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Financial system impact of disruptive innovation

Working paper for the United Nations Environment Programme inquiry

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About the inquiry

The Inquiry into the Design of a Sustainable Financial System has been initiated by the United Nations Environment Programme (UNEP) to advance design options that would deliver a step change in the financial system's effectiveness in mobilising capital towards a green and inclusive economy.

Established in January 2014, it will publish its final report in the second half of 2015. More information on the Inquiry can be found at www.unep.org/greeneconomy/financialinquiry

Contact: Mahenau Agha, Director of Outreach, mahenau.agha@unep.org

Working paper series

This Working Paper is intended to stimulate discussion within the research community and among users of research. The views expressed in this paper represent those of the authors and do not necessarily represent those of the host institutions or funders.

1. Overview and conclusions

In this report we examine disruptive innovations and their implications for the design of a green and inclusive financial system. The scale of the challenge of the transition to such a system calls for flexibility and experimentation with a diverse set of policy approaches.

This research was conducted in support of the United Nations Environment Programme (UNEP) Inquiry into the design of a sustainable financial system that can accelerate the transition to a prosperous and inclusive green economy. Its objective was to examine the implications for the design of such a system of disruptive innovation.

Such innovations are by their nature not mainstream, and may never become so. They can be driven by top-down, centralised innovation in policy and regulation (Section 6) or by bottom-up, decentralised financial market innovation (Sections 2 and 3). Such market innovations can be stimulated by drivers of change that are external to the financial system, such as long-terms shifts in environmental and social factors (Section 4) or technological innovation (Section 5).

An efficient and resilient regulatory regime must not only deal competently with the financial system that exists currently; it must also have adaptive capacity to deal competently with the system that is emerging. Therefore, to be truly effective, financial policy and regulation must be forward-looking and prepared to accept the challenge of keeping pace with disruptive innovation – both realised and potential.

We identify five trends in this report which are relevant to the design of a green and inclusive financial system:

1. Disintermediation of capital and payments

2. New forms of credit creation

3. Long-term environmental and social impacts

4. Technological innovation

5. Innovations in economics and financial policy

For each of these trends we provide examples of innovative business models and policies or specific disruptive factors. Within these 5 trends we identify 18 categories and sub-categories of innovations, which are illustrated by 18 case studies of which 6 are global in scope, and the others are from 7 countries across 5 continents.

We briefly summarise these five drivers of change before considering the implications for the design of a green and inclusive financial system, and drawing some conclusions for policymakers.

1.1 Five drivers of disruptive innovation

1.1.1 Disintermediation of capital and payments

The use of technology combined with new business models is removing traditional intermediaries from financial transactions. Perhaps one of the noisier innovations in recent years has been digital currencies that record peer-to-peer payments (P2P) in decentralised ledgers (crypto-currencies). While Bitcoin is the most famous, the same basic technology can support a huge number of variations.

Alongside disintermediation of payments we are also seeing disintermediation of capital on an increasing scale. Crowdfunding and P2P lending inverts the traditional model of intermediation. Instead of a small number of decision-makers allocating large sums of money, a large number of individuals each allocate a small sum of money. This decentralisation of control over financial capital may have significant implications for overall allocation within the economy, and for regulators seeking to influence sectorial allocation.

The extent to which citizens will seek greater control of their money, or will choose to continue to delegate such decisions to professional experts, remains largely untested. To the extent that they take more control, will they choose a greener, more inclusive allocation than today's bankers and asset managers? Perhaps the wisdom of the crowd ultimately rests on the quality of information they have at their disposal, and hence greater transparency over economic, environmental and social impacts of investments will become essential.

The extent to which P2P payment and capital allocation displaces banks, or merely forces banks' business models to evolve, also remains to be seen but the least likely outcome is that these digitally enabled innovations have no impact at all.

1.1.2 New forms of credit creation

Contemporary monetary systems are based on the use of transferable liabilities, or IOUs, as a medium of exchange. The great bulk of the broad money supply comprises transferable IOUs issued by commercial banks in the form of bank deposits, with the residual made up of central bank IOUs (Ryan-Collins *et al.*, 2011). However, a promise to pay from a non-bank or non-state entity can also function as money, provided that sufficient economic actors agree to accept it as payment. These forms of 'common tender' rest on voluntary acceptance, in contrast with 'legal tender', the acceptability of which is enforced by the state.

In practice, common tender has a long history; new forms of credit, or money, creation have emerged during periods of economic stress such as the 1930's Great Depression (Fisher, 1933). Contemporary models include the Swiss WIR Franc system, the commercial barter industry in the USA, and Brazilian community banks issuing local currencies.

We analyse credit creation separately from payments and capital intermediation precisely because this can be a source of confusion. Banks are often described as intermediaries, but this ignores their critical role as the creators of the money supply. Bitcoin is both a new technology for making payments, i.e., transferring existing purchasing power, and a crypto-currency that acts as a new source of additional purchasing power in the economy. These are two distinct activities.

Credit creation is of particular interest because how new purchasing power is created and first applied in the economy has a significant impact on economic, social, and environmental outcomes. It matters a great deal whether credit is created for the purchase of existing assets, for example land and existing buildings, or for the creation of new assets, for example construction of new buildings. It matters whether credit is created for the extraction of fossil fuels or the construction of renewable energy infrastructure. It matters whether credit is created only for the asset-rich and in the wealthiest locations, or whether it also funds entrepreneurial opportunities in the poorest and most remote corners of the economy.

The reduction in operating costs and increased scope of functionality enabled by advances in digital communication technology may be an enabling factor for new alternative credit systems to scale and proliferate. Experimentation in crypto-currencies demonstrates the potential to design currencies to create credit for particular purposes and therefore they could be of interest for the design of a greener and more inclusive financial system.

1.1.3 Long-term environmental and social impacts

A range of related phenomena – resource constraints, climate impacts, falling labour productivity, stagnating real wages, demographic change, and unsustainable debt levels – has implications for long-term economic trends. Constraints in natural resources relative to demand can be expected to drive shifts in relative prices, and the economic impacts of climate change are highly uncertain. These factors are important for long-term savings vehicles – in particular funded pension schemes – and for the insurance industry. In terms of policy implications, a closer alignment of the risk and reward profile of financial instruments with environmentally sustainable investment and government policies needs to emerge. A collaborative international approach to climate change uncertainty is developing within the insurance industry. This makes sense for a problem that is global in scope, and could be mirrored by a collaborative international approach to financial policy.

1.1.4 Technological innovation

Innovations in technology can often lead to innovations in the financial system. The use of information technology has led to a revolution in the way that financial transactions are recorded and processed as well as leading to the provision of new services and business models. Two interlinked and overlapping technological trends – the increase in volume and variety of data ('big data'), and the move towards everyday devices being connected to networks (the 'Internet of Things') – are likely to require some aspects of the financial system to adjust their practices in order to remain relevant and profitable in the future. They present new challenges for regulation of the financial sector in terms of its use, transparency, and ownership rights of data.

1.1.5 Innovations in economics and financial policy

The financial crisis has led to a re-examination of earlier theories and policy instruments in the field of macroeconomics and finance, with consequences for monetary policy and the regulation of the financial sector. We examine six developments in the area of macroeconomic and financial policy that have potential to contribute to the design of a green and inclusive financial system: capital flow management, green credit guidance, strategic quantitative easing, full reserve banking, financial transactions tax (FTT), and the evolution of a global reserve currency.

Unlike the previous four drivers of disruption, which are factors to which policies must react, these policy instruments could be proactively deployed by governments and regulators to promote a greener and more inclusive financial system.

The six potential innovations reviewed here are only a subset of the many instruments that are available to national and international policymakers. They range from the untested, such as full reserve banking, to policies that are in implementation in parts of the world but which have not reached international consensus for global implementation, such as FTT, green credit guidance, and capital flow management.

1.2 Implications for design of a green and inclusive financial system

The aim of this research is not simply to compile a list of innovations, and drivers of innovation, within the financial system. Neither is it intended to make predictions. The question is to what extent the drivers of change identified here are relevant for the design of a sustainable financial system. We can break this down into a series of further questions:

- Is the innovation likely to have a material impact?
- If so, will it improve, worsen, or have no impact on the sustainability performance of the financial system?
- Might it interact with other innovations in ways that enhance its impact?
- What should the policy response be, if any?

Table 1 provides an overview of potential impact of the 18 different innovation domains discussed in this report.[1]

1. Crowdfunding and P2P lending are combined into one row in the table.

Table 1: Potential impact of innovation domains

	Sustainability impact		Materiality			Likelihood	
Innovation	Green	Inclusive	Current size	Growth potential	Structural change	Adoption stage	Likelihood to scale
Decentralised P2P payment systems	Neutral	●●	●	●●●	●●●	Innovation	●●
Mobile payment systems	Neutral	●●●	●●	●●	●●	Early adopters	●●
Non-banks	Neutral	●●	●●	●●	●	Early adopters	●●
Crowdfunding & P2P	Neutral	●	●	●●	●	Early majority	●●
Community devel-opment banks	Positive	●●●	●	●●	●	Early adopters	●●
Closed loop community credit clearing systems	Positive	●●	●	●●●	●	Early majority	●●
Digital currencies	Neutral	●●	●	●●●	●●●	Early adopters	●●
Pensions	Positive	-	●●●	-	●●●	Early adopters	●●●
Insurance	Neutral	-	●●●	-	●●●	Early adopters	●●●
Big data, profiling, and insurance	Neutral	●●	●●	●●●	●●	Early majority	●●●
Driverless car and insurance	Neutral	●●	●	●●	●●	Innovation	●●
Capital flow management	Neutral	●●	●●	●●	●●	Early majority	●●
Green credit guidance	Positive	●	●	●●●	●●	Early adopters	●●●
Green QE	Positive	●●	●	●●●	●●	Innovation	●
Full reserve banking	Neutral	●	-	●●●	●●●	Innovation	●
Financial transaction tax	Neutral	●	●	●●●	●●	Early adopters	●●
Global reserve currency	Neutral	●	●●●	●●●	●●	Early majority	●●●

Legend: Low: ● Medium: ●● High: ●●●

We assess that disintermediation of capital and payments has a moderate likelihood of material impact on the financial system. The creation of new P2P digital payment systems in particular has the potential to cause systemic change. Although we consider this to be broadly positive for inclusiveness of the financial system, as the spread of mobile phone payments systems in Africa has shown (Section 2.2), the impact on environmental outcomes is neutral. In other words, we see nothing inherent in these technologies that would mean their adoption would improve environmental outcomes of the system as a whole. This presents a challenge for policymakers that we discuss further below. Should policy and regulation that explicitly promotes sustainability be applied to these new business models?

Similar questions arise for new forms of credit creation. We also rate these as broadly positive for inclusiveness, largely because of the explicit social mission of community development banks (Section 3.1). The greater visibility and shortening of supply chains encouraged by mutual credit systems and local currencies should also promote better environmental outcomes. However, these tendencies are not powerful enough to be confident that, if alternative credit systems were to reach a significant scale, this would necessarily and significantly improve the sustainability outcomes of the financial system as a whole.

Whether disintermediation and alternative credit creation do indeed drive significant and structural change will depend on a number of factors, primarily the speed and extent of adoption among consumers and the reaction of incumbents to any loss of market share.

It would be rash to attempt to forecast the speed and extent of consumer adoption. However, the possibility of widespread adoption of innovations in disintermediation and credit is sufficiently high that it would be equally rash to discount it completely in the design of more sustainable financial system. We discuss further what this might mean for policy and regulation later in this section.

We have seen banks starting to adopt new payment technologies, but it remains to be seen whether banks react to eroding market share of personal and small and medium enterprise (SME) lending by acquiring P2P lenders and offering similar services. Equally, P2P lenders might add more customer services to their own business models until they become more like banks.

Turning to the external drivers of change – environmental and technological trends – these seem highly likely to have significant impacts on the financial system. In the case of pensions and insurance (Section 4), the need to take account of long-term environmental impacts such as climate change and resource constraints on financial returns might drive change within the industry to improve its own sustainability. This is far from certain, however, and suggests that active policy and regulatory intervention should be on the agenda. Other innovations, such as big data and the Internet of Things (Section 5), have no inherent impact on sustainability either way and require a watching brief from financial policymakers as to how such real economy innovations might affect the financial system.

1.3 Conclusions for policymakers – external and market drivers of change

These first four drivers of change are ones to which financial policy and regulation needs to design a response that promotes a green and inclusive agenda. However, the applicability of existing financial regulation architecture varies to a great extent. For example, the existence of capital adequacy rules for banks allows the possibility of designing sustainability criteria into them that will have a direct impact on the lending decisions of banks. There is no equivalent lever for P2P lending or new forms of credit.

We assessed the applicability of existing regulatory structures to the different innovation domains discussed above and mapped this against their likely scale and potential to drive systemic change (Figure 1). Using these three criteria we derived three different clusters:

1. High potential for systemic change – existing regulatory structures are applicable.
2. Low potential for systemic change – existing regulatory structures are applicable.
3. High potential for systemic change – existing regulatory structures have little applicability.

1.3.1 High potential for systemic change – existing regulatory structures are applicable

We place pensions in this quadrant (upper-left quadrant in Figure 1) because the uncertainties of financial returns that might be caused by the uncertainties around long-term environmental impacts on the economy could ultimately undermine the existing system of pension provision. The pensions industry is based on financial investments accumulating a fund over an individual's lifetime that can provide some degree of security in old age. The introduction of greater uncertainty about potential returns might create pressure for pensions systems to directly underwrite basic essentials such as housing, energy, transport, health, and social services through collective vehicles, including state and mutual provision, rather than individualised financial investment vehicles.

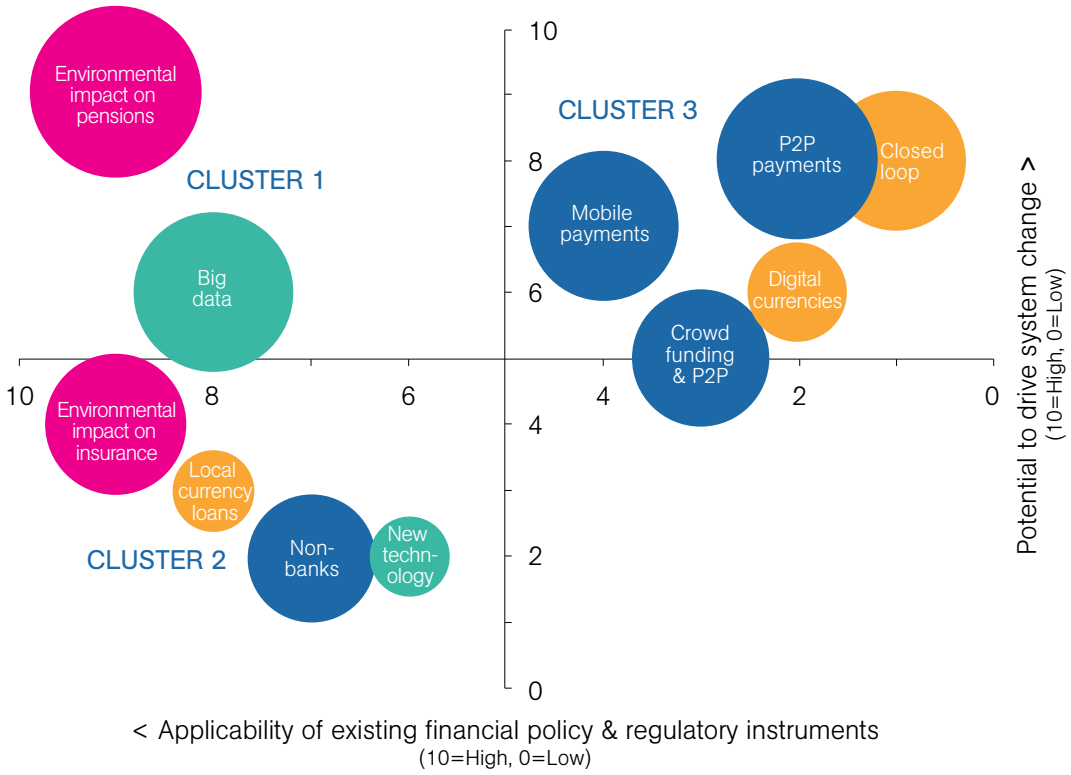
Big data is also a potential driver of systemic change for similar reasons. Advances in medical science combined with big data changes the nature of risk assessment at the individual level. The more that insurance products and premiums are tailored to the individual's specific risk profile, the less like insurance and more like savings they will seem to customers. The case study of genetic profiling in the USA suggests that where risk factors are beyond the individual's control, such as genetic inheritance, the consequent health impacts may be less suited to private insurance vehicles.

1.3.2 Low potential for systemic change – existing regulatory structures are applicable

In this quadrant (lower-left quadrant in Figure 1) we place four domains of innovation. The challenge to the insurance market posed by uncertain long-term environmental changes is one that can be met by the right policy within existing regulatory systems and financial institutions. The entry of non-banks

into the banking market is not changing the rules of the game but just adding new players. Existing regulatory structures are suitable, with some changes to address the boundaries between banking and shadow banking. Local currency loans by community banks also operate broadly within existing regulatory structures. Although the impact of technological innovation in the real economy is harder to predict, there is no inherent reason that this could lead to disruptive change in the financial system itself.

Figure 1: Potential impact of innovations vs. applicability of existing regulatory system



1.3.3 High potential for systemic change – regulatory structures have little applicability

The third cluster sits in the upper-right quadrant of Figure 1. These are potentially disruptive innovations that pose the greatest challenge for the design of policy because they mostly sit outside the existing envelope of financial policy and regulation.

Mobile phone payments (Section 2.2) perhaps offer the least challenge because the operators are large, existing corporations (telecom companies) that can relatively easily be brought within the purview of financial system regulation. However, P2P payment technologies (Section 2.1), the digital currencies with which they are closely associated (Section 3.3), and closed loop credit clearing systems (Section 3.2) are not operated by large established corporations, financial or otherwise, over which financial regulators can have ready oversight.

To date, most discussions on regulation have focused on conduct regulation; P2P lenders and crowdfunders (Section 2.4) are already being brought within its remit. Conduct regulation exists to ensure fair treatment for customers, and we might expect other new business models to also come under suitable conduct regulation sooner or later.

It is other forms of regulation, however, that most offer policymakers the levers to drive particular environmental and social outcomes. For example, extensive micro-prudential (individual firm stability) and macro-prudential (whole system stability) regulations already give financial regulators the ability to intervene in the provision of credit and other services in the interests of financial stability. The same mechanisms can be deployed to intervene in the interests of social and ecological stability.

Such mechanisms do not yet exist for this cluster of innovations and so we conclude that the Inquiry into the Design of a Sustainable Financial System should include a specific inquiry into what new regulatory mechanisms might be needed to drive more sustainable outcomes within these emerging parts of the financial system.

One common feature of these innovations is placing more market power in the hands of consumers, for example by allowing them to choose directly which projects and companies to invest in. This poses an intriguing question: Will the collective decisions of empowered individuals lead to greener and more inclusive outcomes than the collective decisions of today's financial market professionals? If we think they will, then we could be in the ideal position of regulation being redundant. If we are not sure, however, we need to consider what instruments can encourage more sustainable outcomes within a much more decentralised financial system.

Without prejudging the conclusions of such an inquiry, areas that seem of immediate relevance are governance and transparency, with timely, accurate information about social and environmental impacts. By placing information about environmental and social externalities in the hands of empowered citizens, such regulation would be working strongly with the grain of markets.

1.4 Conclusions for policymakers – policy innovation

Finally we turn to changes that are driven by governments and regulators themselves. The policy innovations and case studies in this report (Section 6) illustrate that policymakers have a range of regulatory approaches available that can change the sustainability of the financial system.

Green credit policy and green quantitative easing (QE), as their names suggest, have a positive impact on environmental performance. Other policies, such as capital flow management, have been introduced to meet other objectives such as financial stability, and have the potential to have sustainability criteria designed into them. The challenge for such policy innovations is evaluating their impact against the counter-factual case of having not implemented the policy.

The primary conclusion we draw for the UNEP Inquiry is that financial policy and regulation can be divided into two types: first, those where co-ordinated global action is required, and secondly those where a variety of different national or regional approaches is both possible and desirable. For example, the challenges of attributing risk and losses from climate change impacts within the insurance industry (Section 4.2) demand a co-ordinated global regulatory approach. In contrast, credit guidance by national authorities that seeks to internalise environmental impacts in the allocation and pricing of credit does not require global co-ordination.

Indeed, lack of international consensus at this stage may prove to be an opportunity as well as a threat to successful policy implementation. Given the uncertainties facing the global economy and the scale of the challenge of transitioning to a green and inclusive financial system, experimentation with a diverse set of policy approaches would encourage innovation and speed of development, and allow for the accumulation of a body of evidence on their relative merits based on assessment of practical real world outcomes as well as theoretical robustness. Attempts at global co-ordination that prevented such local policy innovation would be counter-productive and should be resisted.

1.5 Notes on methodology and research

The research methodology we applied for this report involved identifying case studies of disruptive innovation globally that might have significant impact on the financial system, and were therefore relevant to the design of policy and regulation for sustainability. From these, we named 18 different domains of innovation and grouped them into 5 drivers of change.

This work is first empirical and then analytical. However, the forward-looking nature of the Inquiry has also required us to draw some tentative implications and conclusions. These are, by their nature, speculative and we both anticipate and welcome divergent conclusions being drawn from the material presented. The conclusion of which we are most certain is that the past is not necessarily a meaningful guide to the future; proper consideration should be given to emerging innovations and drivers of change discussed in this report, so that an explicit judgement of their relevance to the design of a greener and more inclusive system can be drawn.

2. Disintermediation of capital and payments

Digital technology is enabling new disruptive business models for making payments and matching savers with borrowers. Traditional intermediaries face potentially significant loss of market share to firms that sit outside or on the margins of the current financial regulatory system.

The validation and execution of financial transactions and the intermediation of capital are two services that form the very foundation of our banks and financial institutions. They represent the most common services through which businesses and consumers interface with the financial sector.

Financial transactions are agreements to exchange an asset for payment or transfer money from one person or institution to another. Until recently almost all transactions, unless carried out with cash, required a bank or regulated payment system operator to perform it on behalf of a customer. The importance of non-cash transactions has been rising steadily as evidenced by the declining proportion of the money supply held in banknotes and coins – only 3% in the UK (Ryan-Collins *et al.*, 2011) – and the rapid increase in use of debit and credit cards over the last 30 years.

Turning from payments to the intermediation of financial capital, new business models allowing investors to transact directly with those seeking funds potentially threaten banks and asset managers. As we discuss in Chapter 2, banks are not strictly financial intermediaries because they expand and contract the supply of money rather than purely intermediate the existing supply of money. However, although banks do not move funds from savers to borrowers, they do perform intermediate functions such as credit assessment, aggregation, maturity transformation, and as well as absorbing losses on loans.

Both the intermediation of payments and capital, mainly through the innovative use of technology, are now being disrupted by a variety of systems, organisations, and concepts.

Transactions are being disrupted in two main ways:

1. Decentralised P2P payment systems
2. Mobile payment systems

While capital intermediation is being threatened by:

1. Non-banks providing banking services
2. Crowdfunding and P2P lending

Innovations in payment systems have the potential, if appropriately adopted, to foster a more inclusive economy where almost every citizen of the planet has access to the financial system to send and receive 'value' electronically, thanks to the ubiquitous nature of mobile devices.

Innovations in intermediation are changing the way that capital is channelled for specific purposes. Non-banks entering the market have an incentive to innovate to win market share; they have different incentives for providing financial services and consumer brands that may be more susceptible to negative publicity. This may mean that future innovations by these organisations could result in more responsible allocation of the capital that is invested with them.

Decentralised capital intermediation systems, like crowdfunding and P2P lending, require individuals to proactively decide to invest or fund a specific project or type of activity. As the scope and range of projects that are financed increases, this could provide an avenue for both experimenting with new forms of greener and more inclusive production and consumption as well as embedding tried and tested positive innovations that struggle to get funding through traditional mechanisms.

2.1 Decentralised P2P payment systems

Over the last decade a new means of performing payments has been gaining increased recognition. This new payment system uses a de-centralised distributed ledger, which operates through a P2P network. The system uses cryptographic protocols to validate and perform transactions and to maintain the security of the network. In traditional payment systems, the financial institution is the middleman ensuring the person executing the payment has the necessary funds at their disposal and performs the transfer to the other party. The middleman is responsible for the security of the payment, insures the users against loss, and ensures that no fraud is committed. In the new decentralised systems the middleman is redundant.

An important factor that differentiates these new payments systems is the account information that needs to be shared in order to process a transaction. In the traditional system, the customer must provide sensitive private bank account information so that the merchant can use it to 'pull' the money out of an account. This information could then potentially be reused without the customer's permission, or shared or stolen in order to extract further funds.

In contrast, decentralised payment systems use a 'push' method. When a transaction needs to be performed, the user informs the decentralised ledger of their wish to move a certain amount of money to a certain account. The information used to execute this command cannot be reused and therefore also has no value when shared or stolen. The potential to reduce and eliminate transaction fraud offers a huge incentive to adopt the new technology. At present the most famous of these systems is the Bitcoin payment protocol.

Bitcoin is one of the most-discussed topics in payments right now, but it is also one of the least understood. It is important to distinguish between the technological platform and the design of the particular currency. Bitcoin as a currency has parameters that are variable and a matter of choice – the

number in issue; the method by which they are created; the exchange rate regime; payment of positive, negative, or zero interest on balances. Alternative currencies such as Solarcoin and Freicoin have different parameters. However, all are based on a decentralised P2P method for moving units of payment around the world easily, securely, quickly, and without the need of a financial intermediary. This can eliminate or significantly reduce the costs associated with non-cash transactions. Lower transaction costs would be attractive to individuals, SMEs, and large corporations alike.

Case 1: Bitcoin (global)

Bitcoin was developed in 2008 (Satoshi, 2008) to allow people to transact with each other outside the traditional financial system. The validation and execution of payments, normally activities conducted by a financial institution, is replaced with a cryptographic protocol that is validated though a P2P network (See Annex 1 for a detailed overview of how the Bitcoin payments protocol works).

At present, the underlying technological innovation has not received the same attention as the new currencies that use the P2P payment system. However many knowledgeable commentators recognise that the true innovation that Bitcoin has brought is a new de-centralised payment system and not the new currency itself.

"Bitcoin is a technological tour de force."
Bill Gates, Microsoft co-founder

"Bitcoin will do to banks what email did to the postal industry."
Rick Falvinge, IT entrepreneur

"The fundamental obstacles to Bitcoin being used more broadly in the payments system are arguably not insurmountable, though connections with the conventional banking system are ultimately essential to its functioning."
Goldman Sachs

Bitcoin's greatest potential is as a global payments network, to power transactions that are extremely low-cost, virtually frictionless, and easily flow across national borders. However, it faces some hurdles before it can be widely adopted as a payments platform. Primarily it must reduce the delay in clearing transactions as well as resolve some technical issues. Despite these barriers, its efficiency and low cost in comparison to legacy payments tools like credit cards, money transfer services, or letters of credit, will ultimately prove tempting for merchants, individuals, and business-to-business billing. Even where customers choose to delegate some functions to intermediaries or agents, the costs are very competitive. Bitcoin processors presently charge below 1% to process Bitcoin transactions, compared to the 2–3% often paid by merchants for credit card processing.

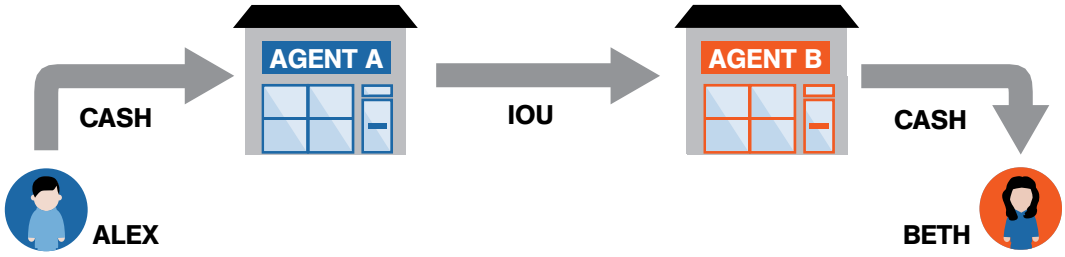
Fidor bank in Germany has just become the first bank to use a decentralised payment system as part of its transaction infrastructure. The bank has decided to use the Ripple open source software to allow customers to instantly send any currency in any amount at a very low cost. (Coindesk, 2014). This is a very significant move because for the first time it will be possible for developers of

decentralised payment systems to demonstrate that established players within the financial sector can also benefit from adopting these new technologies, allowing them to bypass the dominant payment systems and share savings with their customers.

Case 2: Ripple protocol

Ripple was first implemented in 2004 by Ryan Fugger and further developed until 2011 with the code finally being released in 2013 as open source. It was designed to eliminate Bitcoin's reliance on centralised exchanges, use less electricity than Bitcoin, and perform transactions much more quickly than Bitcoin. It has been compared to a digital version of the ancient Hawala network, which is a traditional, non-digital way of sending money from city to city. The network relies heavily on both trust and a strong honour system.

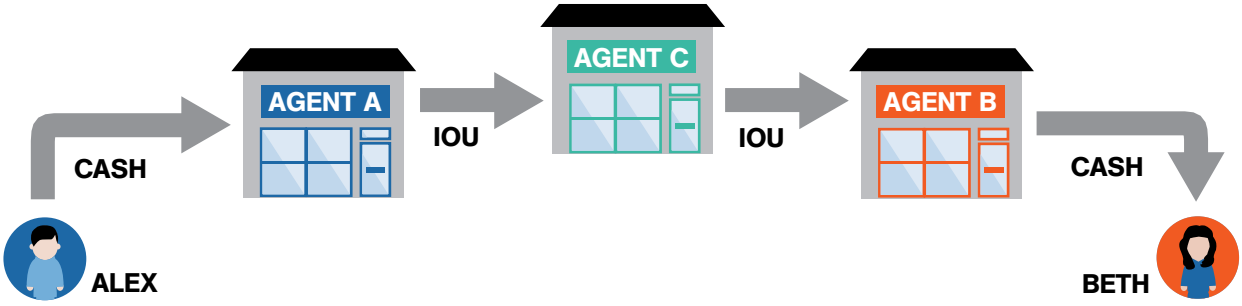
Figure 2: How the Hawala network functions



Note that money has been transmitted from Alex to Beth, but the physical notes have not moved. We are left in a situation where Alex's agent owes Beth's agent money. In the ripple network, websites perform the function of agents and, instead of agents phoning each other, they communicate the IOUs electronically.

The ripple network, building on top of a decentralised ledger, requires users of the system to extend trust to each other in order to be able to perform transactions. Once users and gateways (agents) build up their trust networks they can perform transactions without having to trust each other directly. So long as there are intermediary gateways that can form a chain of trust for the object being passed, the transaction will work. In many respects this also echoes the system of promissory notes, or bills of exchange, that operated very successfully in the medieval era with hierarchies of merchants acting as trusted guarantors of exchanges carried out on credit rather than for immediate payment in coinage or commodity money (Martin, 2013)

Figure 3: How the Ripple trust network functions



At the moment there are ten gateways that meet or exceed the international Ripple Business Association standards, although there are many more in existence which allow for transactions in many different currencies (See Annex 2 for details).

Ripple extends the possibilities of payment by allowing cash to be substituted for anything (gold, euro, dollars, bitcoins) provided that is it an accepted medium of exchange used by the agents in the trust chain.

2.2 Mobile payment systems

Consumer demands are increasingly driving businesses to innovate by creating new means of engaging with payment systems beyond cards. After the evolution and adoption of online payment systems, the next logical step has been the development of payment systems that can be used on mobile devices.

With the ubiquitous availability of mobile phones, innovative mobile service providers are starting to roll out basic banking services that can be used without requiring a bank account or having access to a physical bank branch. This is particularly relevant to developing countries where a majority of the population does not have access to traditional banking. In these countries mobile payment systems are enabling a section of society previously unable to access financial services to participate economically. This can be contrasted with developed markets where mobile payment systems are mostly integrated with the current financial system and merely facilitate the use of existing credit and debit card systems.

Case 3: m-pesa™ (Kenya)

m-pesa™ is a mobile payment system that allows individuals to transact financially without the need to have access to the local banking system. It is now the world's most used mobile payments platform, processing more than 41 million transactions per month with over 18 million registered users (Cracknell, 2012).

Users can pay in and withdraw cash from 78,000 agent outlets countrywide and can use their phones to instantly send money to others, or to pay bills. m-pesa™ is used for salary payments, loans and repayments, cash grants from NGOs, and international money transfer through a partnership with Western Union.

One of the main impacts of m-pesa™ has been to provide the unbanked with access to secure and affordable financial services. Since 2005, mobile money usage has grown from 0% to 68% of the population in Kenya, with 40% of those users not having access to a bank account (Demriguc-Kunt, 2012).

The number of mobile money programmes and the volume of transactions being conducted via mobile devices are increasing at high rate globally (GSMA, 2013)

2.3 Non-banks providing banking services

A recent report by Accenture highlighted the risk that 20% of bank revenue could be eroded by non-banks engaging in the provision of a variety of financial services (Accenture, 2013). There is a growing appetite among non-banks to seek revenue growth outside of their traditional markets; retail banking is a key target area. Often these players have large customer bases (Walmart, Alibaba) and are trusted by their users. In addition to competing for existing banking customers, there is also an ongoing battle to service the 'under banked' or the 'unbanked', which, even in developed countries like the USA, makes up about 25% of people (Reyes *et al.*, 2013)

Case 4: Alibaba (China)

E-commerce giant Alibaba Group has between 600 and 800 million unique users and advanced data analysis capabilities that allow it to know its customer base better than any bank. It has branched out from being a trading platform for goods to offering small loans, securities investments, and payment services. It has also ventured into insurance by co-founding a company to sell policies and settle claims online. It has received most attention for its Yu'E Bao money market fund, which has grown to the fourth largest in the world (ft.com, 2014).

2.4 Crowdfunding and P2P lending

The terms crowdfunding and P2P lending are often used interchangeably but for the purposes of this paper they will be defined as separate but related innovations. Both utilise internet platforms to match those seeking and offering finance without a financial institution acting as an intermediate party to the transaction. However, crowdfunding offers either rewards or equity participation in an enterprise, and P2P lending involves debt contracts and payment of interest.

2.4.1 Crowdfunding

With the advent of P2P technology it has become increasingly possible for a person or organisation to fund projects by connecting directly with their intended customer base. The industry is growing at over 80% per year (125% outside of the USA and the EU) (Berg Kartaszewicz, 2013) and is no longer confined to raising capital for small projects. In 2012, a project to create a new videogame 'Star Citizen' raised over USD40 million through crowdfunding (Wikipedia, 2014). It can be broadly divided into two types: donations/reward-based funding, and equity funding.

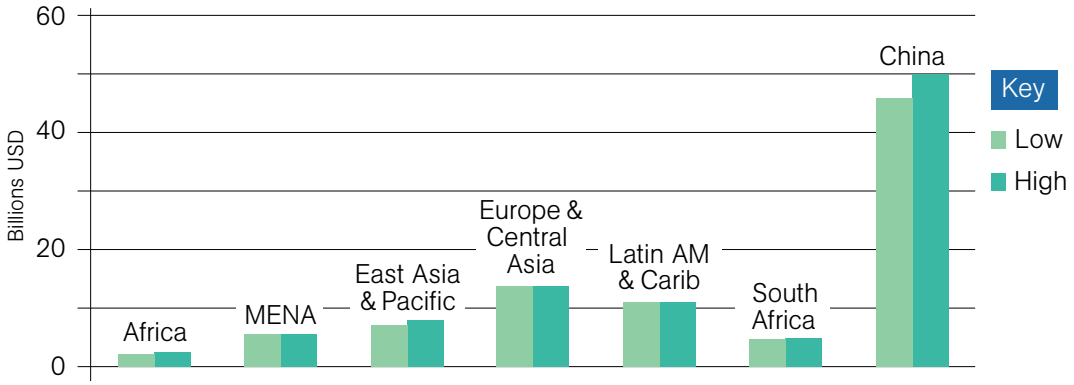
Crowdfunding has gained traction in the developed world but has yet to take off in the developing world. However, just as developing economies have bypassed fixed line telecommunications to move straight to mobile telephony, they could bypass traditional centralised capital market structures and regulatory regimes to move straight to a decentralised crowdfunding model (infoDec, 2013).

Figure 4: Suitability of crowdfunding models for the developing world

Type of crowd funding	Most suitable project type	Average funding sought (US$)	Suitable for developing world
Donation based	Arts	<$100,000	Yes
Reward/pre-sale	Project, product	<$100,000	Yes
Micofinance	Micro development	<$1,000	Yes
Social lending	Micro development	<$50,000	Yes
Equity based	Technology innovation	<$250,000	Yes, with the right structure

(Source – infoDev, 2013)

Figure 5: Estimated crowd-funding volume in USD per year per region in 2025



(Source – infoDev, 2013)

In order for developing countries to harness the full potential of crowdfunding, it will be vital for them to learn from experience elsewhere and to foster an appropriate light touch regulatory regime along with investment in the required network infrastructure. If so, crowdfunding could foster enterprise by allowing capital to flow to credible entrepreneurs.

2.4.2 P2P lending

The market for P2P lending developed and grew along with the emergence and acceptance of P2P networks and technology, and was boosted by the financial crash in 2008. During this time, banks were offering relatively low rates of return, so people with liquid financial assets sought out higher yield elsewhere. In tandem, entrepreneurs and SME businesses found it extremely difficult to raise funds through traditional means.

Case 5: ZOPA (UK)

Zopa is the world's oldest and Europe's largest P2P lending service. It brings together individuals who have money to lend, and individuals who wish to borrow money. The service expects to facilitate £400 million of loans in 2014.

Its streamlined online architecture and minimal physical overheads have allowed it to provide savers with much higher returns than those on offer through traditional financial establishments and to simultaneously offer borrowers lower rates. So far, the default rate on loans has been less than 0.8%, much lower than banks, which regularly see default rates of 3–5% (Moulds, 2012). One significant reason for the difference is the stronger relationship between the borrower and lender, which increases the way in which repayment is prioritised by borrowers. Zopa mainly offers small loans and is most competitive for borrowers on rates below GBP5000.

Case 6: Lending Club (USA)

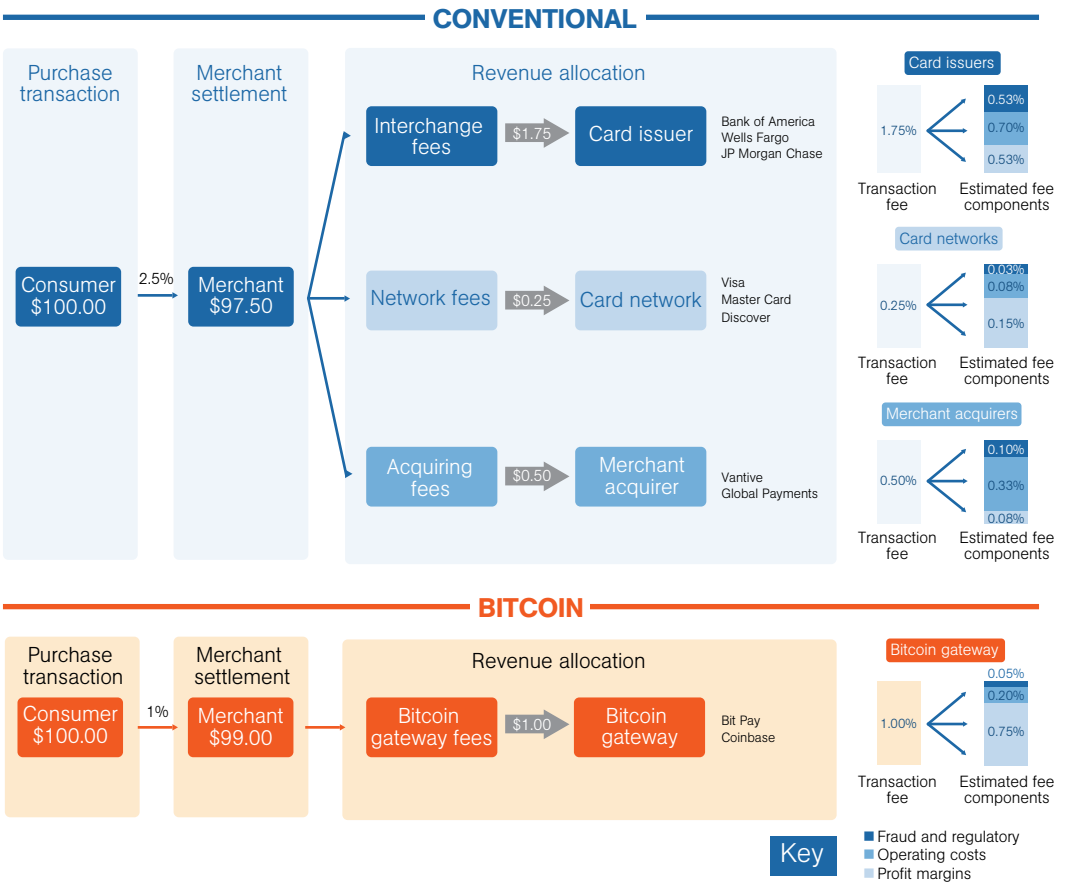
Lending Club, headquartered in San Francisco, was the first P2P lender to register its offerings as securities with the SEC, and to offer loan trading on a secondary market. Lending Club operates an online lending platform that enables borrowers to obtain a loan, and investors to purchase notes backed by payments made on loans. As of April 2014, Lending Club has originated over USD4 billion in loans, and averages USD7.8 million in new daily loans. (Lending Club Website, 2014)

Lending Club allows projects which often may not have found traditional funding to raise capital from individuals and businesses who are interested in the project, often in exchange for an experience or recognition. It offers cheaper rates than traditional banks because it operates online, automates loans for the most part, and has much lower operating costs. For example, it provides refinancing rates that are often at least 5–7% lower than standard credit card rates of 17–30%. Investors on the platform can also get interest rates of 7–24% higher than those offered by traditional investment companies. The company has already processed more than USD2.6 billion of loans and has attracted financing from large companies, including Google.

2.5 Impact on the financial system

P2P payment protocols offer an easy, secure, quick mechanism for moving any form of money around the world. They facilitate global trade through cheaper transnational movements of money and ensure that a higher percentage of remittances reach the beneficiary. The established players in the payment systems market will either have to adopt similar technology or potentially face serious market share erosion. According to Goldman Sachs (2014): 'The annual net savings if all electronic payments were conducted in Bitcoin could potentially add up to over USD150 billion in retail point of sale and USD12 billion in e-commerce fees per annum based on global 2013 purchase volume.' The same report calculates that the potential savings for those engaged in remittance payments, where processor fees are currently the highest, averaging about 8.9%, could see customers save USD48.9 billion if all USD549 billion of remittances were processed through the Bitcoin payment protocol.

Figure 6:- Conventional v Bitcoin payment systems – USD100 purchase overview



(Source: Reproduced from Goldman Sachs (2014))

Canada's central bank recently issued a report (Central Bank of Canada, 2014) highlighting the fact that the payment protocol offers the opportunity to improve financial services in some key areas by lowering transaction costs and removing financial intermediaries.

The generic term for networks such as Bitcoin and Ripple is Distributed Autonomous Systems and further innovation is likely. A system under development known as Ethereum is designed to use the decentralised ledger to record and transfer ownership of any sort of asset class without the need of an intermediary. Potential examples of applications are property deeds, contracts and shares. Such 'smart property' could turn the decentralised ledger into a global registry of ownership in physical assets, rather than just a record of volumes of a particular currency.

The potential for mobile phone payment systems varies between the developed and developing world. In the developed world, the risk to banking incumbents is that new entrants such as Facebook, Google, and Apple, which already have a large social media user base, are quickly able take market share. In the developing world, the key driver for increase in the use of mobile payments has been to allow individuals without access to the banking system to access financial services. The technology has a huge potential to facilitate remittances and will take significant market share from the incumbents in that sector.

Some commentators argue that the threat from Alibaba, and other major non-banks, to the banking industry has been overplayed; they doubt that online success will translate effectively to offline commercial activity, where the online players have no presence or history. Furthermore, assuming that successful non-banks are required sooner or later to submit fully to the same regulatory regime as banks, they will have to comply with tougher requirements on capital and liquidity that will make expansion in the real world much harder than online, as well as eroding their competitive advantage. Specifically related to Yu'E Bao, for example, are issues around how it might be able to handle liquidity fluctuations because of its inability to access the borrowing facility of the central bank or interbank market. Also, although money deposited in the fund has the appearance of ordinary bank deposits, they are not regulated as such and the impact of depositor losses or a run on the fund could be severe.

One of the consequences of Yu'E Boa in China has been that banks have had no choice but to launch their own money market fund (MMF) products and cannibalise their own deposits to defend their customer base. A report issued in February by Chinese International Capital Corp., a domestic brokerage, said that in three years the online money-market funds industry could manage funds comparable to 8% of all bank deposits and shave a 0.15 percentage point from banks' net interest-rate margin (McMahon & Zhu, 2014).

Companies with large customer bases who are deeply enmeshed in their commercial lives (e.g. Apple, Google) have the opportunity to take large market shares in comparatively little time. Walmart signed up over 1 million customers to its prepaid debit card in under 12 months. The implications of non-banks providing investment vehicles like Yu'E Bao for the banking sector are massive because demand deposits, which are most susceptible to being disintermediated by MMFs, currently make up roughly half of all deposits in the banking system and are the bedrock of the banking system's profitability. The ability of non-banks to provide these services outside of the traditional regulatory system has been one of their key advantages. Consequently the regulatory response may be the key to whether they maintain their competitive advantage. Consumer protection may also need to be addressed for this market to flourish, especially if there is an episode involving significant loss of uninsured deposits by investors in a failing money market fund.

In 2012, Andy Haldane, then Executive Director of Financial Stability at the Bank of England, stated that P2P lenders could eventually replace high street banks. (Guardian, 2012) This is especially relevant for small loans where banks find that the unit costs of processing and monitoring such loans are high. The UK government recently announced that it would channel GBP100 million through P2P lenders in order to boost lending to small businesses. P2P lending is growing fast in many countries and there is now evidence that investment managers are engaging in P2P lending, accounting for as much as 60% of the industry's loans, because of the low correlation with other asset classes and high expected returns, thus helping to protect and diversify both their and their clients' investments. This should ensure fast growth in these markets in the future but also change the fundamental nature of what P2P lending was supposed to offer, namely linking individuals with other individuals and small businesses. On the other hand, the use of P2P lending sites exposes users to considerably more risk and uncertainty than if the money was deposited in a bank. This may limit the size of the addressable market. Last year, Eaglewood Capital, a New York-based investment firm, created the first P2P securitisation, which was unrated. Securitising P2P loans 'will increase the complexity and interconnectedness with the broader financial market' (Alloway, 2013) potentially further eroding the distinction between P2P lenders and banks.

3. New forms of credit creation

Contemporary monetary systems are based on the use of transferable liabilities of banks, or bank deposits, as a medium of exchange. Economic actors can also choose to accept other forms of credit as means of payment. This is not a new phenomenon, but digital technology might enable new forms of credit creation to start to displace bank deposits at scale.

Much greater attention has been paid to the mechanisms of credit creation and allocation since the financial crisis of 2008 (Ryan-Collins *et al.*, 2011; Jackson & Dyson, 2012; Bank of England, 2014). This is partly as a result of the growth of shadow banking and the creation of near or quasi monies outside regulated banking sectors, but also reflects a refocusing on credit as a macroeconomic driver. In the present system, the great bulk of the money supply consists not of physical notes and coins but of electronic bank deposits that are created by commercial banks when they extend credit. 'In creating credit, banks simultaneously create deposits in our bank accounts, which, to all intents and purposes, is money' (Ryan-Collins *et al.*, 2011). In being acceptable for all payments, including payment of taxes, and readily exchangeable into legal tender, bank deposits essentially function as legal tender.

However, it is also possible for economic actors to accept other forms of payment based on credit. For example, the size of commercial barter networks globally has been estimated at USD12 billion annually (IRTA website) and the WIR Franc system in Switzerland has been facilitating trade between SMEs without using legal tender since the 1930's Great Depression. Such alternative means of exchange have been termed 'common tender' to denote their voluntary, rather than statutory, basis.

The recent financial crisis has seen a renewed interest and growth in the number and variety of alternative forms of money being used and issued through innovative credit creation processes. One reason for this is the perceived under-allocation of bank credit to local economies, SMEs, and productive sectors.

We highlight three forms of non-bank credit creation that can demonstrate impact on economic and social outcomes:

1. Creating new common tender currency loans that focus on promoting local community development
2. Closed loop credit clearing systems whose members create money by performing transactions among themselves without use of legal tender/ bank deposits
3. Digital cryptocurrencies that create new spending power through the use of computers and cryptographic protocols

3.1 Local/alternative currency loans

Over the last 10 years there has been a burgeoning movement across the world developing alternative means of exchange through the creation of local currencies. Some notable examples have been the Chiemguaer in Germany, the Eusko in France, Berkshares in the USA, and the Bristol Pound in the UK. These currencies mainly seek to increase the velocity of money locally as well as refocus trade on local businesses. They do not, however, create additional purchasing power since they are backed by legal tender, usually at par.

However, some schemes have taken this idea further and created community development banks that are owned by the local community and create new and additional credit, in a local currency, that is specifically directed towards the generation of local jobs and income.

Case 7: Banco Palmas (Brazil)

The Banco Palmas, founded in 1998 in the Conjunto Palmeiras neighbourhood in north-eastern Brazil, provides microloans to those excluded from the 'official' banking system. However, loans for consumption purposes are made in a local currency, which can only circulate within the neighbourhood. The system combines three innovative mechanisms – social currency, intense training and coaching, and a local consumption and production strategy. Loans are made at very low or no interest to businesses and individuals. The banks also provide micro-insurance and banking correspondent services.

There is evidence that where a Banco Palmas bank has been established, a greater percentage of income is spent on goods and services that are generated within the local community (Pozzebon *et al.*, 2011). Banco Palmas has not only democratised access to microloans to very poor people by carrying out low interest and non-bureaucratic lending, but by allocating credit in a local currency it has contributed to local economic regeneration. Following on from the success of the initial bank in 2003, Banco Palmas created the Instituto Palmas with the objective of replicating the experiences of the bank throughout Brazil. Thanks in part to its recognition by the Brazilian central bank, by 2014 there were 103 replica banks throughout Brazil (Instituto Palmas Website).

3.2 Closed loop credit clearing systems

Closed loop credit clearing systems can operate in a variety of ways but fundamentally involve members (either individuals or businesses) trading together using a currency that is issued free of interest. Members are able to purchase goods from other members using their allocated credit that will be honoured by any other member of the scheme or by creating the credit at the point of the transaction being completed, as is the case for mutual credit clearing systems. Usually there are rules to prevent large imbalances building up, with members who make sales and accumulate surplus balances being encouraged to spend them on goods and services from other members. To make accounting simple, the scheme currency is normally denominated in the same unit as national legal tender. However, no legal tender is required for payment with credit offered mutually within the closed membership.

At a time when many individuals and especially small businesses, are struggling to access the credit necessary to meet their working capital needs there have been a number of developments in the creation of new spending power. For individuals, local exchange trading schemes (LETS) have become more frequent since their introduction in the 1980s and lately there has been a revival in business-to-business (B2B) mutual credit systems in both the developed and developing world.

Case 8: Bangla-Pesa (Kenya)

Bangla-Pesa is designed to stimulate local economic activity as part of a poverty reduction programme. By making available a complementary means of payment for local businesses, it increases the possibilities for businesses to trade their excess capacity mainly because the Bangla Business Network acts as a mutual credit clearing system. This complementary currency also seeks to create a buffer against any fluctuation in the money supply due to remittances, weather, holidays, sending children to school, political turmoil, etc.

Slum economies can be very volatile. Sometimes within a month, businesses are booming and demand for goods and services are high, followed by downturns within the same month, where economic activity quickly slows down. In conditions of such volatile income and expenditure, the need for short-term credit to smooth consumption is vital, but not always forthcoming at affordable rates in national currency. The Bangla-Pesa offers a way for businesses to trade without the need for national currency.

3.3 Digital currencies

It would be easy to believe, given the media attention and the confusion surround digital currencies, that they are entirely a new phenomenon. However there is a rich history of over 20 years of development and experimentation from various gold-backed currencies, like e-Gold, to early web-based currencies, like Beenz, to currencies operating in virtual online spaces, like the Linden in Second Life and even experiments in cryptographic protocols like e-cash.

Bitcoin, launched in 2008 (Nakamoto 2008), combines a number of the features that had been experimented with. First, it is a private currency, meaning that it is not issued by a sovereign power; secondly it is decentralised, meaning that there is no centralised issue party or counter party; thirdly it is digital, meaning that it is fully electronic with no physical manifestation; and finally it is cryptographic in that it employs cryptographic protocols to secure the network.

At Bitcoin's launch it did not generate much interest outside of a small group working with cryptography. As the value started to rise in 2011, however, the media and regulators started to take the innovation seriously. The resulting hype and surge in value has led people to develop over 165 new digital currencies since 2011 (http://coinmarketcap.com/), all based on similar principles and code. Developers are continuing to create new currencies on a weekly basis; some simply copying the original Bitcoin code while others are trying to innovate through the development of improved security, functioning or issuance.

One aspect of experimentation is in the manner by which currencies are first issued into circulation. When new units of currency are created and spent, new purchasing power has been created, with credit relying on the credibility of the scheme and security of its technology. We examine three experimental case studies that show the potential direct relevance of new forms of credit creation for facilitating the transition to a green and inclusive economy.

Case 9: Solarcoin (Global)

Solarcoin provides people with one coin upon proof that 1MwH of solar energy has been generated. This can be viewed as an improvement to the issuance mechanism of Bitcoin, which is purely down to processing power.

Case 10: Freicoin (Global)

Freicoin tries to mitigate the hoarding and speculation elements of Bitcoin by creating a cyrptocurrency with demurrage, a negative interest rate, or automated fee for holding the currency, so that it loses value unless spent. This should encourage the currency to be used as a medium of exchange. Also the Freicoin Foundation will distribute 80% of the total coins freely to organisations that support a sustainable world.

Case 11: Auroracoin (Iceland/Global)

Auroracoin is a cryptocurrency for Iceland that sought to establish a large user base right from the start. The pre-mined coins (50% of total) were distributed equally to the entire population of Iceland, from midnight 25 March 2014. This gift's market value at the time of the drop was about USD800; however this dropped to a market value of only USD5 by June 2014 (http://coinmarketcap.com/) demonstrating that, although addressing the user base issue, the coin's creator had not adequately considered and planned for the required currency ecosystem.

3.4 Impact on the financial system

Community banks issuing loans in local currencies operate as a complement to the traditional banking system and may require the partnership and expertise of this sector to succeed. The local banks can create additional local spending power, because of the issuance of loans in local currency and stimulate the local economy. This could result in a more resilient financial system, with communities better able to withstand shocks to the wider financial system and support local needs.

Ultimately however their success rests on active community engagement. These are not initiatives that can be imposed by central authorities. Also in order to ensure real impact, it is vital for these initiatives to engage in strategic partnerships, especially with the central bank. In Brazil, for example, the Central Bank although initially resistant, has become supportive of community banks and the complementary currencies they issue. With a clear legal framework in preparation in Brazil, the community development banks will no longer be vulnerable to legal challenge and to potential recognition issues. This model has potential to be adopted in other countries, particularly to foster economic development in very deprived areas. Falling ICT costs and the availability of good open source banking software have reduced the barriers to entry. However, consumer protection and regulation has to be addressed in each country for this to be widely adopted.

Closed loop community credit clearing systems create additional spending power (money) for their members without the risk of causing inflation because credit can only arise from a completed real economy transaction for which there was sufficient spare productive capacity. Such credit cannot be used for financial speculation or asset purchases.

Research has shown that the Swiss WIR, one of the largest closed loop community credit clearing systems, has a counter-cyclical macro-economic impact, both in terms of availability of money, with WIR money being used when legal tender becomes less available, and velocity or circulation, with WIR money increasing its velocity as legal tender's velocity reduces (Stodder, 2009). With the use of International Reciprocal Trade Association's 'Universal Currency', it is also possible to engage in trade and exchanges between different mutual credit systems internationally, offering scope for mutual credit schemes to increase their impact and scale.

Despite the huge proliferation of cryptocurrencies, it is not clear that any of the current iterations will be the one that really achieves mass adoption. With future currencies constantly being integrated with new features and design elements, however, it may not be long before a first global form of money is created. Future iterations may seek to combine the promotion of social/environmental goals designed into the currency, which could see it have a large societal impact as well as the inevitable economic impact. When designing regulations to cover new digital currencies, it should be feasible to take into account the intended social, environmental, and economic impact of currency issuance.

4. Long-term environmental and social impacts

It is now widely accepted that the climate is changing and this will have major impacts on many global systems. Resource constraints will drive changes in relative prices, and some have argued that high-income countries face a permanent lowering of growth rates. The implications for pensions and insurance have yet to be fully reflected in business models.

The implications of a range of related phenomena – resource constraints, climate impacts, falling labour productivity, stagnating real wages, demographic change, and unsustainable debt levels – point towards a slowing of economic growth. The lower growth rates experienced in developed countries in the aftermath of the financial crisis may in fact represent a permanent shift or a 'secular stagnation' as economist Larry Summers has described it (Summers, 2014).

At a global level, the evidence for resource constraints in particular is compelling (Figure 7). Estimates suggest we can only usefully mine and burn about 20% of known global fossil fuel reserves if we are to experience only a 2oC increase in global average temperatures, without a breakthrough in carbon capture or recycling (Carbon Tracker, 2013). Particular resource constraints will have direct local impacts, for example fresh water, and could impact globally through supply chains and second-order effects such as increased food prices and instability (Ahmed, 2014), while others will have direct global impacts, such as oil.

In addition it is now widely accepted that the climate is changing and this will have major impacts on many global systems. Fundamentally, the environment will become less predictable and more chaotic. Since 1980, the cost of natural catastrophes has grown by USD870 billion in real terms and 2011 was the secondly costliest year on record for natural catastrophes (Maynard, 2014). A draft copy of a major global assessment (Vidal, 2014) of the impact of climate change on the world's food supplies, human health, cities and rural areas compiled by the IPCC, with the input of thousands of scientists, states:

> *'Due to sea level rise throughout the century and beyond, coastal and low-lying areas will increasingly experience adverse impacts such as coastal erosion and flooding. Without adaptation, hundreds of millions of people will be affected by coastal flooding and will be displaced due to land loss.'*

Poorer regions of the world will be particularly hard hit. UNEP estimates suggest it will cost Africa approximately USD350 billion a year to adapt its farming and infrastructure to climate change if governments fail to hold temperatures to less than 2oC and allow them to rise to 4oC (UNEP, 2013). But risk is also higher in certain areas of more developed economies with high vulnerability to weather events such as the farming regions of north-eastern China, the Caribbean Islands, and Florida and other coastal regions in the United States. Over time it is likely that global property risk will increase faster than GDP as population increases lead to infrastructure development in more vulnerable areas of land.

We now examine the implications of these trends on pension provision and insurance services.

4.1 Pension provision

Lack of access to resources, in particular energy, could potentially lead to lower economic growth, which could cause low real interest rates and asset returns. Meanwhile, as the financial crisis of 2007/2008 demonstrated, monetary authorities are willing to suppress nominal interest rates – so-called financial repression – at times of economic stress in a bid to stimulate demand. The combination of these dynamics for long-term savings vehicles based on financial assets, in particular pensions, could be profound. Current financial models are effectively discounting to zero the probability of economic growth being limited by resource constraints and assuming that interest rates will return to their long-run average. In other words, they are based upon assumptions based on historical long-term growth rates – around 2.5% – and nominal interest rates of double that. There is a danger that such models underestimate the value of liabilities in a situation of lower growth, and from the individual's point of view will overestimate the potential returns from long-term investment plans and likely annuity rates upon retirement.

In a report commissioned by the Institute and Faculty of Actuaries (IFoA, 2013) researchers from East Anglia University modelled the impact of resource constraints on a pension fund. The authors model different scenarios and conclude that, even under optimistic projections, there would be considerable impact on a financial vehicle, mediated by the different reaction of governments, regulators, and financial agents. Figure 6 shows a comparison of replacement ratios for the different scenarios (the replacement rate being the initial pension paid on average divided by the salary prior to retirement) for a defined contribution scheme. The more pessimistic scenario would result in a:

> ‘*financial disaster… [with] the assets of pension schemes effectively wiped out and pensions reduced to negligible levels*’,

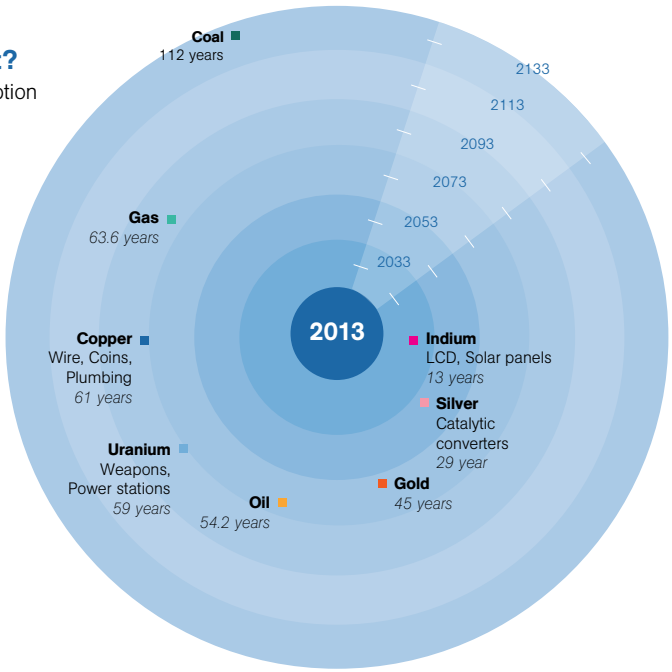
whilst the worst case scenario, with the global economy going in to long-term decline would result in a situation where:

> ‘*the legal basis on which financial products sit could conceivably be undermined, and the sponsor employer may no longer exist to pay contributions, the financial markets may also cease to exist, at least in their current form, and hence the projection would become meaningless.*’

Figure 7: Resource constraints impact on pensions

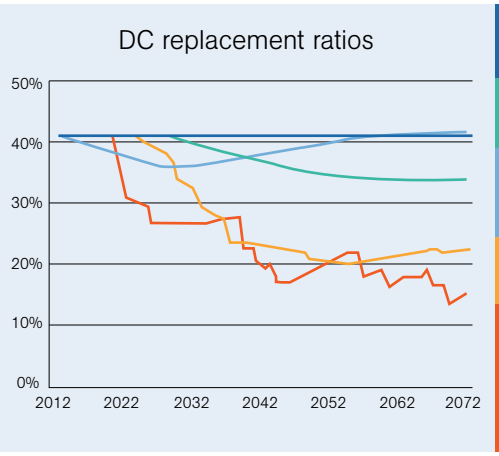
How long will our resources last?

If we carry on at the same rate of consumption as the present day



The impact of resource constraints on pensions

(DC replacement ratios in 5 scenarios)



No constraints: No issues with thesupply of resources, global economy continues to grow as normal.

Green growth: In the most optimistic model the global economy stabilises through the adoption of new technology.

Partial adaptation: Some local economies decline because of food and water shortages but global growth is pushed by new technologies.

Islands of stability: Some countries avoid meltdown as the globe warms.

Severe decline: In the worst case scenario governments and market continue to be short-term focussed, leading to long-term global economic decline (based on energy scarcity) and local decline (caused by food and water shortages).

(Source: Pensions Insight, 2013)

Resource constraint issues are just one possible factor driving permanently lower growth rates in developed industrial countries. A number of recent studies point to declining real median wages, labour productivity, and, related to this, growing levels of private debt/GDP ratios (Onaran *et al.*, 2013). In combination with inflation caused by commodity price increases, these again point towards declining medium term growth trend.

Case 12: British Telecom Pension Scheme (UK)

British Telecom's Pension Scheme (BTPS) has been actively exploring ways to efficiently allocate capital to investments that could outperform as a result of policy moves towards a low carbon economy. For example, in 2011 BTPS invested GBP100 million in a carbon-tilted version of the FTSE All-Share Index (with carbon intensive companies underweighted). BTPS also invests in low carbon infrastructure, with GBP350 million in a global renewable energy fund and GBP5 million invested alongside the UK government in a UK-based environmental innovation fund (Shareaction, 2013).

'Green bonds' are a potentially attractive investment for pension funds because of their low risk and steady income streams. Although the market has historically lacked scale and liquidity, this is beginning to change. Research from the Climate Bonds Initiative and HSBC estimates that the climate bond market almost doubled in 2012 (from USD174 billion to USD346 billion). The research screened bonds in the transport, energy, climate finance, buildings and industry, agriculture and forestry, waste, and water sectors. These presented generally low risk, low yield assets, and as such are relatively easy to place within pension funds existing asset allocations (Shareaction, 2013).

More radical options include the creation of new types of long-term financial assets that hedge against falls in traditional debt instruments and/or would incentivise governments to invest more sustainably. For example, the Nobel prize-winning economist Robert Schiller (Kamstra & Schiller, 2010) has suggested a new type of bond indexed against US GDP growth. This security might pay, for example, a coupon of one-trillionth of GDP, and would stabilise the influence on the budget (as coupon payments fall in a recession with declining tax revenues). Such 'Trills' would enable new portfolio diversification strategies and, in contrast to available assets that protect relative standards of living in retirement, would have virtually no counterparty risk.

Policy performance bonds (also called index-linked carbon bonds) are government-issued bonds where, in their simplest form, interest payments are linked to the actual greenhouse gas emissions of the issuing country against published targets (Mainelli, 2009). An investor in this bond receives an excess return if the issuing country's emissions are above the government's published target. A policy performance bond thus provides a hedge against the issuing country's government not delivering on its commitments or targets. Policy performance bonds can be issued against carbon emissions reduction targets but also forest preservation targets and any other area where policy risk is significant.

In the case of index-linked carbon bonds, the ability to hedge enables the same investor to invest more confidently in projects or technologies that pay off in a low-carbon future because if the low-carbon future fails to arrive, the government also bears direct costs of having to pay higher interest rates on government debt. Index-linked carbon bonds eliminate the one risk that differentiates clean tech projects from other energy projects: the uncertainty of government policy actually being directed at a low carbon future. Examples of potential indices that address this unique risk are

- Levels of greenhouse gas emissions
- Levels of feed-in tariffs for renewable energy or percentage of renewable energy in overall energy supply
- Prices of emission (reduction) certificates in a trading system
- Levels of taxes on fossil fuels or fossil fuel end-user prices

4.2 Insurance and risk

Insurance involves the spreading of the economic consequences of an adverse event from the actually affected over a group of potentially affected. Risk aversion means that most people are willing to pay a certain annual amount greater than the expected economic risk of a particular event – i.e., the 'insurance premium'. A risk will be insurable if it:

1. Concerns a diversifiable event that can justifiably be spread across a population
2. Is more or less quantifiable, in order to allow the calculation of an appropriate premium
3. Can be covered by a binding insurance policy – the customer should be able to rely onthe insurer to settle claims (Tol, 1998)

Climate change poses a challenge to all of the above conditions. First, not only are climate change-related events are very hard to predict, the distribution of climate change's impact is highly uneven, falling more heavily and repeatedly on certain regions of the world. In that sense it cannot be thought of as an 'event' that is easily diversifiable, as with simple weather-related catastrophes in a single country. Rather, climate change is better thought of as a trend with correlated risks.

Secondly, the risk of climate change is extremely difficult to quantify given the unpredictability of changing weather conditions and the difficultly of attributing a particular (weather) event to climate change as opposed to simple natural disaster. In the traditional insurance model, hazard and vulnerability components are informed by examining the previous year's and historical loss data. Even in a world without climate change, however, climate challenges the meaningfulness of the traditional insurance model because climate risk is not uniformly predictable based on previous claims.

Thirdly, climate change is a lasting trend demanding the spreading of risk over time rather than space, as with normal insurance of weather events. It is difficult for commercial insurance companies to insure for a risk covering the next 40 years given fiscal constraints on capital accumulation and regime change. Relatedly, climate change leads to recurrent damages and hence to recurrent climate change insurance claims that could last for a long period of time, eroding the funds of an insurance scheme. Thus, either the premiums and capital accumulation should be rather high, or the claims will be either low or for a short period.

It is also clear that different regions are and will be differently affected by climate change and that there will be knock-on effects for countries not directly affected – for example mass refugee movements/migration and economic/trade shocks. Since developing countries appear to be potentially most at risk from the effects of climate change, developed countries could provide insurance against these risks.

However, there is no international market in which individuals or countries can insure themselves against losses from climate change or related abatement policies. Even if such a market existed, insurance on a country-by-country basis would miss many potential benefits from collectively sharing risks. To the limited extent that insurance could cover climate risks, the insurance premiums would probably be borne inequitably by the parties exposed to those risks. The failure of the world to agree effective carbon reduction targets shows the difficulty of global action in this area. New thinking may be required and here innovations in the financial sector may prove helpful.

Case 13: ClimateWise (Global)

ClimateWise is a partnership of insurers, brokers, and risk modellers, including more than 40 insurance companies and organisations globally that are working together to reduce the risks of climate change. The ClimateWise mission is to promote best practice, and to date this has already resulted in significant advances in modelling the risks of climate change impact, increasing the incorporation of climate change into member investment decisions, developing an approach for considering climate change as a systematic risk in asset management strategies affecting capital allocation, and moving towards top-level responsibility for company sustainability.

The international membership covers Europe, North America, and Southern Africa and all members commit to action, individually and collectively, against the ClimateWise Principles, which include informing public policy, supporting awareness amongst customers, and incorporating climate change in to investment strategies.

Concerned that climate change may be exacerbating their vulnerability to the mis-pricing of risk, insurers increasingly adjust their methodologies. A report commissioned by the UK government (Silver *et al.*, 2010) identified three modified practices

1. Statistical techniques based on past loss events extrapolate insured loss trends and estimate projected total risk for likely future conditions (Allianz, 2008)
2. Catastrophe models which, by overlaying financial exposure with potential hazards, simulate realistic events for given locations based on potential hazard frequencies and magnitudes (Grossi & Kunreuther, 2005)
3. Scenario testing – for example Lloyds of London's disaster scenarios

The aim of risk estimation using these techniques is to predict future losses within a reasonable margin of error such that portfolio management techniques do not overexpose insurers to one type of risk, geography, or sector. Modified risk-modelling techniques, such as those developed by insurers and reinsurers, illustrate the types of development in risk modelling relevant to other segments of financial services.

4.3 Impact on the financial system

Long-term social and environmental factors in essence involve a shift in relative prices between resources, energy, and labour. The former two are likely to become more expensive relative to the latter – with rising energy prices in particular contributing to systemically higher levels of inflation – whilst declining productivity will provide less purchasing power. The result may be that people will have to work longer and save a higher proportion of income. During this adjustment phase of higher savings ratios, depressed consumption might further hold back GDP growth exacerbating the problem.

Individualised pension systems based on investing in long-term financial assets – government and corporate bonds and shares – are therefore likely to be particularly hard hit. Already many countries are taking steps to increase the age of retirement. In addition, the fossil fuel divestment movement is leading an effort to re-examine the concept of 'fiduciary duty' by suggesting that investment in carbon-based energy sources, whilst maximising short-term returns, could endanger their long-term returns.

One potential scenario might be the 'definancialisation' of pension provision with a return to more collective provision of the bulk of pension payments – via pooling of pension fund investment in non-resource-intensive sectors, or a return to state or local government taxation.

Within the financial sector, green bonds, GDP indexed bonds, and policy performance bonds all offer potential to better align the risk and reward profile of financial instruments with the uncertainties caused by long-term social and environmental trends.

The impact of these trends on the insurance industry carries both threats and opportunities. Insurers will need to engage outside their historic, western-orientated client zone, and engage with new customers in the form of state and regional governments in poorer countries. They are also likely to need to engage with international organisations in developing international agreements. The insurance industry can also play a role in supporting the needs of individuals and businesses in reducing the effects of climate change. New products and services that drive changes in consumer behaviour, such as innovative renewable energy project insurance and green-buildings insurance, are important here.

However, despite awareness of the potential impact of long-term environmental factors, insurers do not always find it cost-efficient to include climate change risk in their overall risk estimation because the related margins of error are wider than the impact of climate change if its data were included in the model (Belvedere, 2014). As climate change continues to occur, however, methods of integrating climate risk in traditional risk estimation will become increasingly relevant across all financial service activities.

Outside these types of adjusted risk-modelling techniques, more radical action to provide global insurance against climate change is likely to require public-private partnerships. A number of options present themselves.

One option would be a mutual insurance contract – an agreement between countries subject to similar risks that those who suffer losses will be compensated by others. Such insurance is used, for example, in agricultural cooperatives. In the context of climate change, this type of insurance contract would be a binding agreement in which countries that suffer greater-than-average (or expected) climate-related losses would be assisted by those suffering less-than-average losses. Working collaboratively with national and/or regional governments, insurance companies could play a key role in assessing risk across new areas in a fair and transparent fashion.

A second option would be the development of more complex insurance structures that acknowledge that the overall nature and distribution of some climate-related risks are uncertain and that different actors are entitled to different views on the levels of such risks. This approach requires defining 'risk securities' for each possible outcome that pay out only if that outcome is realised (Arrow, 1953). For climate change, such insurance would require each country to make compensation commitments as insurance against a particular climate outcome. To distribute the risks efficiently, countries would then be allowed to trade these securities. To the extent that the perception of risks varies, such an approach would amount to betting on particular climate outcomes. By allowing for different beliefs about risks, risk securities and mutual insurance would permit a more efficient distribution of those risks (Arrow, 1996). For example, a country genuinely believing that climate change is unlikely to have serious global impacts would be more prone to hold those securities that pay out under these conditions (Heal, 1993). Formal studies note that creating risk securities may provide an objective test of the honesty of national positions on the risks of climate change (Chichilnisky & Heal, 1993).

Just as with carbon emissions reduction, however, surprisingly little progress has been made on the development of multi-state climate change insurance schemes in both developed and developing countries. Given the difficulty of establishing effective risk models, agriculture/farming industries may need to move away from hedging models involving buying futures and towards more traditional buffer stock models involving physical produce.

5. Technological innovation

Innovations in technology can often lead to innovations in the financial system. The use of IT and computers has led to a revolution in the way that financial transactions are recorded and processed as well as leading to the provision of new services and business models. Such technological trends will likely require some aspects of the financial system to adjust their practices in order to remain relevant and profitable in the future.

This section explores how the insurance business specifically might need to adapt to two interlinked and overlapping technological trends; the increase in volume and variety of data ('big data'), and the move towards everyday devices being connected to networks (the 'Internet of Things').

5.1 Insurance and big data

Big data has been defined as 'high volume, high velocity, and/or high variety information assets that require new forms of processing to enable enhanced decision making, insight discovery and process optimisation' (Laney, 2012). It involves the application of inductive statistics to massive data sets to reveal relationships and dependencies, and to perform predictions of outcomes and behaviours. Data sets have grown in size in part because they are increasingly being gathered by ubiquitous information-sensing mobile devices, aerial sensory technologies (remote sensing), software logs, cameras, microphones, radio-frequency identification readers, and wireless sensor networks (Surdak, 2014). The world's technological per-capita capacity to store information has roughly doubled every 40 months since the 1980s as of 2012 (Hilbert & Lopez, 2011). One challenge with big data is ensuring data security and protecting privacy is becoming harder as the information multiplies and is shared ever more widely around the world.

In the USA, insurance companies are banned from using gene-sequencing information but individuals can still get hold of the information. This will create an information asymmetry that will invalidate the risk-models of insurance companies. One way to manage the problem would be compulsory universal provision imposed by the state.

Case 14: Genetic- and post-code profiling and insurance (USA)

Developments in genetics mean it is now possible for individuals to get an individual genetic profile for between USD 2000 and USD 3000 – around one-tenth of the cost of 10–15 years ago. In the UK there is currently a moratorium on the use of genetic test results in insurance assessment. This leads to a problem with adverse selection, whereby individuals choose insurance according to their future health risk and insurers lack the equivalent information. This moratorium is due to expire in 2017, however, at which point the issue will certainly come to a head.

The other use of big data is post-code profiling. Companies like Experian, a personal credit rating company, gather information on purchases and, in addition to providing credit ratings, use the information to generate profiles for different types of people based on spending habits. They have a product called Mosaic, which maps post codes to some 70 'types' of person/family – post codes are required to be supplied with any insurance application. Insurers (and reinsurers) can use the postcode as an additional risk factor, i.e., as an indicator of mortality/health, again creating an adverse selection problem.

5.2 Insurance and the 'Internet of Things'

The Internet of Things refers to the unique identification and virtual representation of everyday objects in a global network infrastructure, enabling such objects to actively 'participate' in domestic and business transactions and enable the development of independent cooperative services and applications. This infrastructure includes existing and evolving Internet and network developments. Applications include waste management, transport, environmental sensing, social interaction gadgets, continuous care, emergency response, intelligent shopping, smart product management, smart meters, home automation and smart events. According to Gartner there will be nearly 26 billion devices on the Internet of Things by 2020, and estimates that companies providing the hardware, software and services could be looking at revenue of around USD 309 billion, with valued added of USD 1.9 trillion with the key vertical industries being manufacturing, healthcare and insurance (Gartner, 2013).

Case 15: Google driverless car (USA)

The Google driverless car uses a laser radar system mounted on the roof of the car which, combined with GPS, allows the vehicle to generate a detailed 3D map of its environment. The car takes these generated maps and combines them with high-resolution maps of the world, producing different types of data models that allow it to drive itself. Advanced software is then used to compute all these inputs to control every aspect of the car, from steering and navigation through to accelerating and braking. Google's development team has so far completed over 300 000 'autonomous driving miles' accident-free. Four US states have passed laws permitting autonomous cars as of December 2013: Nevada, Florida, California, and Michigan. Many expect the first commercial driverless car to arrive on our roads before the end of the 2010s.

The driverless car could have massive impacts on the insurance industry. Auto insurance represents the largest class of non-life insurance. In the USA, where a collision occurs every 14 seconds, and a fatal crash once every 16 minutes, there are net premiums of almost USD200 billion and over 250 000 employees working in the sector. The frequency of claims has fallen by almost 20% in the last ten years, partially due to advanced impact protection mechanisms and advanced on-board computers; total auto insurance net premiums have also fallen almost 7% in real terms.

Some estimates suggest claims values will fall as much as 90% with increasing automation and it is also expected that claims fraud will almost be eliminated by the presence of vast amounts of data relating to every single motion of the cars involved. Claims 'inflation' as parties fail to agree on resolution could also become a thing of the past. Near perfect information about every incident should ensure that disputes are settled long before they reach the court.

Under such a scenario, the future car insurance industry could be expected to shrink to around one-tenth of its current size (USD20 billion in the USA) (CFC Underwriting, 2012). The role of claims handlers and loss adjustors could become the domain of data analysts. Insurance could be priced and sold by computers and it will be the cars that are ensured, not the drivers.

5.3 Impact on the financial system

Attempting to assess the impact of technological innovation on the financial system involves a double uncertainty: we cannot predict the impact on the real economy of disruptive innovations and we also cannot predict the impact on the financial system of such real economy changes. In the case of big data, however, there may be more direct impacts on financial services firms.

Big data offers the opportunity for financial sector firms to reshape their business strategy based on customer analytics and real-life trends (Garel-Jones, 2011). A number of organisations are creating new 'Chief Data Officer' or 'Chief Information Officer' positions, recognising that data is a significant corporate asset. This pressure is driven by business leaders wanting more consistency in information and by regulators becoming increasingly concerned about the quality of data they receive during a time when regulatory demands are growing. This is made clear by the increasing number of references to the 'integrity' of data in each new regulatory requirement. For example, the International Basel Solvency II regulation requires insurers to have 'internal processes and procedures in place to ensure the appropriateness, completenessm and accuracy of the data' (Toor *et al.*, 2013). These processes and procedures could (and usually do) involve technology, but should also include data policies, standards, and roles and responsibilities to ensure data integrity is appropriately governed.

The strategic value in big data is the insight it can give into future trends. Predicting how customers and competitors' customers will behave and how that behaviour will change enables more accurate tailoring and pricing of products. Sophisticated quantitative analysis is being applied to many aspects of life. For example, personal-finance websites and banks are aggregating their customer data to show up macroeconomic trends, which may develop into ancillary businesses in their own right (Economist, 2010).

The challenge is to establish which data is required to achieve these objectives, who needs it, and how often. Big data will also involve using multiple data sources, internally and externally. Geo-spatial data, social media, voice, video, and other unstructured data come together in enabling firms to know their customers and their likely future behaviour. For example, leading firms are looking at using both internal and external data, both structured and unstructured, to develop personalised banking products. Customers are more likely to be attracted and retained with personalised products – increasing their 'lifetime value'. Similarly, analytics have an increasingly important part to play in the recovery of bad debt. Recoveries departments typically focus their efforts based on the delinquency status of the account without any other information about the customer. However, a better understanding of customer circumstances can improve targeting and have an immediate impact on recovery rates while also reducing cost (Garel-Jones, 2011).

The impact of the Internet of Things on financial services will depend more on how it changes patterns of production and consumption in the real economy. With information asymmetries rapidly declining in sectors such as car insurance due to automation and telematics, the insurance sector will need to shift its focus towards other areas or risk a collapse in turnover. One area where there may be growth is in care for the elderly given demographic changes, particularly in the developed world, but also in newly industrialised nations such as China where obesity could become a major health issue.

Small companies in particular traditionally have used bank finance (overdrafts and short-term loans) for working capital to smooth out lumpiness or shocks to sales and inventory adjustments. Internet of Things technology, such as connected, automated manufacturing systems, could significantly reduce such lumpiness as 'just-in-time' production, transportation and delivery becomes feasible for small firms. Already large firms are taking advantage of the masses of data online purchasing provides. For example, Amazon practices and has patented 'anticipatory shipping', studying consumer purchasing history to predict their future purchasing behaviour and shipping goods before orders have even been placed. In deciding what to ship, Amazon said it may consider 'previous orders, product searches, wish lists, shopping-cart contents, returns and even how long an Internet user's cursor hovers over an item' (Wall Street Journal Blog, 2014).

Big data and the Internet of Things allow organisations to gather unprecedented amounts of information in quantity and quality, and seem likely to throw up new challenges for regulation of the financial sector in terms of its use, transparency, and ownership rights of data.

6. Innovations in economics and financial policy

The financial crisis has led to a re-examination of earlier theories and policy instruments in the field of macroeconomics and finance, with consequences for monetary policy and the regulation of the financial sector. Given the uncertainties facing the global economy, there is merit to experimentation with a diverse set of innovative policy approaches.

Prior to the crisis, neo-classical models dominated the field of macroeconomics with credit and money aggregates and banks often excluded completely or given a relatively minor role as causing 'frictions' or 'amplifying' technological shocks. Following the 2008 crisis, Federal Reserve Chairman Alan Greenspan told Congress that:

> *"... I made a mistake in presuming that the self-interest of organisations, specifically banks, is such that they were best capable of protecting shareholders and equity in the firms ... I discovered a flaw in the model that I perceived is the critical functioning structure that defines how the world works. I had been going for 40 years with considerable evidence that it was working exceptionally well"*
> **(Greenspan, 2008)**

The crisis undermined the key assumptions underlying the Dynamic Stochastic General Equilibrium (DSGE) models used by most central banks and academic economists. In such models, credit markets clear when interest rates lie in equilibrium and prices naturally adjust until such equilibrium is reached. Post-crisis, central banks, think-tanks and, to a lesser extent, academia, have begun the search for new ways of modelling, forecasting, and regulating the economy, with credit seen as a potentially causal and independent variable.

In monetary policy, change has been slow; but there is evidence of gathering momentum. For example, the Bank of England has adopted new policies, including Funding for Lending, which subsidises credit to particular real economy sectors and Forward Guidance, which ties interest rate rises to changes in employment in the wider economy. In the USA, the Federal Reserve has departed from orthodox central bank policy by purchasing billions of dollars-worth of mortgage assets to support bank balance sheets. Meanwhile the Bank of Japan has been explicit in using quantitative easing purchases to help support a massive expansion of government spending on infrastructure to reflate the economy.

These developments, along with quantitative easing, mark a major shift in the role of central banks. Whereas since the early 1990s they have been seen primarily as independent technocrats focused on maintaining price stability with a strict divide between monetary and fiscal policy, post-crisis they have had a much more active and flexible role. With austerity policies set to remain in place long into the future, given the very high levels of private and public debt across the globe, the lines between monetary and fiscal policy may have become permanently blurred. This opens up the opportunity for political parties and civil society to make the case for central bank support for particular sectors of the economy in need of investment, for example green transport or energy infrastructure.

For the last two decades, financial services have enjoyed the fruits of deregulation, laissez-faire central bank oversight, free flows of international capital and, post-2008, massive tax-payer-funded rescue packages. This has resulted in high profits and the creation of a culture of short-term returns.

The intellectual foundation – of well-functioning and efficient financial markets – on which this model was based, has been called into question. The assumption that banks and other institutions can function effectively with minimal or even self-regulation has been abandoned. Pressure is growing for the state and regulators to take a more active role in shaping financial systems. Banks are being asked to hold considerably higher levels of capital, reducing their profit margins and there are threats to break up larger organisations which have become 'too big to fail'. The laissez-faire approach of central banks over the past 20 years has ended with more invasive inspections and demands for greater transparency about bank lending, both in terms of sector and geography. These developments pose major threats to the big players but also create room for smaller, nimble players such as P2P lenders willing to exploit recent developments in communications technology.

We examine six developments in the area of macroeconomic and financial policy with potential to contribute to the design of a green and inclusive financial system:

1. Capital flow management
2. Green credit guidance
3. Strategic quantitative easing
4. Full reserve banking
5. Financial transaction tax
6. Evolution of a global reserve currency

6.1 Capital flow management

Capital flow management involves the use of measures such as taxes, restrictions, or outright prohibitions on the flows from capital markets into and out of the country's capital account. Although out of favour since the 1970s, the 1990s saw a number of capital account crises in emerging market economies, which were precipitated by a sudden reversal of capital inflows.

This occurred against the background of financial market deregulation, capital account liberalisation, and financial sector deregulation and liberalisation. Although these changes brought about benefits in the form of economic growth, at the same time, they created a new source of vulnerability to the balance sheets of commercial banks, corporations, and the public sector. As the evidence has grown that capital flow management can, when correctly applied, provide a positive boost to a local economy, the IMF now supports their re-introduction in certain circumstances (Baba & Kokenye, 2012). Capital controls serve two main functions: acting as a policy response to excessive macroeconomic activity, and as a prudential regulation. Some 40 countries have adjusted their capital flow management at least once just between 2009 and 2011 (Forbes *et al.*, 2013a).

Case 16: Capital controls (Malaysia)

Through the use of capital control measures in the late 1990s, Malaysia, along with a small band of other countries, bucked the overall trend to deregulate capital flows and instead tried to protect its economy from unstable capital movements. From 1998 to 2001 Malaysia introduced a series of time-limited controls with specific policy aims to deter speculation in the national currency (ringgit), regain monetary policy independence, pre-empt exodus of capital, and re-engage foreign investors. Initial controls were on transfers of funds from ringgit-denominated accounts for non-residents not physically present in Malaysia, in effect imposing a 12-month holding-period restriction for repatriation of the proceeds from sale of Malaysian securities, with retroactive effect. From February 1999, with the worst of the crisis-abating controls were gradually eased until they were totally removed in May 2001.

Recent experience, especially with outflow controls, seem noteworthy, as the controls appear to have achieved the objective of securing monetary independence under a fixed exchange rate, allowing interest rates to decline substantially during a period of output contraction. Kaplan and Rodrik (2001) argue that Malaysia has enjoyed a faster economic recovery; a smaller adjustment in employment, real wages, and stock prices; lower inflation; and a greater fall in interest rates by imposing temporary capital flow restrictions. It is also important to consider that the success of the Malaysian control measures may also be due to the fact that they were explicitly introduced as time-bound measures, supported by a sound macroeconomic policy framework, bank and corporate restructuring, a currency widely perceived to be undervalued, and credible supervision and implementation.

6.2 Green credit guidance

Credit guidance policies recognise that the purpose for which credit is extended is an important indicator of its value to improving the economy and that the central bank and governments can, and should, set targets on the quantities or proportions that banks should lend to various sectors of the economy or set addition criteria, such as environmental impact, to govern whether a loan is extended.

In most countries of the world today, banks have relatively free reign to decide on the quantity and direction of their loans. There is evidence that larger banks, wishing to maximise their returns, tend to provide the bulk of their loans not to the 'real' (GDP-contributing) economy, but rather to speculative lending or lending against existing assets (e.g. existing homes). Debt can be good for growth if loans are used productively, so that both the debt and GDP grow. However, problems arise when overall debt grows beyond the rate of GDP growth, as this can be a clear indication that the debt is fuelling asset bubbles. As Adair Turner remarked: 'Public Authorities need to treat both the quantity of new credit created and the mix of that credit between different purposes as key economic variables which need to be managed by strong public policy levers' (Turner, 2014).

Case 17: Green credit policy (China)

China's green credit policy consists of a set of voluntary guidelines which require signatory banks to incorporate social and environmental issues in project financing. China introduced the green credit policy in July 2007. The policy was upgraded in February 2012 (China Banking Regulatory Commission, 2012) to a directive and is notable for its explicit language on adhering to international standards of environmental and social safeguards, as well as extending the policy to international loans.

Wang Zhaoxing, vice-chairman of China Banking Regulatory Commission, has stated that they will use the adherence to the policy 'as a reference for regulatory rating, institutional access, business access and the promotion of top executives' (Yanpeng, 2012). Some concrete achievements were made, which saw some plants blacklisted from receiving loans because of their pollution record. For example, by the end of the first quarter of 2012, Industrial Bank Co. Ltd had offered 2857 green loans with a total value of 129 billion Yuan ($20.3 billion). 'The projects we supported have an effect equivalent to shutting down 146 thermal power stations that produce 100 trillion watts or halting the service of 70 000 taxis for 44 years', said Li Renjie, CEO of Industrial Bank (Yanpeng,2012). From the data collected by NGOs, 11 of 14 banks examined appear to show notable growth in loans to greener projects, as well as an intention to disclose information (Ying, 2011). One problem is that the voluntary nature of the green credit scheme creates problems when it comes to implementation. The Green Credit Directive marks a unique opportunity for China to lead by example, but the record of its implementation over the last year remains relatively poor.

6.3 Green quantitative easing

Quantitative easing involves large-scale asset purchases by central banks to support the liquidity of the financial system and push down medium- to long-term interest rates (Bowdler & Radia, 2012). Central banks have preferred to buy high-quality assets, such as government bonds, but have also bought large quantities of mortgage debt (in the USA) and corporate debt (in Japan). Since these kinds of asset purchases also have significant distributional effects – mainly via asset price increases – and help reduce government debt levels, a number of commentators have suggested that such activity blurs the line between fiscal and monetary policy.

With considerable constraints on fiscal policy given the high levels of public and private debt in many developed and developing economies, there have been a number of calls for central banks to extend the range of future asset purchases (or re-purchases of maturing assets) to support socially or environmentally useful activity. For example, the Green New Deal Group (2013) has called for 'Green QE' to support the retro-fitting of housing in the UK and the fitting of solar PV on roofs.[2]

In order to counter accusations of 'picking winners' or political bias, the most sensible mechanism for conducting such a policy might be for central banks to capitalise existing, or newly created Green Investment/Development or Infrastructure Banks that stand at arms' length from government. National development banks are able to provide credit to companies on terms more favourable than those of the market, basing their lending decisions on their countries development strategies, in addition to the financial return of investments. Development banks can play an important role in delivering finance to the low-carbon economy, and many of them have already set up specific lending programmes. In the 2007–2012 period at least USD425 billion has been provided by development banks to projects on renewable energy production, energy efficiency and other environmental-related activities (BNEF, 2013). In 2012, investments had reached USD109 billion, growing 19% from the previous year and thus in contrast with the negative trend of private green investments in the same period.

Some of the largest contributors to green investment are the China Development Bank (CDB), the German Kreditanstalt fur Wiederaufbau (KfW), and the Brazilian Banco Nacional do Desenvolvimento (BNDES) (Mazzucato, 2013). Development banks also usually provide technical assistance to the projects and facilitate dialogue with political institutions.

To address concerns about the central bank's independence and inflation, governments could create independent bodies that could decide how best to distribute QE funds to development banks (Ryan-Collins, *etal.*, 2013). The new body could be staffed by independent experts but be accountable to elected officials rather than the central bank, given its more fiscal remit. The advantage of the above proposal is that funds would be central bank assets rather and thus not count towards government debt.

6.4 Full reserve banking

Currently our banking system operates on a fractional reserve system meaning that banks hold on demand only a portion, and sometimes a very small portion, of the funds their customers hold in deposit accounts to ensure that they can satisfy the potential demand for withdrawals. In order to mitigate the inherent risk in running such a system, banks are supposed to be regulated to ensure their soundness. In addition, to try to prevent bank runs, regulators, central banks, and governments often offer deposit insurance, up to a specified amount, as well as acting as the lender of last resort.

2. Based on 2011 figures when around 20 000 installation jobs were created putting PV on 150 000 dwellings, the Green New Deal Group estimate a million homes a year programme would eventually create 140 000 jobs. If that were then to be extended to all the potential nine million homes that could benefit from PV then the employment growth would be much larger still, and there would, of course, be the added benefit of all the energy generated (Green New Deal Group, 2003, p26)

Many of the founders of free-market economics, including Irving Fisher and Milton Friedman, had serious concerns about the efficiency of fractional reserve banking. The current economic crisis has led a range of organisations and high level figures to agree with the comments of Mervyn King, ex-governor of the Bank of England, that 'of all the ways of organising banking, the worst is the one that we have today' (King, 2010) and to develop new and innovative ways of ensuring a function and more stable banking system.

One of the most interesting developments has been the resurrection of the concept of full reserve banking that separates the functions of lending and credit (money) creation and requires all banks to back their customers' bank deposit accounts fully with reserves held at the central bank.

Under this proposal, banks would no longer be allowed to create new money, 'commercial bank money' or 'bank credit', in the form of credit in connection with their lending activities. Instead, the central bank would be solely responsible for the creation of all forms of money, not just paper money and coins. The principal impact to the banking industry would be to turn banks into pure intermediaries where they solely lend out the money of their depositors to those wishing to borrow it much as P2P lenders do.

The IMF has recently published a Working Paper on Full-Reserve Banking (Kumhof, 2012) using state-of-the art macroeconomic modelling techniques, which found significant societal benefits. In addition Martin Wolf (2014), senior economics editor for the *Financial Times* also recently endorsed a UK proposal for full reserve banking put forward by Jackson and Dyson (2012)

6.5 Financial transaction tax

A financial transaction tax (FTT) is a levy placed on a specific type of monetary transaction for a particular purpose, an idea first proposed by John Maynard Keynes in his *General Theory of Employment, Interest and Money*. It was later developed by Nobel winner James Tobin. In the present great recession, with public expenditure being cut all over the world and jobs at risk, some sections of society have been re-examining the way in which public revenue is generated and from whom. There has been increased call for financial institutions, especially those engaged in high frequency trading, to be made to contribute more proportionately to the public purse.

Case 18: Financial transaction tax (EU)

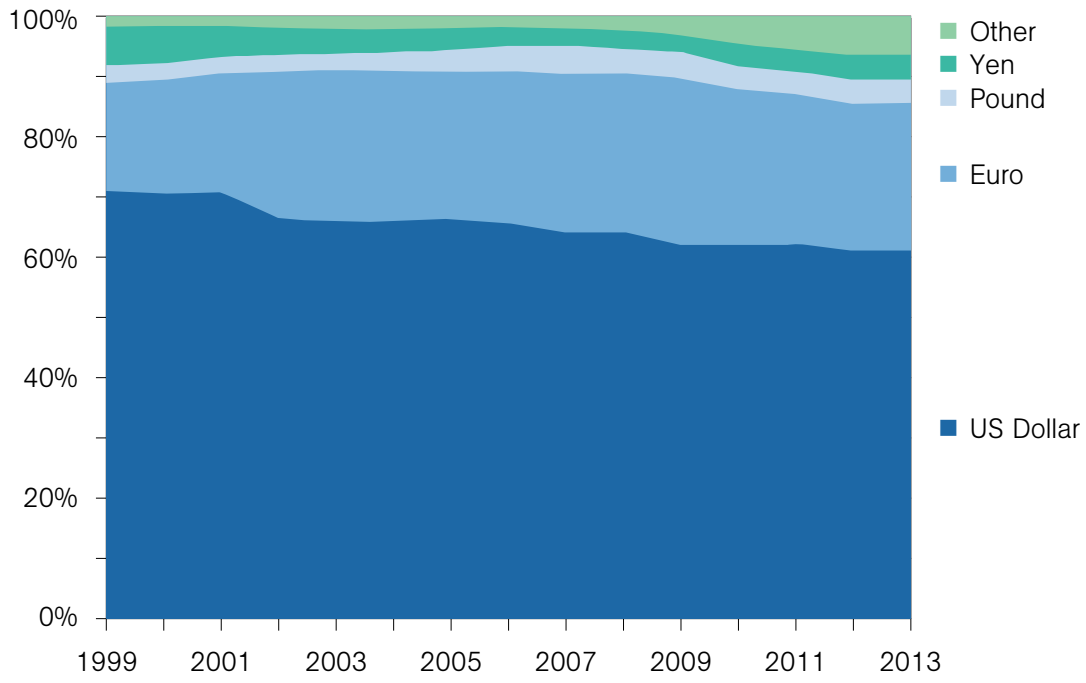
The European Union has been moving towards the implementation of a European-wide FTT over the past four years. At the present time, the proposal has the support of 11 of the 28 EU members, most notably France and Germany, with France recently shifting its position to one where it now supports the taxation of derivatives. The FTT would involve taxing securities trading (shares and bonds), derivatives agreements and 'financial-market bets' at 0.01% and estimates suggest it could raise up to EUR35 billion a year.

FTTs are effectively stamp duties on the transfer of ownership and not based on tax residence, making them harder to avoid. If the transfer has not been 'stamped' and taxes paid, the transfer is not legally enforceable. The tax would fall most heavily on short-term holders of securities, such as high-frequency traders, hedge funds, and bank proprietary trading desks. It would fall least heavily on long-term holders such as pension funds, life-insurance companies, and private equity firms. This would likely trigger a shift away from short-term trading in favour of long-term holding that may reduce asymmetries in markets and their subsequent abrupt adjustments or crashes.

6.6 Global reserve currency

Reserve currencies can be defined as currencies that are held in significant quantities by governments and institutions as part of their foreign exchange reserves, and that are commonly used in international transactions.

Figure 8: Relative proportion of national currencies held as reserve currency



(Source ECB 2005, IMF 2010)

Although alternative national and regional currencies (such as the euro) compete with each other as international reserve assets and means of international settlement, since 1945 the US dollar has maintained its predominant role in both regards. It is clear that the system is 'unstable, incompatible with global full employment, and inequitable' (UN, 2009).

There are broadly three different options under discussion for a global reserve currency system that could replace the US dollar.

6.6.1 New national currency to dominate global reserves

The natural option is for the Chinese Yuan/Renimbi to take over from the US dollar as economic dominance shifts to the east. However the Chinese central bank has argued against the use of a national currency as the global reserve currency citing the Triffin dilemma, which holds that a conflict of economic interests arises between short-term domestic and the long-term international objectives when a national currency also serves as a world reserve currency (Xiaochuan, 2009). Russia also supports the creation of a new supranational currency (United Future World Currency website).

6.6.2 Special drawing rights

The UN issued a report calling for a new reserve currency based on SDR, managed by a new global reserve bank (UNCTAD, 2009). This was echoed by the IMF stating that using SDRs could help stabilise the world economy (IMF, 2010).

6.6.3 New global currency

Bernard Leitaer has proposed the Terra which would be based on a basket of the 9–12 most commonly traded commodities. Proponents argue that the currency would be by definition inflation resistant (Leitaer, 2002).

6.7 Impact on the financial system

Unlike the previous four drivers of disruption, which are factors to which policies must react, this chapter has dealt with potential policy instruments that could be proactively deployed by governments and regulators to promote a greener and more inclusive financial system.

There is now mounting evidence that capital flow management, done well, can reduce country vulnerability to crises. Indeed the IMF states: 'There is, however, no presumption that full liberalisation is an appropriate goal for all countries at all times' (Baba & Kokenye, 2012). Capital flow management has been successfully pursued in order to limit exchange rate appreciation, reduce portfolio inflows, provide greater monetary policy independence, reduce inflation, reduce volatility, and/or reduce financial fragility. Controls should, however, only be temporary and persistent capital flow issues can often be better dealt with through the use other mechanisms. There is now also theoretical and empirical evidence that 'capital controls can help avert financial crises' and when applied correctly can 'improve bank confidence' (Bauman, 2013). In addition, it has been found that control of capital inflows can, over time, reduce the share of investor's portfolio located in the country instigating the controls (Forbes *et al.*, 2011). Implemented properly, capital flow management can 'stabilise financial systems by reducing vulnerabilities and improving other macroeconomic measures over time' (Forbes *et al.*, 2013a). Stable economies are better placed to tackle the long-term environmental challenges that we face today.

The overview of the potential of green credit guidance leads to the implication that optimal monetary policy cannot avoid differentiating between the different categories of credit. In the context of the UNEP Inquiry, credit guidance could be an important instrument to accelerate the transition to a prosperous and inclusive green economy. This could be achieved by structural changes, for example the creation of new types of banks focused solely on the provision of credit to businesses in order to fund new low-carbon capital investments, or by guidance or binding targets that allow existing banking institutions to make individual lending decisions within a set quantitative limits for certain sectors or types of credit. Such policies were common place during the 1945–1970 period in the USA, Europe, and Japan.

For full reserve banking, the IMF working paper has identified six key benefits that would accrue to countries that adopt full reserve banking. First, the country would have much better control of bank-lending-driven business cycles, leading to a flattening of the boom and bust cycle. Second, there would be a complete elimination of bank runs, since there is no risk of banks not having sufficient funds to meet customer withdrawals. Third, there would be a dramatic reduction of the (net) public debt coupled with a dramatic reduction of private debts. Fourth, there would be large output gains, especially during the transition, which could approach 10%. Fifth, the system would remove liquidity trap problems and finally it would make zero-rate long-run inflation attainable.

FTTs have the potential to raise additional revenue to enable the government to better cope with the budgetary costs and repercussions of future financial, economic, and ecological crisis. Their implementation should also curb short-term speculative and computerised high-frequency trading in financial markets by raising the cost of financial transactions. In addition, curbing short-term trade could reduce asset mispricing and market volatility by reducing noise trading. Interestingly, with the FTT being a tax on financial intermediation, application of the FTT could further encourage the existing trend of disintermediating financial transactions.

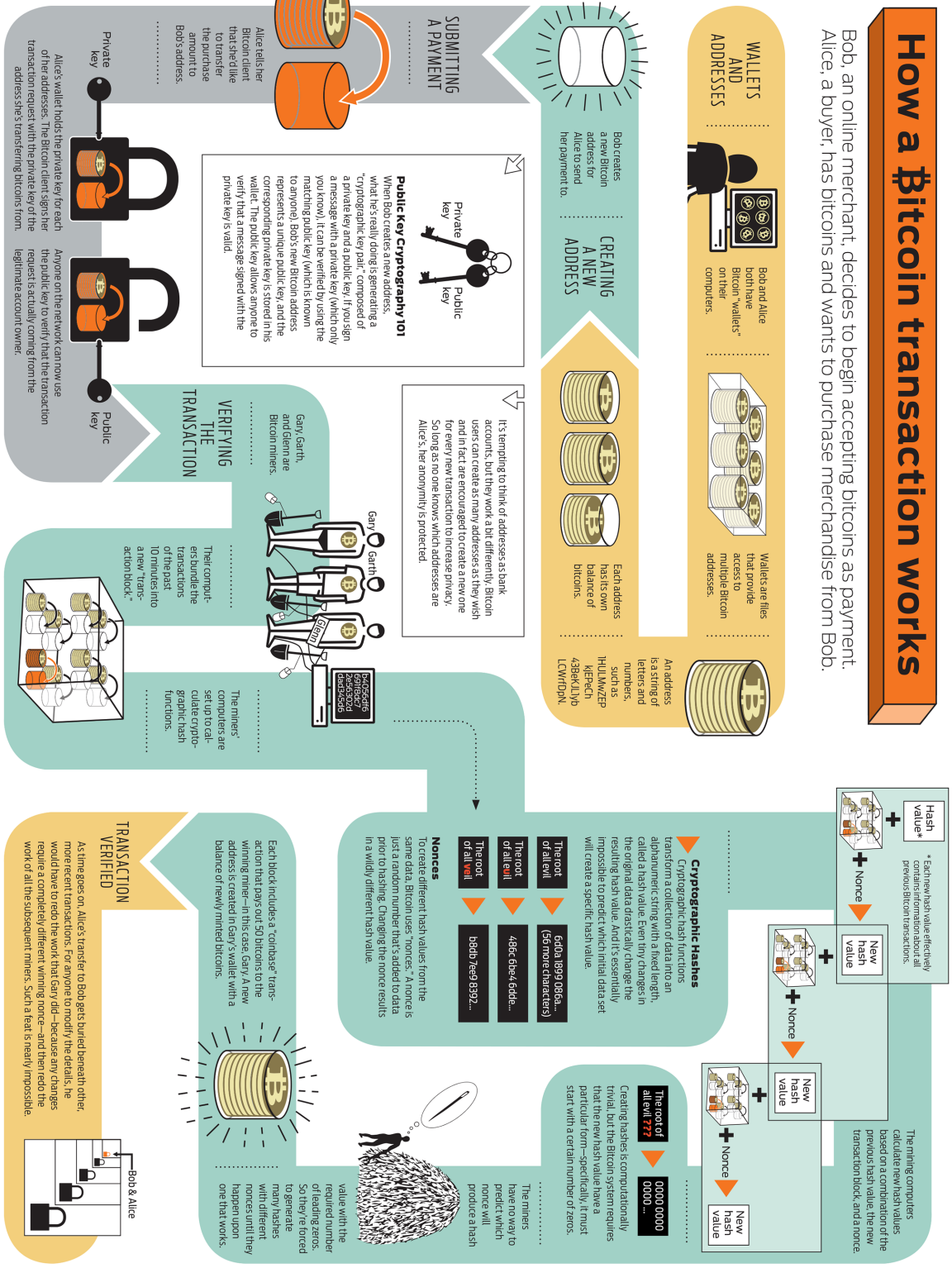
There are a number of major issues and impacts that would need to be addressed along with any shift in the global reserve currency. On a global level, many commodities are currently priced in dollars. This system would potentially need to be revised. The US economy would no longer be able finance its debt so easily as its interest rates would necessarily rise. It would discipline the USA and developed economies, using the dollar, since they will also have to factor in currency exchange risks when doing transnational business. The massive Eurodollar market would also be impacted.

The potential for design of a sustainable financial system is similar to that for new forms of private credit creation. The creation of a new global currency unit would allow for credit creation to finance low-carbon investment in developing nations. One such proposal suggested that SDRs could be issued to developers of large-scale, new, renewable energy infrastructure in developing nations that would otherwise struggle to borrow sufficient foreign currency for its construction (WFC, 2011).

The six potential innovations reviewed here are only a subset of the many instruments that are available to national and international policymakers. They range from the untested (e.g. full reserve banking) to policies that are in implementation in parts of the world but which have not reached international consensus for global implementation (e.g. FTT, green credit guidance, capital flow management).

Lack of international consensus at this stage may prove to be an opportunity as well as a threat to successful policy implementation, however. Given the uncertainties facing the global economy and the scale of the challenge of transitioning to a green and inclusive financial system, the emergence of experimentation with a diverse set of innovative policy approaches would allow for the accumulation of a body of evidence on the relative merits of different policy approaches based on assessment of practical outcomes as well as theoretical robustness.

Annex 1. How a Bitcoin transaction works



Annex 2. Ripple gateways and currencies

Gateway	Origin	Deposit/withdraw currencies	Issued currencies
Bitso	Mexico	BTC, MXN	BTC, MXN, USD
Bitstamp	Europe	BTC, USD	USD, GBP, JPY, EUR, AUD, CHF
btc2ripple	Worldwide	BTC	BTC
Coinex	New Zealand	AUD, BTC, NZD, USD	AUD, BTC, NZD, USD
Justcoin	Europe	EUR, NOK, USD	BTC, LTC
RippleChina	China	CNY	BTC, CNY, LTC
RippleCN	China	CNY	BTC, CNY, LTC
Ripple Singapore	Singapore	SGD, USD	SGD, USD, XAG, XAU, XPT
SnapSwap (US)	United States	USD	USD
The Rock Trading	Europe	BTC, DOG, EUR, LTC, NMC, PPC, SSL, USD	BTC, DOG, EUR, LYC, NMC, PPC, SLL, USD

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About the authors

Tony Greenham, Head, Finance and Business Team

Tony is a Chartered Accountant and former investment banker at Barclays Bank and Credit Suisse, where he raised equity finance for UK companies. He then spent several years in the commercial sector as a director of an Internet marketing agency, an art gallery group, an award-winning sustainable food retailer, and a high-street accountancy practice. He has a BA in Politics, Philosophy, and Economics from the University of Oxford and an MSc in Environmental Assessment and Evaluation from the London School of Economics.

Tony holds the following positions outside NEF:

- Department of Business, Innovation and Skills – Member of the Regional Growth Fund Advisory Panel
- Transition Network – Trustee & Treasurer
- Alliance Trust – Sustainable and Responsible Investments Advisory Committee
- Finance Innovation Lab – Fellow

tony.greenham@neweconmics.org

Josh Ryan-Collins, Senior Researcher, Finance and Business Team

Josh's research examines the impact of private bank credit creation and allocation on the macro-economy and alternatives, including public banks, credit guidance by central banks or governments, 'sovereign money' proposals (full-reserve banking) and decentralised complementary and peer-2-peer (P2P) currency systems. He is the lead author of NEF's guide to the UK monetary system – Where does money come from? – which sets out in non-technical language how commercial banks dominate the creation and allocation of credit and money and is being used as a university text book. Josh is the founder of the Brixton Pound, the UK's first urban local currency based in South London. He previously worked as a strategic communications consultant in the private and public sectors. He is studying for PhD in Finance at the University of Southampton examining the relationship between monetary policy and economic growth.

josh.ryan-collins@neweconomics.org

Duncan McCann, Assistant Researcher, Finance and Business Team

Duncan holds a law degree as well as a postgraduate certificate in the Circular Economy and a Master's Certificate in Project Management. Duncan currently works in the area of complementary currencies and financial innovation at NEF. Prior to joining NEF, he worked for Positive Money looking into the connection between money and monetary policy and the environment. Duncan previously worked for Cisco Systems in a variety of environmental roles focusing on new business opportunities and sound reuse and recycling of used equipment. As well as working at NEF, he leads the UN policy taskforce – Solving the E-Waste Problem – which seeks to analyse existing approaches and e-waste policies in order to issue recommendations for future developments in both the developed and the developing world.

duncan.mccann@neweconomics.org

Written by: Tony Greenham, Duncan McCann and Josh Ryan-Collins.
Edited by: Mary Murphy
Designed by: danfarleydesign.co.uk
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New Economics Foundation
www.neweconomics.org
info@neweconomics.org
+44 (0)20 7820 6300
@nef

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