminate their roles. A switch from funding settlement (a post-trade process) to pre-funding settlement accounts still leaves ample scope for custodians to extend credit and liquidity, in the form of collateral as well as cash, though collateral management services would not be unaffected by the use of blockchain-based networks.

## The Threat

Securities borrowers could post collateral through a blockchain, by tokenising assets held in custody, and mobilise collateral that is presently inaccessible by the same means. Cash borrowers could post collateral using the same technique. Both would reduce the rewards of custodians as securities, lending agents and collateral managers (though market participants might still attach value to their willingness to cover the risk of loss through indemnities).

### The foreign exchange revenues of custodians are also at risk

Foreign exchange markets exhibit the same high levels of intermediation, and the consequent need to reconcile the records of buyers, sellers, brokers, banks, and market infrastructures across borders as the securities markets. By offering all parties a single, shared view of the same transaction, blockchain has the potential to eliminate the custodial role in foreign exchange markets of the trusted intermediary and risk taker.

Finally, the core business of any bank – net interest margin – will be squeezed by blockchain technologies. While the need to pre-fund accounts for real-time settlement will place a premium on available cash, tighter control of the treasury transaction process through the immediate and immutable record-keeping offered by blockchain should enable cash managers to manage their cash flow more effectively, reducing the value they share with custodian banks.

## The Research



The eight business areas are **clearing and settlement, custody, fund administration, buy-side insourcing, treasury, issuer services, technology and securities and treasury operations.**

### The research findings are based on the detailed revenues and expenses of six major global custodian banks in each year between 2012 and 2015<sup>3</sup>

The data, which is held in the McLagan Investment Services database, was organised into standardised categories to ensure valid comparisons. In all, the findings are based on 28 standardised expense and revenue metrics spread across eight broad business areas.

The eight business areas include clearing and settlement, custody, fund administration, buy-side insourcing, treasury, issuer services, technology and securities, and treasury operations. Assumptions were made regarding the percentage of expense and revenue recorded in each of the 28 metrics that will likely be affected by the introduction of blockchain technologies.

The percentages are itemised above the textual analysis for each of the eight business areas between pages 7 and 16 below. Due to the high degree of uncertainty about the percentage assumptions, the impact on both the expenses and revenues of the six banks in the data set is shown as a range in the charts on pages 11 and 12. However, our assumptions suggest that revenues (down \$13 billion) will fall faster than costs (down \$6 billion).

The six banks in the data set provide a robust proxy for the industry as a whole given that they account for roughly 80 per cent of all assets in global custody. If the projections are extrapolated to encompass the remaining 20 per cent of assets in global custody, the savings increase to \$8.3 billion, while the revenues fall by \$16.7 billion.

This represents a significant call to action, as blockchain threatens the entire business model of the custody industry today. The findings present custodians with a stark choice. If they embrace blockchain technology but fail to use it to generate new revenue streams, their continued existence is at risk. On the other hand, the costs savings are compelling enough to transform the economics of the industry, enabling custodians to solve their biggest single challenge: the inability to widen their margins by reducing costs and developing new businesses.

<sup>3</sup> The six banks are BNY Mellon, Citi, Deutsche Bank, J.P. Morgan, Northern Trust and State Street.

# The Findings

## Clearing and settlement



### Central Assumption:

#### Expenses:

**90%**

Impact

#### Revenues:

**90%**

Impact

### Clearing and settlement

The cost of clearing and settling securities transactions would be drastically reduced by the introduction of blockchain technology. Securities can be issued directly by the issuers on to a blockchain, where they could be purchased directly by investors. The number of securities purchased would be delivered to the account of the purchaser in exchange for the payment of cash to the account of the issuer.

If secondary trading of the securities also took place on a blockchain, buyers would likewise deliver cash to the blockchain accounts of sellers, and sellers would deliver securities to the blockchain accounts of buyers. Since both the securities and the buyers and sellers are all on the blockchain, these exchanges can be cleared and settled simultaneously and instantaneously.

For custodians, the processing of securities, derivatives, and treasury transactions is an expense, which they seek to recover through transaction charges. Blockchain will have a direct impact on the costs of capturing and managing client transactions and then “clearing” and “settling” them. Savings will be magnified for the blockchains on which different asset classes are executed, cleared, and settled.

In this case, “clearing” refers not to the submission of a matched trade to a central counterparty clearing house (CCP), but rather to the back-office procedures that take place after a trade is executed and not yet settled. This includes the matching of trade details (between the brokers on the buy and sell sides), the confirmation of the transaction (between the brokers and their buy-side clients), and its affirmation (between the brokers and the custodians to the buy-side clients).

In theory, the blockchain collapses all procedures into a single process. The parties included in the trade share a single set of data, which cannot settle unless all agree the terms (price, amount, charges) and its validity.

“Settlement,” or what is generally called delivery versus payment (DvP), is the delivery of securities or fund shares against cash payment. This would likewise become part of this single clearing-and-settlement process. It is, however, subject to an important constraint. At present, the cash leg of securities transactions settle on a real-time gross basis (RTGS) between the accounts of the custodian banks at the central bank. Until central bank money is issued to a blockchain, blockchain settlements will have to take place in commercial bank money. To achieve this in real-time, the account of the buyer will also have to be pre-funded with the necessary cash, and the account of the seller pre-funded with the necessary securities.<sup>4</sup>

The requirement to pre-fund accounts implies that custodian bank revenue received from lending money and securities to clients to enable settlement of trades on time will not disappear completely. Although the revenue loss from clearing and settling orthodox transactions is in theory absolute – in a single global blockchain encompassing execution, clearing, and settlement in all markets and asset classes, revenues would indeed fall to zero – there will be a period of transition in which blockchains inter-operate with existing clearing and settlement systems. A minority of transactions in off-exchange or illiquid asset classes may continue to require such high levels of manual intervention that they never move to a blockchain. These considerations restrict the eventual impact to 90%.

<sup>4</sup> For the continuing reliance of blockchain networks on existing cash settlement systems, see page 9.

# The Findings

## Custody



### Central Assumption:

#### Expenses:

**70%**

Impact on global custody

**100%**

Impact on sub-custody

#### Revenues:

**80%**

Impact on global custody

**100%**

Impact on sub-custody

### Custody

The work global and sub-custodians perform in storing, updating, and reporting records of transactions and ownership of assets and entitlements on centralised ledgers can, in principle, be transferred wholesale to distributed ledgers maintained on blockchain technologies. The technology could even improve the quality and value of the work, due to its ability to maintain a complete and immutable record of the history of all transactions. It can track ownership through multiple layers of intermediation down to the level of the beneficial owner. This is valuable at a time when regulators are pressing for segregated accounts in the name of the end-investor.

Blockchain will also have an impact on the asset servicing activities of both global and sub-custodian banks. In theory, issuers can distribute entitlements such as dividends, interest payments and rights, and notifications of other corporate actions, directly to investors holding accounts on blockchain. They could even automate the distribution through the use of smart contracts. In the same way, investors can issue instructions to issuers, including how they wish to vote at shareholder meetings. In straightforward asset-servicing tasks of this kind, the role of the custodian is likely to be reduced to regulating the admission of issuers and investors to the blockchain network, and even that task may eventually accrue to CSDs.

The clearing and settlement revenues of the sub-custodian banks are likely to be eliminated. If transactions are cleared, settled, and recorded on a common but distributed ledger as part of a single process, the role of the sub-custodian in reconciling records of transactions with brokers, CSDs, and global custodians becomes unnecessary. The centralisation of the settlement process in Europe through Target2-Securities (T2S) offers a preview of this phenomenon. Importantly, the T2S experience also suggests that asset-servicing is best integrated with the settlement process because it is impossible to distribute entitlements without knowing who bought what.

In practice, however, non-standard asset servicing tasks such as voluntary corporate actions, tax reclaims, securities lending and financing, collateral management, and short-term credit are likely to continue to require manual intervention. Emerging markets, which have higher transaction costs and less well-developed clearing and settlement infrastructure, are also likely to transition to blockchain technologies first, while higher-volume developed markets will transition more slowly.

This will preserve a residual and temporary role for global custodians in clearing, settling, monitoring, and recording assets and transactions across a mixture of blockchain and legacy clearing and settlement networks – until a global network of inter-operable blockchain networks fully emerges. Non-digital assets will also continue to require physical custody and delivery, though many of these are just as likely to be held by sub-custodians as global custodians. In that sense, it would be incorrect to consider global custody less affected than sub-custody.

## The Findings

### Fund administration



#### Central Assumption:

#### Expenses:

**30%**

Impact on fund accounting

**90%**

Impact on transfer agency

#### Revenues:

**20%**

Impact on fund accounting

**90%**

Impact on transfer agency

#### Fund administration

The fund administration businesses of the custodian banks perform two main functions. The first is fund accounting, or the calculation of the value of the shares in a mutual, hedge, private equity, or real estate fund, and net of liabilities (generally, the fees owed to the managers and administrators of the fund).

Blockchain will not affect this Net Asset Value (NAV) calculation function immediately or directly. Once the financial assets held by a fund are acquired and traded on a blockchain, fund accountants will retrieve prices from the blockchain, as they do from conventional trading platforms today. It is important to note that blockchain technologies cannot reinvent the NAV calculation process itself. Once all the assets of a fund are traded on blockchains or networks of blockchains, smart contracts could be coded to calculate the NAV of the fund.

Even in the short term, trading blockchains could provide fund accountants with access to up-to-date prices of securities, at a lower cost than the services they currently purchase from data vendors. Until that point is reached, though, the impact of blockchain technologies on fund accounting will be indirect.

The faster reconciliation of the records of assets held by the fund manager, custodian, broker, and the fund administrator will allow the holdings of the fund to be established more quickly and for a lower price, permitting sooner and frequent calculations of NAVs. Once calculated, NAVs could also be published to exchanges, the media and fund distributors through a blockchain. However, the benefits will be restricted to straightforward assets. Illiquid and hard-to-value assets will continue to require manual intervention to establish a price.

The other main function carried by custodians in their role as fund administrators will be more severely affected. Transfer agency is a settlement and registration function, and

one with high levels of intermediation.<sup>5</sup> It also contains a higher degree of manual processing that even surpasses the securities industry. This substantially inflates fund distribution costs, which blockchain technologies can reduce dramatically.

Both the settlement of fund subscriptions and redemptions, and the maintenance of a register of fund investors and/or their advisers and clients, can be performed more efficiently and at a substantially lower cost on a blockchain. Eventually, fund shares will be issued directly by fund managers or promoters to investors through a blockchain, and the common ledger will serve as the registry. Subscriptions and redemptions of shares will settle delivery against payment in real-time between accounts on the blockchain, in the same way as securities transactions.

Even the Know Your Client (KYC), Know Your Client's Client (KYCC), Know Your Distributor (KYD), Anti-Money Laundering (AML), and sanctions screening functions carried out by transfer agents are vulnerable to blockchain technologies. A distributed ledger containing a common set of information about a client or distributor, created by investors publishing their verified identity documents or digital identities on a blockchain, is a more efficient method of verification than every transfer agent performing a separate manual check each time the investor buys shares in a fund.

Smart contracts could be coded to check individual investors against the information held on the blockchain, allowing subscriptions to proceed immediately. The technology would enhance these services since the distributed ledger maintains an immutable, time-stamped record of all transactions. These are among the reasons why we expect blockchain to have a much more dramatic impact on transfer agency than fund accounting.<sup>6</sup>

<sup>5</sup> Fund managers (to buy and sell stocks); data vendors (to collate prices of securities); fund accountants (to use the prices to calculate NAVs); fund distributors (to sell funds to investors); correspondent banks (to move cash from buyers to sellers); custodians (to hold stocks in custody); and transfer agents (to maintain a register of investors and settle subscriptions and redemptions). In some markets, CSDs also settle fund transactions.

<sup>6</sup> Another area where blockchain might help is payment of commissions (or retrocessions) to fund distributors. A group of 15 insurance companies (B3i) are exploring the use of blockchain to make payment of retrocessions between insurers and reinsurers more efficient. In that case, insurance brokers rather than transfer agents are vulnerable to disintermediation.

## The Findings

### Buy-side in-sourcing



#### Central Assumption:

#### Expenses:

**30%**

Impact on in-sourcing of buy-side back office processes

#### Revenues:

**30%**

Impact on in-sourcing of buy-side back office processes

#### Buy-side in-sourcing

Custodians have developed a substantial business in which they in-source a range of fund management company back and middle office functions that fund managers used to perform themselves. The custodians reconcile records of assets, transactions and valuations with brokers, sub-custodians, CSDs, fund accountants and transfer agents, collect entitlements such as dividends, interest payments, and tax reclaims, lend and borrow securities from the portfolios of the client, and clear, settle, and collateralise transactions with brokers, sub-custodians, CSDs, and central counterparty clearing houses (CCPs).

Evidently, blockchain technologies have the power to transform the principal “back office” function of clearing and settling securities transactions.<sup>7</sup> Its impact on the “middle office” is harder to gauge due to the wide range of definitions for the “middle office” that currently exist. But they certainly include maintaining a continuously updated database of assets owned by clients, based on execution and settlement instructions obtained from fund managers, brokers, sub-custodians, and CSDs; reconciling discrepancies between the separate databases maintained by fund managers, brokers, sub-custodians, and CSDs; and reporting the reconciled data to fund managers.

All of these activities are clearly vulnerable to blockchain technologies, which enable fund managers and custodians to share a single, immutable book of record, obviating the need for the updating, reconciliation, and reporting services currently provided by custodians. More importantly, this complete and immutable book of record achieves a long-time goal for fund managers: the attainment of a single investment book of record (IBOR) for the front, back, and middle offices to share as a so-called single source of truth. Unlike a conventional fund accounting system, which is updated once a day or overnight by batch processing, a blockchain-based IBOR provides fund managers with accurate data for decision-making in real-time.

## The Findings

### Buy-side in-sourcing

Figure 1

#### % Change in Expenses

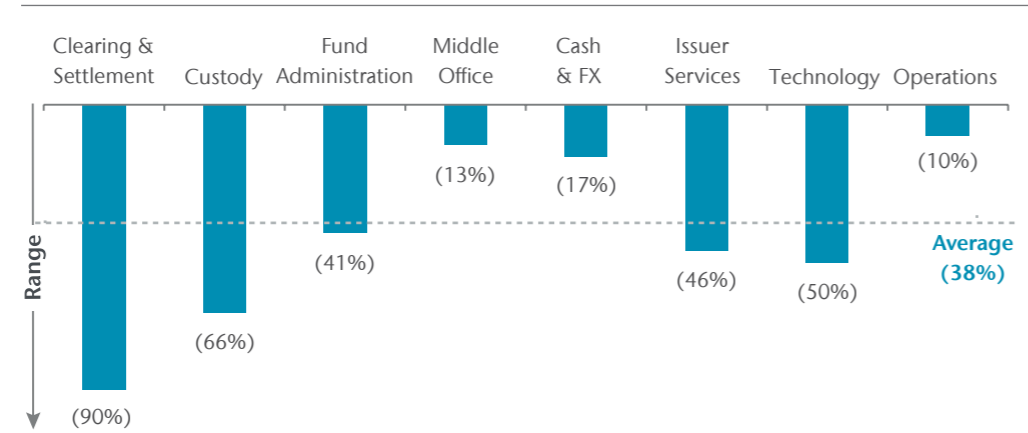


Figure 2

#### % Change in Revenue

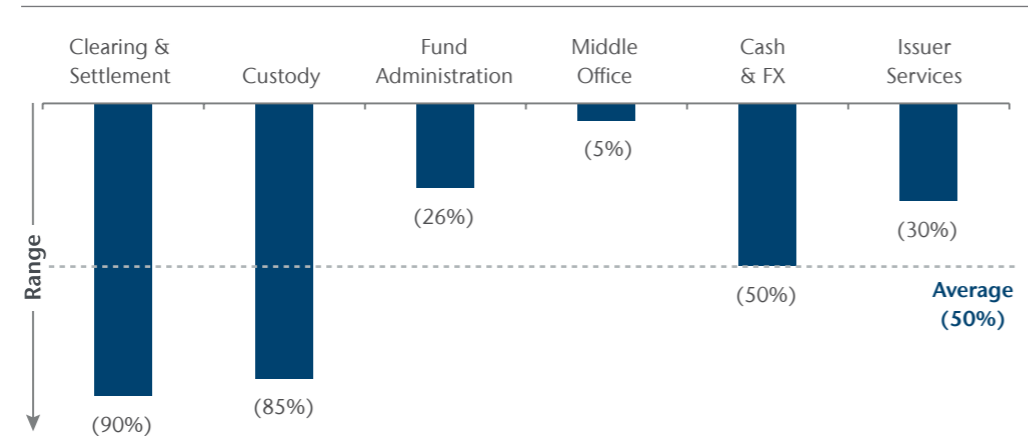
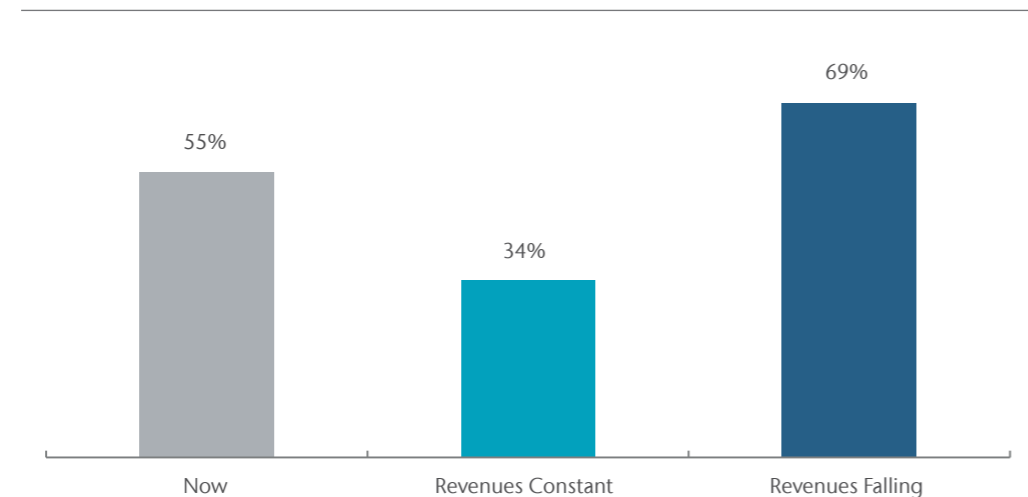


Figure 3

#### Cost : Income Ratio

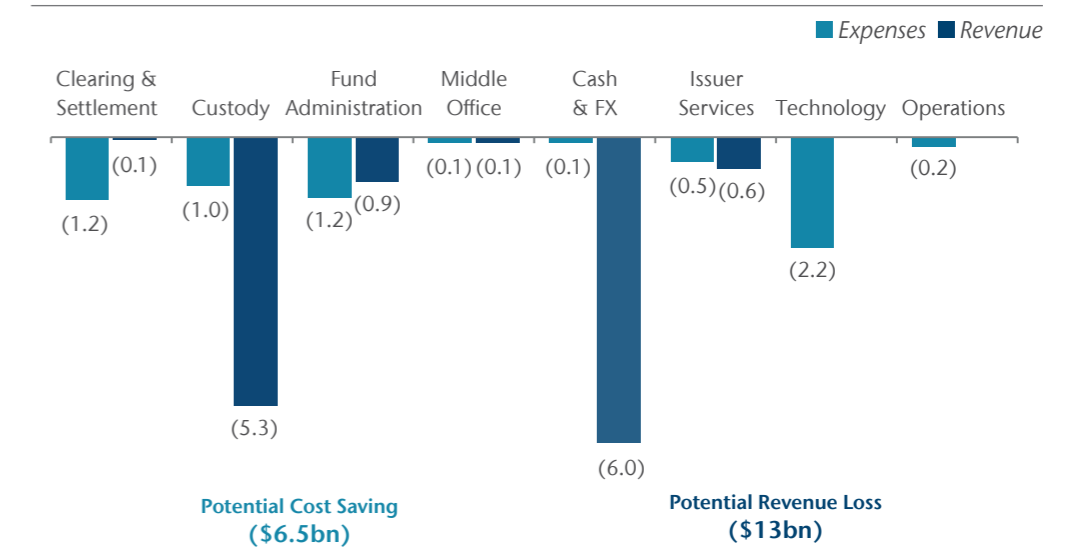


## The Findings

### Buy-side in-sourcing

Figure 4

#### Absolute Change in Revenue and Expenses \$bn



A second function conventionally located in the middle office is derivative processing. On behalf of fund managers, custodians confirm and settle derivative transactions, value derivative positions, reconcile discrepancies between fund managers and investment banks (in bi-lateral swap transactions) or clearing brokers (in transactions centrally cleared via a CCPs), source and post collateral to meet margin calls, and help fund managers comply with regulations by reporting transactions to trade repositories.

In a blockchain, many of these functions could be disintermediated. Counterparties could clear and settle their obligations directly, without intermediation, by clearing brokers and CCPs, let alone operational support from a custodian. The need to reconcile positions and valuations would disappear. Margin calls could be initiated and executed automatically by smart contracts. Transactions could be reported by admitting trade repositories to membership of the blockchain network, effectively sharing the contents of the ledger with the regulators. However, complex valuation procedures (such as those required for illiquid swaps) would continue to require manual intervention. This is an important reason why custodians will still be able to generate revenue by providing some middle office services to fund managers.



## The Findings

### Treasury



#### Central Assumption:

#### Expenses:

**17%**

Impact on  
Treasury

#### Revenues:

**50%**

Impact on  
Treasury

### Treasury

Custodian bank clients invested in multiple markets need more than clearing and settlement services. They need to buy foreign currency to invest and sell foreign currency when they disinvest. They expect options to invest cash awaiting reinvestment in securities, and opportunities to generate additional income, from lending securities to investment banks and fund managers that need to cover short positions. Their trading and investment activities also must be financed, making it necessary to post cash or securities as collateral to counterparties that lend them cash or securities.

The appetite of clients for some of these services will be reduced by real-time settlement on blockchain networks. A shared blockchain for foreign exchange transaction processing would disintermediate custodians altogether. In the securities market, real-time settlement of transactions on a blockchain will require clients to pre-fund their accounts, reducing the opportunity for custodians to lend cash or securities. On the other hand, the same requirement to pre-fund might increase borrowing by some clients, though other measures that require market participants to have assets in place have not yet put this into effect.<sup>8</sup>

If faster settlement on blockchain networks does reduce the demand to borrow stock – and the need to pre-fund accounts with securities or cash means even real-time gross settlement on a blockchain does not eliminate the need to borrow – this will ease prices in the securities lending markets, shrinking custodian bank revenues. It will also reduce the demand to raise eligible collateral, especially in the securities markets. Cash collateral will still be required by clients to cover their fluctuating exposures to long duration derivative transactions. In fact, the most substantial threat to the securities lending revenues of the custodians lies in the possibility that securities borrowing and lending migrates to a blockchain, allowing lenders and borrowers to transact directly rather than via a custodian bank as an agent lender.

A similar threat is apparent in cash management. If the principal money market instruments used by custodians for cash investment – repos, commercial paper, and treasury bills – are instead issued directly to investors with blockchain accounts, custodian banks risk disintermediation from a large proportion of the market. On the other hand, custodians will still be trusted to indemnify clients against any losses they incur in cash investment. They will also retain a role as global cash managers, aggregating cash invested across multiple blockchain and legacy systems, just as they will for securities. On balance, however, the revenues of custodians are likely to fall faster than their costs.

<sup>8</sup> The EU Regulation on Short Selling, effective from 1 November 2012, is discouraging in this respect. It allows short selling of sovereign debt only when the sale is covered and the transaction is to hedge risk, forbids naked shorting of uncovered sovereign CDS, requires short positions above certain extremely low thresholds (0.1% of the net short position for Greece, 0.5% for most others) to be reported, and empowers governments to suspend short selling of sovereign debt altogether. It is judged to have reduced the amount of securities borrowing.

## The Findings

### Issuer services



#### Central Assumption:

#### Expenses:

**46%**

Impact on  
Issuer Services

#### Revenues:

**30%**

Impact on  
Issuer Services

### Issuer services

Custodian banks provide corporate issuers with a variety of services. These include acting as trustee to investors in bonds, and serving as paying and redemption agent to bond issues, syndicated loans, and other financings. Custodian bank issuer services also include administering the depositary receipt programmes by which issuers make their shares more attractive to foreign investors. They do so by offering a form that is easy to buy and sell through domestic rather than international brokers, and can collect entitlements in their own currency.

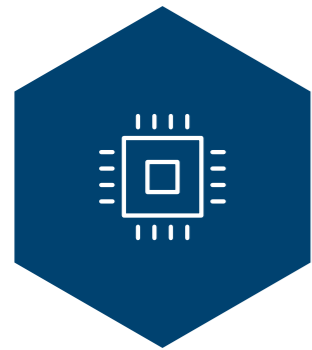
Blockchain will affect the businesses directly. Any asset can be issued on to a blockchain, and depositary receipts are no exception. At present, custodians issue (take shares into custody) and cancel (sell shares into the market) depositary receipts, looking to manage the integrity of the issue by keeping the stocks in custody aligned with the amount in the depositary receipt programme. All three of these functions can be handled more efficiently on a blockchain.

However, depositary receipts exist for many reasons, including the differences between the laws and regulations of different securities markets around the world. It is true to say that if differences between markets did not exist, and blockchains made it equally convenient for investors to buy securities directly, depositary receipts would disappear altogether. But blockchain cannot re-write the legal and regulatory regimes of multiple markets.

The other main business in issuer services – paying agency services – remains highly manual. Blockchain provides a less people-intensive way of distributing dividends, interest payments, and redemption proceeds to investors. A process by which issuers pass payment to custodian banks, which then allocate and distribute the payment to individual investors, is likely to give way to one where payments are sent directly to investors, in line with the holdings registered in the distributed ledger. Trustee functions, on the other hand, will be largely unaffected.

## The Findings

### Technology



### Central Assumption:

Expenses:  
**50%**

Impact on  
Technology

Revenues:  
**0%**

Impact on  
Technology

### Technology

Blockchain will have no impact on revenues in the field of technology because the budget consists of expenditure only. There simply is no revenue for blockchain to put at risk. But blockchain could have a large effect on technology costs by allowing custodians to terminate obsolescent and legacy systems, and replace them with cheaper and more efficient blockchain technologies.

The systems most obviously at risk are any used to clear and settle transactions in securities or funds, and ones used to record and monitor the ownership of assets and entitlements. The data warehouses built by most custodians to aggregate data retrieved from multiple underlying systems will also be eliminated. The costs of maintaining and interrogating legacy systems, and transferring data between them, will disappear.

However, the transition from legacy systems to blockchain will take time, postponing the realisation of the benefits. The continuing reliance of custodians on legacy systems reflects custodial reluctance to embrace the costs and risks of migrating critical business functions, even to better conventional systems. In an industry which believes it cannot afford a failed migration, savings from a transition to blockchain networks will materialise slowly.

In fact, there are reasons to believe that the transition will be exceptionally gradual. First, even successful blockchain networks will still have to inter-operate with legacy networks, until all networks are based on blockchain. Even then, data standards will need development for proprietary blockchain networks to properly inter-operate. Secondly, the investment required to move a business to blockchain networks and de-commission existing networks, will not be trivial. It will take time to muster the capital.

## The Findings

### Securities and treasury operations



### Central Assumption:

Expenses:  
**10%**

Impact on  
Operations

Revenues:  
**0%**

Impact on  
Operations

### Securities and treasury operations

Not only do custodians in-source the back-office operations of their clients, but they also host substantial back and middle office operations of their own, in both their securities and treasury businesses. The costs recorded here do not include servicing client transactions,<sup>9</sup> but do include the cost of on-boarding clients to technology and service platforms, calculating and issuing invoices, managing internal business projects, and maintaining financial controls, including the reconciliation of invoices. Blockchain technologies offer the prospect of substantial savings in these areas.

One area that will be heavily impacted by blockchain is control and reconciliations. Since most of the work in this area consists of reconciling multiple ledgers containing accounts of the same assets and transactions, their replacement by a single distributed ledger will eliminate manual reconciliation processes altogether. Although blockchain will have no impact on the policies and procedures that govern financial controls, blockchain could also accelerate access to the data used to police compliance with internal financial controls.

Another area in which blockchain technologies can add efficiency is the invoicing of clients. Blockchain eliminates the process of reconciliation of invoices because both the custodian banks and their clients will share the same data about the services that were delivered and the charges levied. These savings are multiplied to the extent that clients also trade on blockchains linked to the blockchain that generates the client statements and invoices.

The introduction of blockchain into client on-boarding processes – which make up a significant proportion of the costs

incurred by both the securities and treasury operations arms of the custodians – will not be as impactful. Where it can help is in reducing the fastest rising component of on-boarding costs: increased Know Your Client (KYC), Know Your Client's Client (KYCC), Anti-Money Laundering (AML) and sanctions screening requirements.

A dedicated blockchain that held details of the digital identities of all clients and potential clients, and to which all members of a blockchain network contributed, would create savings in the on-boarding process.<sup>10</sup> Even more substantial savings will accrue once the KYC process becomes an integral part of the settlement process on a blockchain, in which identity checks and verifications are part of a single clearing, settlement and custody process on a distributed ledger.

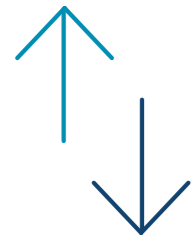
An efficient KYC process on a blockchain network requires the universal adoption of Legal Entity Identifiers (LEIs), the alphanumeric codes which are unique to every counterparty. These allow the hierarchies which separate nominal ownership from beneficial ownership to be understood. Adoption of LEIs is progressing but is not yet complete.

The impact of blockchain technologies on the management of in-house business improvement projects, and especially business transformation projects, would, of course, be decisive if a custodian bank chose to adopt the technology. If the current estimate of the transformational power of blockchain technologies prove to be accurate, the consequences will dwarf all other projects custodians currently have in hand. This is why the impact on both costs and revenues is set so high.

<sup>9</sup> The proportion of operational costs accounted for by processing securities and derivatives transactions on behalf of clients is recorded under clearing and settlement costs.

<sup>10</sup> See page 16. Deloitte has built a digital identity service on a blockchain. Called Smart ID, individual and corporate customers create and store their digital identities on a blockchain using driving licences, passports, company registration documents, legal entity identifiers (LEIs) and ownership records, which are then endorsed by third parties to become verified credentials for use in transactions, obviating the need for the KYC process to start all over again every time a new relationship begins. FinTech company Tradle is also using blockchain to provide a similar customer-controlled KYC service to banks and insurance companies.

# The Limitations



To maintain confidentiality, and mitigate the risk of collusion, **there is now a widespread expectation that some form of governance will be required for blockchain networks.**

## The potential savings that would accrue to the custodian banking industry through the introduction of blockchain technologies itemised are substantial.

Its likely impact on industry revenues is potentially even greater. However, the projections compare what is happening today with what will likely happen in a blockchain future, and don't take into account the time the transition will take, or

the factors that might delay its progress. In reality, a number of factors are likely to mitigate or postpone the effects of blockchain technologies on both the costs and revenue of the custodian banking industry.

## Public versus private blockchain networks

The first is the distinction that has emerged between public and private blockchains. A Bitcoin-style public network is completely open. Anyone can join it, without permission, and see the entire contents of the ledger. A private network conversely allows only approved participants to join and restricts access to the ledger to authorised or "permissioned" participants only.

There is a widespread expectation among custodian banks, their clients, and regulators that any active blockchain networks in the securities industry will have to be permissioned. This is because public blockchains would be problematic if they were applied in an unmodified way to securities services. The most obvious problem is that private information about asset ownership and financial transactions would be visible to all members of the network.

Technical issues also argue for permissioned networks. The reliance of trust-less blockchain networks on a consensus mechanism incurs a security risk. Consensus mechanisms are vulnerable to the collusion to obtain the required minimum of 51 per cent of network members deeming transactions valid by proof-of-work before they are added to the

blockchain. This creates the network risk of being captured by "bad actors," since any group that controls more than half of its computing power can determine the outcome.

To maintain confidentiality, and mitigate the risk of collusion, there is now a widespread expectation that some form of governance will be required for blockchain networks. The conventional view holds that somebody will have to decide which entities are admitted to the network, and assume responsibility for monitoring the network for abuse (notably in the operation of the consensus mechanism). It is a role that some CSDs are looking to fulfil, yet could fall to any trusted independent party.

Another technical constraint revolves around the fact that the consensus mechanism requires large amounts of computing power. This prevents transactions from being processed in real-time. It also limits the number of transactions that can be processed quickly to levels far below everyday volumes in securities markets. In Bitcoin networks, confirmation times are now ranging from 30 hours, and participants must pay more to receive faster results.

# The Limitations

Currently, the development of **closed, proprietary blockchains in different asset classes** seems unavoidable.

Even 30 hours compares well with the trade date plus two days (T+2) settlement timetable in the securities markets, but a large part of blockchain's appeal lies in its potential to settle transactions instantaneously, since that is what will make clearing and settlement less capital-intensive. Fortunately, proof-of-work is not relevant to permissioned networks, so the speed constraint can be bypassed by running separate blockchains in parallel.

## The importance of network effects

Network effects in blockchain are like network effects in telephony: the network will increase in value in line with the number of market participants connected to it. If counterparties in the securities and funds markets around the world are diverted into multiple closed networks instead, the power of network effects will be diminished.

In fact, the bulk of the projected savings from blockchain technologies are contingent on the networks having as wide a membership as possible. The business case for adopting blockchain technology hinges on other market participants adopting the technology and becoming accessible through it. In fact, it is not hyperbolic to say that the entire case for blockchain hinges on widespread adoption.

At present, however, most blockchain proof-of-concept projects funded by the custody industry focus on a component piece of the post-trade value chain, such as collateral management or proxy voting. The single use-case approach currently pursued

All of these factors mean the custody industry is likely to develop not a single global blockchain network, but a series of private, permissioned networks in different markets and asset classes, and within different markets and asset classes. This excludes the possibility of collusion since the members of a network are always known. There is, however, an important consequence: unless they can inter-operate seamlessly, multiple blockchains will limit the benefits of network effects.

might seem less risky, but its capacity to slow down the impact of network effects could prove fatal to the widespread adoption of blockchain technologies.

Currently, the development of closed, proprietary blockchains in different asset classes (cash, securities, derivatives), functions (clearing and settlement, asset servicing, KYC and KYCC), and industry segments (investors, trading platforms, insurance) seems unavoidable.

To reach the full efficiency gains from blockchain, a means for these networks to inter-operate must be found. Indeed, since the transition from current post-trade processing systems to blockchain alternatives will inevitably be slow and incomplete, there must also be a way to enable blockchain networks to inter-operate with legacy clearing, settlement, and asset-servicing platforms such as Real Time Gross Settlement (RTGS) payment platforms and CSDs.

## The Limitations

RTGSs will play an important role in the transition to blockchain technologies.

### Standards

One way to link multiple closed blockchain networks, and with networks reliant on non-blockchain technologies, is to adopt a common language for exchanging information. This means agreement on messaging standards so the various networks can inter-operate.<sup>11</sup> Thus will not be easy. Despite the success of bodies such as SWIFT, the international messaging standards co-operative, standards have not penetrated the financial services industry to anything like the optimum extent.

### Market infrastructures

One group of institutions that will help to govern the pace of adoption of blockchain technologies is the existing financial market infrastructures of the securities and payments industries. These are the central bank-operated Real Time Gross Settlement systems (RTGSs) that settle inter-bank transfers between accounts at the central bank, the CSDs in which securities are transferred between accounts against payment in central bank money, and the central counterparty clearing house (CCPs), which act as counterparty to all transactions in a variety of asset classes, including securities and derivatives.

RTGSs will play an important role in the transition to blockchain technologies. This is because a cash ledger on blockchain cannot be operated until fully fungible cash equivalent to modern fiat currencies is issued on to a blockchain. No central bank, as issuer of a fiat currency, has yet agreed to do this, nor has any central bank accepted payment in an alternative currency (such as bitcoins), even though counterparties are prepared to do so.

Even where standards are adopted, there are often local variations, and banks and their clients do not always agree to use the latest versions. In the custody industry, in particular, there is a longstanding reluctance to endorse standards, because they make it more difficult to lock clients into a relationship they cannot escape. The likely delays to the adoption of a standard language for blockchain networks will create fictional costs which mitigate the benefits. Those frictional costs will be eroded over time, but in the short term, they will be part of the residual revenues of the custody industry.

The result is that, although it will be possible to deliver securities against cash payment, cash settlement will not take place on the blockchain. It will occur in established payments mechanisms agreed between the counterparties. They could settle in commercial bank money, either directly, or through one of the automated clearing houses (ACHs) that net payments between banks for submission to the RTGS, or through a “tokenized” currency issued on to the blockchain, but underpinned by cash holdings in escrow accounts.<sup>12</sup> The clients of custodian banks, however, are likely to prefer cash settlement in central bank money.

This represents a serious constraint on the rapid adoption of blockchain technologies. Delivering assets into a blockchain, and retrieving them from a blockchain, will remain subject to existing settlement timetables even if movements are made free of payment. This will remain the case regardless if cash or securities remain in custody with banks or CSDs (into which assets are issued, and by which the integrity of issues is maintained, and transactions settled), and are exchanged on the blockchain in “tokenized” formats.

<sup>11</sup> See SWIFT information paper, Distributed Ledgers, Smart Contracts, Business Standards and ISO 20022, September 2016.

<sup>12</sup> Blockchain payments specialist SETL, for example, addresses this problem by issuing details of funded customer accounts at a bank to its blockchain, and authorising payments from those accounts by checking the digital identities of the people initiating the payments.

## The Limitations

Regulators have encouraged the development of blockchain technologies, because they see in them the potential to lower costs to investors and encourage new entrants.

This is one reason CCPs are also likely to survive, at least for the short term. Theoretically, real-time settlement on a gross basis in a blockchain removes the need for a CCP to eliminate counterparty risk and net transactions against each other. In practice, the persistence of conventional timetables means central clearing will, at least for some time, retain its appeal. Counterparties to longer-dated derivatives transactions may even continue to see value in netting via a CCP in the long term. After all, it is better suited to managing counterparty risk over time, rather than per transaction (though netting can also be done via a blockchain).

However, infrastructural constraints can be expected to gradually disappear, as central banks issue fiat currencies on to blockchains, and CSDs develop blockchains for securities issuance and settlement. It will nevertheless

### Regulation

Regulators have encouraged the development of blockchain technologies because they see their potential to lower costs for investors and encourage new entrants. Financial markets, though, tend to be internationally focused. Implemented regulations, therefore, make it difficult to move cash and assets across borders. The consent of multiple domestic regulators to operate a blockchain internationally will be required.

The main reason the existing bi-lateral links between CSDs – in which one CSD opens an account at another, and vice-versa – have failed to improve the efficiency of cross-border settlement is that regulation means each link between any pair of markets has to be unique. This costs time and money. In theory, a blockchain network transcends this problem since the assets will not have to move out of the custody account at the local CSD. Instead, the customers will issue “tokenised” rights over the assets on to a blockchain, allowing rights-to-assets rather than transferring the

take time. Although some CSDs are intrigued by blockchains,<sup>13</sup> they know many of its benefits can be obtained with conventional technology. If CSDs installed links between their settlement platforms, for example, they could already provide real-time delivery against payment across market and asset classes.

The cheapness of the blockchain alternative is likely eventually to triumph. Its higher level of security is the principal reason. Inter-CSD links would connect centralised databases, while a blockchain network would provide multiple copies of a single database. The fact that the database is distributed means there is no dependency between databases, no single copy, and no single point of failure. However, even a successful and mature blockchain network cannot escape regulatory constraints.

assets themselves to settle a claim or cover an exposure. Instead of building a bi-lateral link to each CSD in the network, every CSD can connect to every other CSD in the network by connecting once through a blockchain.

Exchanging “tokenised” rights of ownership, while allowing assets to stay in custody in their original jurisdiction, saves further time and money by eliminating the need to reconcile different accounts of the transactions held in proprietary ledgers at separate CSDs. What this technique cannot overcome is the restriction of settlement to conventional timetables. Securities can only be delivered against payment to the timetable set by the underlying CSD and cash payments infrastructure, which is usually trade date plus two days (T+2). But trading “tokenised” rights on a blockchain does mean a genuinely global network can be grown. If regulators were bold enough to mandate technological change – as they were with T2S – the global blockchain network could emerge much sooner.

<sup>13</sup> The Australian Stock Exchange (ASX) is planning to build the next version of its CSD using blockchain technology.

## The Limitations

Unbounded enthusiasm for new technologies tends always to leave transition time out of the equation.

### Transition time

It is not, however, expected it to emerge that soon. Even if the lack of fiat currencies on blockchains, differences between national regulatory regimes, continuing reliance on current settlement systems and timetables, and the industry preference for a piecemeal, use-case approach were not obstacles to progress, a sudden switch from existing technologies to blockchain technologies is impossible.

Legacy and blockchain systems will have to run in parallel for a time, even if there is eventually a wholesale switch from existing technologies to blockchain technologies. Some asset classes and markets are likely to move to blockchain faster than others, and the pioneers will have to inter-operate with the laggards.

Unbounded enthusiasm for new technologies tends to always leave transition time out of the equation. Investment is a cost and one full of risk. It is undertaken only when the future rewards are adequate to compensate for the cost and the risk. In fact, the principal reason the custody industry has not invested already in higher levels of automation using conventional technology is a lack of managerial conviction that the costs and risks will be rewarded adequately.

It is not yet clear that blockchain technologies have altered that calculation. However, it is reasonable to believe that

the markets in which the risks are lower will transition to blockchain sooner. Emerging markets, which have less invested in legacy technologies and techniques, are likely to switch first. This will slow down the otherwise inexorable disappearance of the most obviously vulnerable group: the sub-custodians.

It also means that somewhat counter-intuitively, the emerging market sub-custodians will lose their occupation first. It is in emerging markets that custody fees remain the most abundant, simply because the transaction volumes are lower and the market infrastructure has devoured less of the value sub-custodians add. For the same reason, the real savings on sub-custody fees will not be realised until the high volume developed markets transition to blockchain.

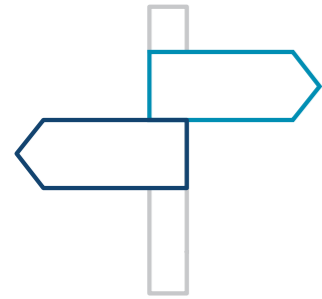
Likewise, global custodians will persist for a time, albeit in an altered form. They will be needed, even as blockchains encompass an ever-wider range of markets and asset classes, to help buy-side clients cope with an environment characterised by a combination of multiple blockchains inter-operating with multiple legacy systems. But their disappearance will only be postponed. Once global markets have shifted to a single global blockchain network or network of blockchain networks, the extended transition of global custodians to a future that has no further use for them will be over.



“There is nothing more difficult to plan, more doubtful of success, nor more dangerous to manage than the creation of a new order of things...  
**Whenever his enemies have the ability to attack the innovator they do so with the passion of partisans, while the others defend him sluggishly, so that the innovator and his party alike are vulnerable.’’**

Niccolo Machiavelli, *The Prince*

# Next Steps



...regulators are encouraging new technologies as well as new entrants, they are also mindful of the need to maintain the stability of the clearing, settlement, and custody infrastructures on which current services depend, avoiding any increase in systemic risk.

**Shifting any existing business process on to any new technology is always a more complicated and time-consuming process than using a new technology to compete with incumbents using an old technology.**

Digital technology has certainly steepened the “innovation adoption curve” described by Everett M. Rogers – mobile telephones, for example, achieved 100 per cent penetration in Western Europe and North America within a decade – but the pace of innovation in the custody market will not be rapid, unless it attracts firm central bank and regulatory support.

Although regulators are encouraging new technologies as well as new entrants, they are also mindful of the need to maintain the stability of the clearing, settlement, and custody infrastructures on which current services depend, avoiding any increase in systemic risk. Their concern is amplified by the fact the custodian banking industry is highly concentrated. As a result, the industry is heavily regulated. Shareholders in custodian banks, though interested in raising returns, are also wary of managements that wish to embark on bet-the-bank technology strategies, causing a high degree of conservatism in the custody industry.

This caution is magnified by the knowledge that blockchain technologies face a number of obstacles before they can operate at the necessary scale. Chief among them is the fact that the underlying technology is not yet mature. There are many successful proofs-of-concept but no implementations in the industry yet. Although methods of escaping the speed and capacity limits of the proof-of-work consensus mechanism of Bitcoin-style blockchain technology are being developed, Bitcoin remains the only large-scale implementation of the technology so far – and it is running into operational challenges of its own.

The number of unconfirmed bitcoin transactions recently cleared 200,000, as the operators of the computers – the “miners” that compete to earn Bitcoins by solving complex mathematical problems to process transactions for addition to the blockchain – disdain to work for the proffered transaction fees. For a technology that is challenging a custody industry reluctant to move from netting and batch processing to real-time delivery-against-payment, it is ironic that bitcoin traders have taken to netting transactions against each other to reduce transaction fees – but without an agreed or standardised timetable for delivering value, which in turn, creates counterparty settlement risk.

It is also clear that many inefficiency issues in the custody industry can be solved without blockchain, by using traditional database technologies. In fact, the crucial component in the collapse of the extended chain of intermediaries is not blockchain, but a shared ledger. A common database of this kind could be created today by, for example, a CSD opening up its accounts to all participants in the industry instead of just the custodian banks that make up most of their membership.

# Next Steps

...any technology that threatens to cannibalise existing revenue streams is hard for incumbents to adopt. They are bound to argue that blockchain technology is over-hyped, instead diverting time and money into innovation laboratories that they can control, or into discrete use-cases that fail to progress.

Such a database does not need to be centralised. It is possible to operate a distributed ledger without using blockchain technology. However, it remains true that, in any use-case where multiple parties transact while maintaining its own copy of transactions, the efficiency gains from adopting a single but distributed ledger using blockchain technology will outweigh those achievable by any other means.

Those efficiency gains can accrue to the custody industry. They are also capable of doing serious damage to the revenue model of the industry. Unless custodians are prepared to look beyond the efficiency improvements offered by this new technology, in particular, the new sources of revenue it might offer, their future prospects are bleak. Those new opportunities are likely to be found in areas where blockchain can transform the economics of business, providing services that were previously too expensive to provide at a profit.

But any technology that threatens to cannibalise existing revenue streams is hard for incumbents to adopt. They are bound to argue that blockchain technology is over-hyped, instead diverting time and money into innovation laboratories that they can control, or into discrete use-cases that fail to progress. In short, incumbents have every incentive to make adoption of blockchain seem difficult. While this may sap momentum and stall innovation, if the technology can indeed deliver the benefits it promises, the strategy involves of postponement, not survival.

In the end, the rate of adoption of technology is driven by customers rather than service providers. There is no doubt that if blockchain technology proves robust and scalable, the customers of the custodian banks will want to take advantage of the benefits it offers in terms of economy, security, asset safety, and transparency. What remains in question is the pace at which adoption occurs. This depends on the willingness of the custodians’ customers to challenge existing providers to adopt the new technology, as well as making a valiant effort to back new entrants that are using it already.

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