

CENTRAL BANKING AND CLIMATE CHANGE

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Introduction

The role of the financial system in the economy is to facilitate the necessary financing for human activity to thrive – not only today, but also for future generations. Central banks and financial regulators play an important role in controlling the risks that imperil the stability and sustainability of the financial system and hence the economy. Following the Great Financial Crisis of 2007-09 (the GFC), central bank mandates have come under increasing scrutiny and in some cases, they are developing their operations as part of broader financial regulatory reforms to help “generate strong, sustainable and balanced growth” (G20 ,2009).

Central banks can play a major role in mitigating the risks from environmentally unsustainable economic activity, particularly that which contributes to climate change. We argue that the potential consequences of climate change - for the economy and especially the financial sector - mean that it falls squarely within the existing mandates of central banks and their primary objectives. Beyond that, many central banks have secondary objectives to support wider government policies which enable them to go further, without compromising their primary objectives.

The lead authority for mitigating climate change is always the government. Uniquely, it controls legislation, tax and expenditure programmes, has overall responsibility for regulatory frameworks and makes direct economic interventions. And the main agents for implementing its policies are in the private sector - which generates most of the risks and has the greatest potential for addressing them.

Notwithstanding those roles of government and the private sector, we argue that central banks must take climate change into account to the extent that it is part of their core mandate in delivering monetary and financial stability. Beyond that, there is more that they could choose to do in line with their secondary objectives – neither role should be underestimated.

This chapter analyses the responsibilities of central banks: monetary stability, financial stability and micro-prudential supervision – as well as broader balance sheet and corporate responsibilities.

2. Environmental Risks and Central Banking

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2.1 Historical Overview

Economic historians have demonstrated relationships between weather, agricultural markets and financial markets to show that there are linkages between natural disasters (e.g. drought) and financial market instability.³ The United States suffered from dust bowls in the farm belt states in the 1880s and 1890s and again in the 1930s, because of soil erosion that occurred from unsustainable farming methods (Hornbeck, 2012). Some of the banking sector distress experienced in the farm belt states can be attributed to the dustbowl phenomenon (Hornbeck, pp. 1481-3).

More recently, increased hurricane activity in the Caribbean and south eastern United States caused huge losses to businesses and individuals. Hurricane Andrew caused US\$24bn in damages to the South Florida economy in 1992, while Rita, Wilma and Katrina each caused widespread and extensive damage in the region. Katrina ranks as one of the costliest natural disasters in U.S. history (Lambert et al, 2017, p 3). The damages led to high loan losses and provisioning for banks that were based in the impacted areas. Those losses led US regulators to review the adequacy of bank risk models regarding credit risk and hurricane damage.

The Arab oil embargo of 1973 imposed constraints on the supply of oil that led to a near tripling in its US dollar price by the spring of 1974. This led to a substantial increase in the flow of petrol-dollars into the global banking system, thereby creating serious stresses in the Eurodollar and Eurocurrency markets, which contributed to the failures of several western banks (e.g. Franklin National Bank and Herstatt Bank).⁴

More recently, the International Panel on Climate Change (IPCC) has documented the scientific evidence in support of the proposition that carbon-intensive activities lead in the longer-term to global warming, rising sea levels and ocean acidification, while in the shorter term they can lead to increasingly volatile weather patterns, including extreme temperatures and intensified flooding of coastal and low-lying areas, water shortages, and the health costs of pollution⁵. The linkages between environmental sustainability and economic and financial stability raise the fundamental question of whether, and if so how, central banks should respond to the risks associated with environmentally unsustainable activity.

The scale of the economic impact of such risks and of the economic transformation required to address them is significant. A study by the United Nations estimates that the annual cost to the global economy of maintaining the current scale of unsustainable economic activity will reach nearly US\$28trn by 2050, equivalent to 18% of global GDP (UNEP FI & PRI, 2011, p.20). Meanwhile, estimates indicate that around US\$1trn of additional investment is needed annually through to 2030, for new green infrastructure in energy, transport, buildings and industry (World Economic Forum, 2013).

Some believe that these externalities will be controlled and even mitigated through adaptations in the economy, such as alternative production processes and re-directing transport routes to avoid flooded coastlines (Nordhaus, 2013). According to this view, investors, aware of the scientific evidence

³ For a review of the literature, see Landon-Lane et al., 2011, pp 73-84.

⁴ See Goodhart, 2011, p 37.

⁵ See IPCC, 2018, and earlier publications.

supporting the risks from climate change, should discount the value of high carbon assets and increase the value of low carbon assets, resulting in investment shifting over time to low carbon assets. Nevertheless, the history of financial crises demonstrates that financial markets suffer from serious over- and under-estimation of risks because of asymmetric information and moral hazard, resulting in large externalities for the economy and society (Eichengreen, 1999, pp 80-82; Aliber and Kindleberger 2015). Financial stability is a public good and market participants do not have the incentive to invest the necessary capital to provide it themselves because the benefits of stability spill over to free-riders.

The risks from climate change are undoubtedly amongst the most important and urgent facing the world today – the annual 2019 World Economic Forum Global Risks Report was once again dominated by climate and environmental factors amongst the top ten risks.⁶ But what is it that central banks can reasonably do to limit or mitigate the risks from climate change?

2.2 Modern Central Bank Responsibilities

Central banks have developed into a successful class of public institution, largely since the 1990s when many were given independent authority to set monetary policy to achieve anti-inflationary objectives. This model is now recognised as best practise globally across a wide range of developed and developing countries, less than 30 years since New Zealand led the way in February 1990, with the first explicit inflation target. By 2018, over 40 central banks had an explicit Inflation Target framework and over 20 had a price stability objective operationalised in much the same way (IMF, 2019).

Other core responsibilities of central banks include: the issuance of domestic currency in the form of bank notes; providing clearing and settlement accounts for the banking system; and responsibility for payments systems. All of these core responsibilities relate to the broad concept of 'sound money' or 'monetary stability' and its role in supporting economic welfare over the medium term.

Most central banks also have an actual or implied remit to preserve financial stability, either as a primary or secondary objective. This focus has grown as a result of the GFC and can now be treated as core in most countries, although we note that the EU Treaty setting up the European Central Bank (ECB) is unclear about its financial stability role.

Some central banks (e.g. ECB, Bank of England) also have responsibility for prudential regulation and supervision of the banking system and sometimes other financial institutions (e.g. insurers, pension funds). But in many countries (e.g. Japan, Sweden, Australia), prudential supervision rests with an independent supervisory agency or agencies.

Central banks which are responsible for prudential supervision may also have responsibility for other aspects of financial regulation such as conduct, market effectiveness, consumer protection or competition. In large developed countries, these usually rest with a separate conduct or securities market regulator. In other countries (e.g. Singapore, Ireland, Botswana) all financial sector regulatory responsibilities are combined within the central bank.

⁶ Extreme weather events were regarded as the most likely of the main risks and the second most impactful after weapons of mass destruction (World Economic Forum, 2019).

In this chapter we take the broadest view of central bank objectives regardless of national differences. These immensely powerful responsibilities are allocated to ‘independent’ central banks- who’s leaders are unelected and re largely technocratic organisations and operate within legal remits. On what basis could we expect central banks to play a role in climate change policy? This is a question which is being increasingly raised, not just by campaigners, but by the central banks themselves (Schoenmaker, 2018; PRA, 2018a; Cœuré, 2018; Debelle, 2019).

3. Monetary Stability

Monetary stability is perhaps the prime responsibility of a modern central bank. In developed countries it usually involves targeting price stability directly, although many countries (e.g. Hong Kong, Saudi Arabia) remain focussed on the exchange rate (IMF, 2019).

The primary tools of monetary policy are market operations – involving the purchase and sale (or repo) of bank assets and government debt - to guide short-term market interest rates and the supply of the narrow money base.⁷ In recent years, with interest rates close to zero, the focus in many larger countries (US, euro area, Japan, UK) has been on expanding the supply of money through Quantitative Easing (QE) to prevent deflation.

Central banks use these tools to influence intermediate targets such as the balance between real aggregate demand and supply and to influence inflation expectations. The economic theory is founded on the observation that, although there can be a short-term positive correlation between inflation and output in response to demand shocks, that relationship evaporates in the medium-term, and if consistently exploited, will lead to ever higher inflation. This tempts politicians to over-stimulate the economy for political gain in the short run leading to boom and bust. Committing to keep inflation low and stable is a prerequisite for maintaining sustainable growth and is in the broader public interest.⁸ Similar medium-term considerations apply to both financial stability and micro-prudential supervision: seeking to steer a medium-term, resilient path for the economy rather than maximising (or allowing financial firms to maximise) short-run gains which lead to subsequent, costly crashes.

In the context of climate change, the imperative is to take a longer-term view⁹ of sustainability than just the 5-7 years of the business cycle or the somewhat longer credit cycle. Sustainability needs to be considered across generations if the right policy choices are to be made (Stern Review, 2006). Carney (2015) described this as the ‘Tragedy of the Horizons’ in which the costs of preventing or mitigating the effects of climate change are lower, the sooner action is taken. But since the benefits largely accrue to later generations, current generations may not be willing to bear the costs. The likely consequence is much more costly actions, taken later.

⁷ The narrow money supply, or base money, defined as bank notes in circulation plus private sector deposits held at the central bank in domestic currency.

⁸ This is described in the Annual Remit given to the UK’s Monetary Policy Committee, see H M Treasury, 2018.

⁹ See for example EC, 2018a.

In economic language, it suggests using a low discount factor to reflect future welfare. We might also identify market failures – that there are externalities to current decisions, which are not priced properly. The market-based solution would be for governments to apply carbon taxes to correct the externalities directly – but for various reasons, including lack of international co-ordination, that route does not seem to be making progress.

The risks associated with climate change are directly relevant to central banks because of their impact on monetary policy and in particular on price stability. As global temperatures rise, and so do sea levels, the impact of physical climate events such as droughts, storms, floods and wildfires, could cause large relative price shocks: especially for food and other agricultural-related produce. There will also be price shocks arising from the transition to a lower carbon economy or to a higher temperature economy (possibly both) caused by changes in economic structure affecting the demand and supply of goods and services e.g. the demand for air conditioning will likely rise. Longer-term impacts could include the re-location of large populations from flooded or drought-stricken sites. There may also be structural change resulting directly from policy action e.g. the banning of fossil fuel-driven vehicles from city centres.

These are supply-side shocks, and the likely impact on inflation will be at varying frequencies: both relatively slow-moving trend changes in price differentials, and sudden volatility in relation to climate or policy shocks. In all cases, there could be a rise(fall) in the retail price level that show as a temporary upwards(downwards) movement in recorded inflation – possibly for some years - but not as a permanent change unless inflation expectations also rise(fall) and policy is accommodative. In the past, such effects have been evident in the case of oil price shocks and, to a lesser extent, food prices and tax changes.

Monetary policy is simplest to set for demand shocks – if output and (expected) inflation rise together, then the obvious policy is to tighten (and vice versa for negative shocks). But supply shocks drive inflation and output in opposite directions and policy is then less clear. Tightening to bring down inflation after a supply shock could worsen the fall in output – an unnecessary cost if the inflation movement is temporary. Policy should be adjusted only if there is a significant risk of inflation expectations becoming de-anchored, threatening a more general inflationary(deflationary) outcome.

The appropriate monetary policy response to a supply shock could be confined to communications aimed at anchoring expectations. But the more frequently such shocks occur, the more likely it is that temporary inflation movements lead to expectations changing.

3.1 What can monetary policy do to mitigate the threats from climate change?

Firstly, we observe from previous crisis episodes, that when monetary or financial stability is lost, the resources of governments and central banks alike become devoted to short-term crisis management. That is probably the easiest way to lose sight and control of any longer-term sustainability agenda. Indeed, one of the main motivations for low and stable inflation is precisely that it enables economic agents to concentrate on matters related to real outcomes and long-term planning without being distracted by the costs of inflation or short-term boom and bust. Central banks must not compromise on their core objective of monetary stability. Sound monetary and financial control is a pre-requisite for a long-term sustainable economy.

Secondly, central banks need to refocus their analytical abilities more to the supply-side, including better data collection. In the history of inflation targeting, it was widely assumed that changes in potential growth were too slow moving to be relevant for monetary policy, whilst supply shocks were isolated and transient. It was only labour markets that were of interest on the supply side, as they had long been seen as a source of inflationary expectations manifesting themselves via wage increases.

Thirdly, central banks have monetary tools that involve adjusting the size of their own balance sheets to change the level of base money supply. These tools could affect the supply of credit or liquidity for banks and the financial system to support lending and investment in environmentally sustainable sectors of the economy. Between 2009 and 2014, the Bank of England followed a ‘Funding for Lending’ scheme that involved the central bank providing liquidity at low interest rates to banks, secured largely on illiquid assets, in order to reduce the pressure on bank funding that had been driving up the interest rates paid on deposits.¹⁰

The FLS, and similar schemes in the UK and in the Euro Area, have raised the question of whether central banks should routinely make funding available to banks or other credit providers in order to promote increased lending to environmentally sustainable economic activity. Other central bank monetary actions could involve, for example, favourable treatment as collateral in routine liquidity-providing operations.

Collateral policy is a relatively narrow, technical issue. Normally central banks will prefer liquid, safe assets as collateral in lending operations. That may or may not include ‘green’ or ‘brown’ assets. We note that markets are generally more liquid where the assets are eligible at the central bank and that could suggest a more positive stance towards sustainable assets. Meanwhile, the risk stays with the collateral provider unless there is a default, when central banks may become the asset owners. It would be appropriate for central banks to review their collateral policies on both market liquidity and risk grounds.

An example of this in practice is the People’s Bank of China (PBOC, 2015). The PBOC initiative involves utilising more proactive measures to provide additional liquidity support to Chinese banks, such as the acceptance of “green asset backed securities” as collateral for liquidity support for Chinese banks (Huan et al., 2018).

3.2 *Bank Notes*

An area of monetary stability that is directly relevant to carbon emissions is the issuance of bank notes. Although the actual process of printing banking notes is largely industrial and often outsourced, central banks retain the policy responsibility and, in some cases, they operate the actual printing presses.

Traditionally, banknotes were made from cotton-based paper. But polymer bank notes have been in circulation in some countries for decades (Australia since 1988) and introduced in others more

¹⁰ See Fisher (2013) for an assessment of the FLS.

recently (Canada in 2011; UK in 2016). To meet government commitments to limit global warming, it should be expected that all manufacturing processes will come under pressure to be more energy efficient and less polluting.

Polymer bank notes are more durable than paper-based notes and, perhaps surprisingly, easier to recycle, but they cost more to produce. A conservative estimate by the Bank of England is that they would last 2.5 times longer than a paper-based equivalent. Based on that, a Life-Cycle Analysis commissioned from an independent consultant concluded that polymer had less environmental impact than paper (Bank of England, 2013). A report commissioned from The Carbon Trust (Bank of England, 2017) certified that over their full life cycle, the carbon footprint of a £5 polymer banknote is 16% lower than the previous £5 paper banknote, while that of a £10 polymer banknote is 8% lower.¹¹ The economic and sustainability case for polymer bank notes seems clear- although it was notably rejected by the ECB (Reuters, 2014).

3.3 *Policy recommendations in relation to Monetary Stability*

Central banks should:

- i) Keep a focus on low and stable inflation as a priority, to support the sustainable growth rate, but take a long-term (inter-generational) view of what potential growth is sustainable.
- ii) Shift the balance of their economic analysis to the supply-side and potential growth, relative to short-term demand fluctuations.
- iii) Review their collateral policies both on risk and sustainability grounds.
- iv) Support national authorities to consider whether monetary measures can be used to help provide credit to support their climate adaptation or mitigation strategies
- v) Consider moving to polymer banknotes, and if no change is made, the reasoning should be published in full.

4. Central Bank Balance Sheets

4.1 *Quantitative Easing*

Central bank balance sheets are primarily used to implement monetary policy. Whether there is an exchange rate target or an inflation target, the policy instruments of interest rates and/or the narrow money supply must be adjusted to suit. Foreign Exchange Reserves may also be part of the central bank balance sheet and used for monetary policy purposes. Occasionally, central bank balance sheets are used to support financial stability, in part by being Lender of Last Resort (LoLR) to the banking system.

The central banks of most of the world's large developed economies began quantitative easing (QE) during the GFC, undertaken as a combination of both their monetary and financial stability responsibilities. After interest rates were cut to near zero, QE involved buying large quantities of financial assets. That automatically injected historically large amounts of base money and hence liquidity into the system, reducing interest rates and spreads at all maturities.

¹¹ All documents available from Bank of England website:
<https://www.bankofengland.co.uk/banknotes/polymer-banknotes>

One of the main motivations for QE was to counter the risk of falling prices at the same time as stagnation in output, a combination which could have been very difficult to escape otherwise. QE was generally successful in pushing inflation back up towards target. Arguably it was most effective during the periods in which financial markets were dysfunctional – during 2008-09 and then the Greek sovereign debt crisis in 2012. We note that, despite popular misconceptions to the contrary, expanding the money supply can not (much) affect the medium-term growth rate and is not a cause of, nor a cure for, poor productivity growth.

Fisher and Hughes Hallett (2018) suggest that it is likely that central bank balance sheets will remain much larger than before the GFC, since banks require many more liquid assets to meet their new Basel minimum liquidity requirements. The base money injected into the system through asset purchases, by necessity ends up in commercial bank deposits with the central bank. Those deposits are the most liquid asset a commercial bank can hold, being used to make inter-bank payments.

Expanded central bank balance sheets have highlighted several questions including how large they could be and what assets should be held? In particular some politicians and campaigners have argued that central banks could invest in social or green assets (“People’s QE” or “Green QE”). The question has become acutely political for the ECB which bought large quantities of corporate bonds, and some Members of the European Parliament have demanded to know what the carbon footprint of these assets is, and why climate change risks were not taken into account when selecting bonds for purchase.¹²

We note that QE operations are intended by central banks to be market neutral ie not to allocate capital between competing borrowers. And whatever is purchased, all asset prices tend to rise together, and hence green and brown assets are both automatically supported by any form of monetary expansion.

Purchasing particular assets in large scale using cash can also be used to change the liquidity properties of financial markets (a) buying less liquid assets reduces total market liquidity risk; (b) buying long-dated assets shortens total market-held duration risk; (c) buying credit-risky assets reduces credit-spreads. By reducing risks and hence spreads, all of these factors can then force some investors to seek out higher returns. And if a market for a particular asset is dysfunctional for some reason, then central bank buying of those assets can improve market functioning (e.g. the US Federal Reserve policy of buying housing-backed assets and ECB purchases of corporate bonds). This can be termed ‘Credit easing’ rather than QE.

Should QE be used to purchase green assets? At the start of 2020, there is no shortage of demand for green assets – if anything there is insufficient supply. Green bond issues are regularly increased in size during the issuance process, without any detrimental effect on price. Given that, there is currently no obvious policy case for central banks buying green assets. It would simply crowd out private sector purchases by removing those bonds from the tradeable market at a time when the investor base is still growing rapidly. That is more likely to disrupt market growth, rather than add to it. Meanwhile,

¹² See ECB, 2018.

existing QE will have been indirectly supporting private sector demand for all assets. The balance of demand and supply may change in future but for now the purchase of green assets by the central bank in large scale would likely be counterproductive.

There are also other concerns. Central bank balance sheets need to be able to both expand and contract quickly – whatever assets are purchased for monetary purposes may be sold quickly if policy needs to tighten. And if central banks wanted to buy assets on ESG grounds they would first need to be able to identify them – that would currently be difficult given the lack of defined asset classes.

Overall, there are good reasons why central banks might prefer to remain neutral in their asset purchases. But a counter case can be made. First, central banks are exposed to climate risks in their asset holdings, just like any other financial institution. These risks should be recognised in their own risk management frameworks. Second, central bank balance sheets will likely stay enlarged. If so, there will be a large portion of their asset base which will not need to be sold in future and risk considerations aside, there is no clear policy reason for holding, or not, any particular type of asset. Some portion of the expanded balance sheet could be allocated to hold an investment tranche of long-term assets other than government bonds.

There is one other area where central banks could amend their balance sheet operations: transparency. The recommendations of the FSB Task Force on Climate Related Disclosures (TCFD, 2017) were not designed for central banks, but they could be adapted. Arguably the public has a right to know, at least generically, what assets are being held by public sector institutions and what their carbon footprint is.

4.2 Foreign Exchange Reserves and Sovereign Wealth Management

Central banks often hold large quantities of foreign exchange reserves on balance sheet or manage them on behalf of governments. Currency reserves may be held for policy purposes such as potential intervention in foreign exchange markets or as a store of national wealth. Where the latter is large, it is often split into a Sovereign Wealth Fund (SWF) which can be a more active manager. Governance varies from the central bank owning the SWF (e.g. Botswana) to managing it (Norway), to having partial responsibility (China) to having none (Singapore). Leaving aside the policy tranche, the investment funds/SWF can be very large and very significant international investors – China has US\$3trn of reserves and the largest single SWF is the Norwegian Government Pension Fund Global at over US\$1trn.

The considerations for managing such funds are very similar to large private sector asset managers except for the fact that sovereign investors have more political/social mandates and they might be expected to take rather more externalities into account. These funds are for national saving and should be used to generate sustainable returns for future generations. We should therefore expect SWFs to demonstrate best practice in managing their investments sustainably. For example, that may mean avoiding the obvious downside tail risks from investing in the coal industry, as Norway have announced. Such decisions by the larger SWFs could be important for their leadership signal.

4.3 Policy recommendations for central bank balance sheets

Central banks should:

- i) Be prepared to engage constructively with their governments around the use of expanded balance sheets to explore and explain in what ways they can, or cannot, be used to support wider government social and economic objectives.
- ii) Not purchase large quantities of green assets as part of QE portfolios, as that could crowd out private sector investors and be counterproductive under current conditions. But consider an investment or SWF tranche of green assets for a balance sheet which is expected to stay expanded.
- iii) Help to regulate disclosures by authorised firms to be in line with TCFD recommendations and
- iv) Either (a) be completely transparent about all its own holdings of assets; and/or (b) regularly commission an independent calculation to establish their portfolio's carbon footprint.

5. Financial Stability

Systemic crises usually occur when risks have accumulated unseen or been under-estimated and then suddenly crystallise lead to market price 'jumps'. Financial market prices do not always adjust smoothly. They are forward-looking, which means that particular pieces of news are extrapolated across time and sectors to take account of broader implications. This can cause asset re-pricing to be exacerbated, potentially to large jumps for whole asset classes.

Ideally, one would aim to prevent such severe financial shocks from happening. Recognising that unforeseen shocks will occur, financial stability policy is oriented towards making the system resilient. Hence the regulatory objectives for the banking system might include for the inter-connections between institutions not to be such that a single failure brings down the system. And to hold enough capital to absorb severe but plausible losses under a stress scenario, whilst continuing to provide financial services to the economy. Co-ordinated stress tests are now undertaken to help meet this objective, in at least the US, the euro area and the UK.

The main financial stability risk from climate change is that there could be a sufficiently large and widespread fall in financial asset prices, perhaps from stranded fossil-fuel assets for example, to cause system-wide effects that disrupt financial services. The UK has made its first proposals for climate stress tests (Bank of England, 2019).

Market price jumps could occur as a result of transition risks crystallising, via sudden government policy changes – especially if global in impact. These would be regarded as extreme tail risks, but preserving financial stability generally requires being robust to tail events. Changes in energy policy have already led in whole, or in part to significant changes in the prices of individual stocks (RWE and Eon in Germany; Peabody Energy in the US).

One can also imagine financial market dislocations arising from physical events, should they be sufficiently severe or simultaneous. An extreme example would be if there were floods in London, severe hurricanes in New York and an earthquake in Tokyo by random chance at the same time. Not only would markets be disrupted by those events, but also by changing assessments of the likelihood of future disruptions.

One policy response to the risks of climate change, which would make the system more resilient, is to have more public information on climate related exposures of corporate entities. Such information can be used to price the risks that firms face (including the credit risk in loans), and to re-price should an event change perceptions of the future. That should mean that jumps in asset prices are smaller and occur less frequently.

A major benefit of disclosure is that the firm disclosing must first evaluate the risks that it is exposed to and that alone may prompt changes in behaviour. One disincentive to disclosure is the risk of a negative market reaction and so the worst carbon emitters are least likely to disclose voluntarily. That argues for making such disclosures mandatory.

The main policy initiative on disclosure has been the G20 Financial Stability Board and the Task Force (TCFD) it set up to make recommendations on voluntary Climate-Related Financial Disclosures. This was private sector led and reported in July 2017 (TCFD, 2017) concluding that firms should report, in their main financial filings, on how they are managing climate related risks in four areas: Governance, Strategy, Risk Management and Targets and Metrics. Specific advice was given for certain industrial and financial sectors although the Report is not a blueprint for disclosures. In particular it argues for scenario analysis to assess the risks facing a company, particularly for the transition to a lower carbon economy.

A number of countries have endorsed the TCFD recommendations, including the EU and the UK, and hundreds of large companies around the world are seeking to implement them (see TCFD, 2018, 2019). In the longer-term, once the methods for disclosure have become settled, it is probably inevitable that such disclosures will be written into reporting requirements – the EU are already moving in that direction with changes to the Non-Financial Reporting Directive (EC, 2018b).

5.1 Policy recommendations for financial stability

Financial stability is not just a matter for central banks, and so some recommended policy actions must be exercised in conjunction with or through other regulatory authorities:

- i) National authorities should implement TCFD recommendations through domestic regulatory requirements.
- ii) Early actions by governments to mitigate climate change are less likely to cause major financial instability than delayed actions which need to be greater in magnitude. A sense of urgency is needed.
- iii) Supervisory authorities should use their powers to address risk management in authorised firms and we turn to this next.

6. Prudential Supervision

Not all central banks undertake prudential regulation and supervision, but they are usually a key stakeholder and policy contributor through their interest in financial stability. Broadly speaking we can describe regulation as setting and enforcing rules, and supervision as a more investigative and intrusive over-sight. Both have a role to play. In this section, we outline the nature of the risks in insurance and banking and then consider how regulators might intervene.

6.1 Insurance Supervision

In 2015, the Bank of England's Prudential Regulation Authority (PRA) published an influential paper on the risks to the UK insurance industry (PRA, 2015). This has been followed with an assessment of risks to the UK banking sector (PRA, 2018a). Insurance firms are in the front line for climate risks, as it affects both their under-writing and asset management functions. The market has broadly three categories of insurer, each facing different risks: general, life and re-insurance.

- iii) General Insurers are those who write insurance policies for retail and corporates relating to day-to-day risks such as accidental damage, loss, theft etc. These policies cover general business and consumer disruption, including climate-related events such as floods, storms and droughts and even catastrophes. Their modelling has to reflect the trends and the tail risks. These policies can usually be re-priced every year and so the general insurance industry – providing it stays alert and extrapolates reasonably - can protect itself. Indeed, it has a key part to play in climate risk adaption – helping to spread the costs from global warming over time, space and people.

In much of the world, especially in poorer countries, insurance coverage is weak. And particular risks may become uninsurable even in developed countries. For example, as sea levels rise or rainfall increases in certain areas, flood insurance may no longer be available. In the UK, this has led to the Government and Industry jointly creating Flood-Re – a reinsurance company that helps insurance companies to pass on their more extreme risks.

Climate losses can also be large and unpredictable. A report by Lloyd's of London (Lloyd's, 2014) into Super Storm Sandy in New York in 2012, estimated that the losses from the ground water upsurge were increased by some 30% (cUS\$6bn) because of the rise in sea-level at the Battery, of some 20cm since the 1950s.

- iv) Life insurance companies (or superannuation funds) face additional risks on the asset side. These insurers need to match their longer-term liabilities with similarly long-term assets. These assets, especially property, are subject to physical and transition risks.
- v) Re-insurance can reduce the capital requirements of the industry by diversifying underwriting risks – if uncorrelated enough they shouldn't all crystallise at the same time, so capital can do 'double duty'. There is a risk from climate change, however, that correlations may be changing e.g. climate events appear to be becoming more directly inter-dependent, in which case the diversification benefits may be over-estimated – an example of 'wrong-way' risk.

6.2 Banking

The risks for banks are more nuanced because their assets tend to be shorter-term, and they take security against loans. But banks lend to some activities which will become unsustainable – such as the coal industry. Over time, the associated credit risks will increase, and could crystallise suddenly: Peabody Energy, the world's largest private coal producer eventually filed for Chapter 11 protection in the US, after a US Government shift in policy in favour of gas. And short-term lending is not always less risky than long-term - the original maturity date of a loan is not relevant if default happens suddenly.

The availability of collateral to take as security can also be a false comfort. That security is often in the form of property (e.g. for a mortgage) or plant (for a firm). Physical climate events could cause the borrower to default and simultaneously wipe out the physical asset. Hence it is a 'wrong-way' risk. The collateral may be protected by insurance. But banks do not typically keep records of whether their borrowers have maintained the relevant insurance. So, they do not know how much security they would really have in the event of extreme climate events.

6.3 *The role of regulators*

The role of financial regulators is to make sure that the financial system remains stable, not to protect the shareholders or management of individual companies. Even if a financial firm needs to be publicly supported so it can continue to provide necessary services, the shareholders should be wiped out and senior management fired. But climate risks are systemic and will most likely affect the whole financial system at the same time.

Alexander (2014) argues that the Basel system of capital requirements has all the elements that are necessary to protect the banking system in the context of climate change. Basel regulations comprise 3 pillars. Pillar I is the system of minimum capital requirements that apply to all firms. Pillar II is additional capital that is required to cover risks not captured by Pillar I. Normally, these will be idiosyncratic to the firm: capital 'add ons' can be imposed using supervisory judgement. Pillar III is market discipline through disclosure.

Climate change represents a material financial risk and, regardless of the minimum calculations specified, the rules require banks to hold capital against all material risks that the firm itself has identified. So, the first responsibility is that of the bank. Supervisors should be examining their firms to see whether climate-related risks are being properly identified and risk-managed and that capital is being held appropriately. If not, then capital add-ons can be either threatened or imposed to incentivise action. In itself, that pressure should help banks to decrease their exposure unsustainable activities.

This process is hindered by the lack of definitions of what assets are, or are not, sustainable. The EU is developing a taxonomy of green assets to remedy that, as part of its action plan on sustainable finance (EC, 2018b, 2019). But, at the current time, supervisory action needs to be justified on broad grounds of risk management, rather than related to specific assets.

There have been propositions in favour of reducing Pillar 1 risk weights to incentivise green lending. In particular the so-called Green Supporting Factor (EBF, 2018) which was proposed by some European banks to be an ad hoc cut of 25% in risk weights for 'green' lending. Alexander and Fisher (2019) argue that this would be a mistake on a number of grounds.

Financial stability is a pre-requisite for a sustainable economy and, consistent with that, the Basel capital weights system is risk-based. It would be a mistake to jeopardise financial stability, and hence sustainable growth, by making non-risk-based adjustments to capital requirements.

Pillar 1 capital weights are both approximate and complicated. There are not yet any green asset classes defined to which differential capital weights could apply and there is no evidence yet that the risk-based weights in the Basel system are inappropriate for green lending. It is much more likely that lending to unsustainable activities could justify increased weights. Producing evidence to support changes in risk weights would be a lengthy and difficult process, however. In contrast, Pillar II is immediately available and can be used by supervisors now to directly increase capital requirements where banks do not have adequate risk management. That is the path on which leading supervisors are embarked (PRA, 2018b), although until there are more specific definitions, it will be up to the banks to both identify their risks and take appropriate action.

These arguments were rehearsed by the European Commission's High-Level Experts Group (the HLEG) on Sustainable Finance (EC, 2018a). The Commission promised to investigate the issue further, with the condition that risk weights should remain risk based.

Similar arguments apply to the insurance industry. One difference is that the use of internal models to assess risk and capital is more advanced for an insurer which needs to link its assets to its liabilities, whereas a bank typically judges its capital needs solely by its assets. In both sectors internal models should eventually capture any risk benefits of green lending and any costs from brown, but these risks will not be in the data underlying their models yet, since climate change is on-going. Ideally one needs to use forward-looking scenario analysis to judge the extent of the risks and this may well be easier to do in the approach of insurance modelling where balance sheets are simulated tens of thousands of times, using different parametric assumptions.

Finally, one of the key supervisory issues is Governance. The UK has shown a lead here by making the responsibility for managing climate risks a designated function under its Senior Managers Regime. All authorised firms are now required to have a named person with that function, who can be held personally responsible for any failures (PRA, 2018b, 2019c).

6.4 Policy recommendations in relation to prudential regulation.

Supervisors should:

- i) Ensure that authorised firms are identifying and managing the risks from climate change and not simply ignoring them.
- ii) Help by constructing forward scenarios that will help the industry to judge its capital requirements in the face of future threats (PRA, 2019c).
- iii) Seek to enshrine the TCFD recommendations in disclosure rules on a mandatory basis – at least once the reporting techniques and standards have established best practice.
- iv) Re-examine Pillar I risk weights based on new official taxonomies, once the latter are introduced. But this process should not be used as an excuse for inaction on other fronts.

7. Market regulators: conduct, consumer protection and market efficiency

In many smaller countries the central bank has responsibility for all market regulations. So, we briefly consider how climate change may affect market conduct and related duties. The UK's

Financial Conduct Authority is one of the first¹³ conduct regulators to take climate risks seriously, and it only published its first paper on the topic in October 2018 (FCA, 2018).

One imperative is that the financial sector provides services which meet the needs of citizens effectively. There is a growing demand for investment in green assets, but not much opportunity for the retail investor, who has limited access to information or suitable products. Promoting the development of effective markets to ensure they meet consumer needs is within the broad remit of at least some 'conduct' regulators.

A particular issue is that Independent Financial Advisors do not appear to be routinely asking their customers about their sustainability preferences and thus do not end up recommending funds dedicated to sustainable outcomes – despite many opinion surveys revealing a latent demand. This is not simply a question of whether customers are willing to trade off some returns for the comfort of investing sustainably. There is growing evidence that companies with high Environmental, Social and Governance (ESG) ratings produce higher returns over the medium term. Following a recommendation from the Commission's High-Level Experts Group on Sustainable Finance (EC, 2018a), the EU are adapting the MIFID (Markets in Financial Instruments Directive) rules to make it a requirement for investment advisors to ask their clients about their sustainability preferences (EC, 2018b).

Given the demand by investors, both retail and professional, there is also an incentive to advertise investment products as 'green' when they are not. This so-called 'green washing' is clearly a conduct issue. In addition, many working practices of asset managers have been challenged for not being aligned to sustainable capital. This may include excessive churn of securities, excessive focus on very short-term returns, and a misunderstanding of fiduciary duty.

Fiduciary duty has been interpreted at times to mean maximising the short-term returns for shareholders. In fact, fiduciary duty relates to the interests of the corporate entity as a whole, not just its current shareholders and not just to monetary returns – the future franchise value matters, as does the interests of employees. Recent legal opinions have supported this. Hutley and Davies (2016) argues that because climate change represents a clear and material financial risk, fiduciary duty requires boards to assess the risks and take them into account. Failure to do so will leave directors liable in the event of climate-related losses.

7.1 Policy recommendations for conduct and market regulators

These recommendations are consistent with those of the HLEG (EC, 2018a):

- i) All funds offered to retail investors should be required to report simple sustainability metrics, preferably relating to impact.
- ii) Those funds specifically offering themselves as 'green' or 'low carbon' should be required to provide evidence consistent with that label.

¹³ ASIC in Australia is also on the case. See <https://asic.gov.au/regulatory-resources/corporate-governance/corporate-governance-articles/disclosing-climate-risk/>

- iii) All financial sector firms, including asset managers and independent financial advisors should be able to demonstrate awareness of the issues and risks to financial investments arising from climate change.
- iv) Financial advisors should be required to ask clients about the preferences for investing sustainably.

9. Conclusions

In the wake of the financial crisis of 2007-09, there have been extensive reforms to international banking and financial market regulation, and greater scrutiny of the mandates and operations of central banks. In our view, central banks should play a major role in coordinating the use of policy tools and measures alongside governments and other financial and environmental regulators to generate strong, sustainable and balanced global growth. The urgency for policy and regulatory intervention cannot be over-stated as environmental sustainability risks are amongst the biggest risks that the world faces today.

In this chapter we have set out an analysis of why and how central banks can and should be involved in addressing the financial risks associated with environmentally unsustainable activity, consistent with their existing mandates and objectives. Environmental sustainability risks affect central bank primary objectives through monetary conditions, banknotes, financial stability and the prudential requirements of authorised firms (and market conduct where applicable).

Financial stability considerations suggest that central banks should go further than this, to positively promote a transition to a sustainable and hence lower carbon economy, as part of their primary objectives. The full recognition of secondary objectives, to support the government's wider economic policies, can be invoked as necessary. That includes on issues such as managing expanded balance sheets. It could be possible for a central bank to buy green assets, perhaps as an investment tranche of its assets, although this needs to be carefully considered so as not to disrupt nascent green markets.

Central banks have a duty to act under their existing mandates and should be getting on with that – and some are. The new central bank and regulator group – The Network for Greening the Financial System - has grown rapidly since it was founded towards the end of 2017¹⁴ and had 54 members at the end of 2019. It has already achieved a remarkable track record of involving industry and academia in debating what should be done in financial markets, from the perspective of the authorities and private firms. It can and should play an important role in spreading best regulatory practice in this area.

¹⁴ See NGFS website hosted by the Banque de France: <https://www.banque-france.fr/en/financial-stability/international-role/network-greening-financial-system>.

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