

Durham Research Online

Deposited in DRO:

24 July 2020

Version of attached file:

Accepted Version

Peer-review status of attached file:

Peer-reviewed

Citation for published item:

Langley, Paul and Morris, John H. (2020) 'Central banks : climate governors of last resort?', *Environment and planning A : economy and space*, 52 (8). pp. 1471-1479.

Further information on publisher's website:

<https://doi.org/10.1177/0308518X20951809>

Publisher's copyright statement:

This article is distributed under the terms of the Creative Commons Attribution 4.0 License (<https://creativecommons.org/licenses/by/4.0/>) which permits any use, reproduction and distribution of the work without further permission provided the original work is attributed as specified on the SAGE and Open Access pages (<https://us.sagepub.com/en-us/nam/open-access-at-sage>).

Additional information:

Use policy

The full-text may be used and/or reproduced, and given to third parties in any format or medium, without prior permission or charge, for personal research or study, educational, or not-for-profit purposes provided that:

- a full bibliographic reference is made to the original source
- a [link](#) is made to the metadata record in DRO
- the full-text is not changed in any way

The full-text must not be sold in any format or medium without the formal permission of the copyright holders.

Please consult the [full DRO policy](#) for further details.

‘Commentaries’

Central banks: Climate governors of last resort?

Paul Langley (Durham University)

and

John H. Morris (University of Warwick)

Abstract

The global and regional leadership of central banks in response to the COVID-19 pandemic has heightened public and political debates over their role in the governance of an arguably more fundamental planetary crisis: the climate crisis. Strategically harnessing the resources and reach of central banks would seem crucial to achieving a genuine step-change in the governance of the climate crisis. We consider how critical social scientists might contribute to debates over the potential of central banks to act as ‘climate governors of last resort’.

Keywords: central banks; climate crisis governance; financial stability; risk management; macro-prudential stress testing

Central banks: Climate governors of last resort?

Introduction: Last resort governance

More than at any time since the establishment of the Swedish Riksbank in 1668, it would now seem appropriate to speak of ‘central-bank-led capitalism’ (Bowman et al., 2013). In response to the COVID-19 pandemic, the Federal Reserve (Fed), Bank of England (BoE), European Central Bank (ECB), People’s Bank of China (PBC) and Bank of Japan (BoJ) have, in particular, further exercised and entrenched their positions of global and regional leadership in economic governance (Jackson, 2020; Tooze 2020a). Since the economic ramifications of the pandemic first became apparent in early March 2020, the Fed and other major central banks have made an extensive and expensive array of complex crisis management interventions. Central bank leadership is rooted in their institutional monopoly over the issue and management of sovereign territorial money (i.e. ‘currency’). In David Harvey’s (1982: 247) terms, this places central banks at the ‘commanding heights’ of ‘the hierarchy of monetary institutions’ in domestic economies, as they seek to ‘guarantee the creditworthiness and quality of private bank moneys’. Central banks have been further empowered in the post-Bretton Woods era of fiat money, as their issuance of sovereign currencies is untethered from gold reserves. In pursuit of monetary stability mandates and low-inflation targets, central banks also typically enjoy independence by statute from government in liberal democratic states. Moreover, the global and regional leadership of central banks rests on a further hierarchy, the international hierarchy of monetary power. This presently gives the Fed, in particular, the kind of extra-territorial reach necessary to guarantee private banking and financial markets that are largely denominated in US dollars, and increasingly operate at a transnational scale.

Nonetheless, many of the key crisis management techniques adopted by the principal central banks in recent months were only minted a decade or so ago. Honed during the global financial crisis of 2008 by the Fed and BoE in particular (Langley, 2015), asset purchase and quantitative easing (QE) techniques, resourced by monopoly over fiat money issuance have become crucial to central bank capacities to fulfil their broadened financial stability mandates. This is because these techniques enable central banks to take up the position of ‘investor of last resort’ during crises, purchasing and guaranteeing bonds and other assets in capital markets in order to keep borrowing costs down and prevent precipitous devaluations and investor insolvencies. Current crisis management by the major central banks thus extends well beyond their historical role as the ‘lender of last resort’ (LOLR), a role that was first specified and

legitimated for the BoE by Walter Bagehot in the latter half of the nineteenth-century (Mehrling, 2011). Through to the crisis of 2008, the scope and scale of crisis management by central banks was shaped largely by the ‘Bagehot dictum’: lend feely and promptly, at a penalty rate and against good collateral, to solvent but illiquid banks. In contrast, and for the second time in the twenty-first century, today’s leading central banks are enacting wide-ranging crisis management programmes of last resort investing, alongside monetary policy decisions and emergency liquidity lending to banks. At the time of writing, in July 2020, they have already pledged resources on a scale that far surpasses those committed during the global financial crisis.

Our *Commentaries* contribution responds to the public and political debate over central bank leadership in the governance of an arguably more fundamental planetary crisis: the climate crisis. This debate has gained new urgency amidst the management of the COVID-19 crisis, not least because so much of the global capitalist economy has moved onto the balance sheets of the major central banks during the last few months. The unrivalled monetary resources and seemingly ever-expanding last resort governmental responsibilities of central banks have been in evidence during the COVID-19 crisis, and this is provoking reappraisals of their capacities for global climate change governance.

Private banks and institutions have certainly developed the specialist products and services of the ‘green’ or ‘carbon finance’ sector in recent years. But a huge ‘investment gap’ persists between current realities and the estimated volume of new capital required in each and every year to finance a low-carbon transition of economy and society. At the same time, ‘Green Keynesianism’ and a ‘Green New Deal’ stand as a potential alternative to the prevailing private finance- and NGO-led approach to climate change governance. But the scale of fiscal funding required for a Green New Deal approach is likely to become even more problematic going forward, given the shrinking tax revenues and stimulus packages promulgated by the COVID-19 pandemic. Regardless of the approach to be taken-up in the future, strategically harnessing the resources and reach of the major central banks would seem to be crucial to the governance of the climate crisis. Prevailing and progressive political agendas have variously converged on the possibility that central banks could act as what we call the ‘climate governors of last resort’.

How, then, might critical social scientists intervene in the debate over the potential leadership of central banks in climate change governance? Given fresh impetus by last resort governance during the COVID-19 pandemic, many proposals for last resort climate governance are presently circulating in academic, public and policy debates that seek to graft climate-related concerns onto the financial stability mandates and techniques of central banks. While

these proposals should be broadly welcomed, we will call for research and political engagement that, first, foregrounds the centrality of the technocratic and exceptional power of central banks in the reproduction of contemporary capitalism, and, second, attends to the neoliberal governmental rationality and market-based risk management techniques that central banks are already adopting in relation to climate change. For us, critical social scientists should highlight the limitations and delimiting consequences of the emergent governmental programmes of central banks, informed by an oppositional politics that recognises how a genuinely progressive step-change in climate governance will likely require the democratic transformation and fundamental repurposing of central banking itself.

Capitalist central banking

Drawing on existing accounts of the centrality of central banks to capitalism (e.g. Harvey, 1982; Hall, 2008; Goodhart et al., 2014; Mann, 2010 Epstein, 2019), there would seem to be solid reasons to adopt a profoundly sceptical analytical and political position in the current debate over central bank leadership in climate change governance. When push comes to shove, arguably central banks will prioritise the stability and growth of capitalism in its present form. The current last resort investing programmes of the major central banks would seem a case in point, as they have been largely indiscriminate when providing life support to the assets of ‘dirty’ and ‘clean’ economic sectors alike. Placing faith in central banks to provide last resort leadership in the climate crisis is perhaps to misunderstand the challenge to be confronted as a problem of the governance of capitalism, rather than one of the reproduction of capitalism. As capitalism variously seeks to redirect investment to provide a ‘socio-ecological fix’ for its reproduction (Ekers and Prudham, 2015), central banks will perhaps only ever be a handmaiden to the strategies and practices of private finance capital. The contemporary crisis-laden period is one of central bank-led capitalism, then, but central banking essentially remains capital-led.

To take terms from Geoff Mann (2010: 618), moreover, the sovereignty of central banks has ‘a distinctively Hobbesian quality’, wherein the ‘Technocratic, class-privileged, autonomous governance of central material and ideological aspects of collective and individual life ... is difficult to reconcile with any acceptable definition of democracy’. It is largely down to the central banks themselves to decide if they accept the juridical and statutory remit of their sovereign power, or instead to choose to step up to the plate as the climate governors of last resort. Exceptions to their legal remits can be declared by central banks themselves, as has happened in recent crises with their moves beyond last resort lending and into last resort

investing. Yet, these legal boundaries can also provide a bulwark for central bankers who are wary of ‘mission creep’, and who wish to remain ‘above politics’ and beyond public debates and democratic pressures (Economist, 2019). Juridical provisions are therefore significant in shaping the role of central banks in the ‘Climate Leviathan’ (Wainwright and Mann, 2018), the emergent mode of global governance that is incorporating climate change into the existing institutional machinery for managing global capitalism. Most notably, for some staff at the only truly globally powerful central bank, such as San Francisco Fed Executive Vice President, Glenn Rudebusch (2019), ‘environmental sustainability’ and ‘climate change are not directly included in the Fed’s statutory mandate of price stability and full employment’.

It is certainly tempting at the outset, therefore, to dismiss current political debates about central bank leadership in climate change governance, and to simply assert that these institutions are structurally ill-suited to anything more than ‘adaptation projects’ that stabilize capitalism (Wainwright and Mann, 2018). However, much of the present interest in the progressive possibilities for central bank leadership has followed on the back of nascent actions already underway at major central banks. Prior to the COVID-19 pandemic, the BoE, Bank of France and ECB in particular demonstrated a willingness to play a leading role in climate change governance (Carney, 2016; Carney et al., 2019), spurred on by international collaboration and international organizations (Adrian, Morsink and Schumacher, 2020; Network for Greening the Financial System, 2019). Indeed, as the economic ramifications of the pandemic have unfolded and calls to ‘build back better’ have grown louder, commitments to this agenda have been publicly reaffirmed by some (Bailey et al., 2020; Khalaf and Arnold, 2020), supported through the publication of best practice technical advice aimed at all central banks (Network for Greening the Financial System, 2020a, 2020b). For social scientists, engaging critically in debates over central bank leadership in climate change governance increasingly requires attention is given not only to whether or not capitalist central banks can act as climate governors of last resort, but also to how they are already attempting to doing so.

Financial stability, climate change risk and stress testing

For central banks, it is the financial stability implications of climate change that to date have prompted their governmental interventions and proposals, and not the climate crisis itself. To borrow terms from the UK government’s strategy for the financial sector response to climate change (HM Government 2019), central banks are relatively inactive at present in relation to ‘financing green’ (i.e. supporting and shaping flows of private investment in support

of a low-carbon transition). Instead, they concentrate on ‘greening finance’ (i.e. encouraging the transformation of financial market-based risk management to embrace so-called ‘climate change risks’). Climate change risks encompass two types of risk that impact the valuation of financial assets: ‘physical risks’ that have a direct impact and arise from the increased incidence of storms, floods, droughts and so on; and, ‘transition risks’ that materialise from changes in climate change policies and green technologies feeding through into the wider economy (e.g. IMF, 2020). What worries central bankers is that there has been very limited progress on the calculation of climate change risk across global financial market institutions (see Christophers, 2019). A pre-requisite for such calculation is transparency and the availability of sufficiently detailed information. But the widely lauded voluntary global standards for corporations – i.e. the Financial Stability Board’s Task Force on Climate-related Financial Disclosures (TCFD) - will not be fully implemented for at least another two-three years.

The ‘quintessentially neoliberal modality of governance’ (Christophers, 2017) shared by central banks holds that improved assessment of climate change risks is necessary for the smooth and stable transition of financial systems towards a low-carbon future. There is certainly some disagreement between central banks at present over whether their leadership is required to ensure that this transition takes place. The Fed, for example, is clear that it expects climate change risk to be included in the risk management practices of the private banks that it supervises, but has not yet issued specific regulatory guidance to this effect (Brainard, 2019). Meanwhile, for Bundesbank President Jens Weidmann, improving the calculation of climate change risk is primarily a problem for credit rating agencies, who need to invest in widening the scope of their analytical tool kits (Bloomberg, 2019). Regardless of these differences, the approach that all central banks are presently taking to climate change is constituted in the first instance through a body of expert neoliberal economic knowledge on financial stability and market-based risk management that has developed and changed over the last three decades or so (Morris, 2018), and not through climate science.

For the more activist central banks such as the BoE and ECB, their self-proclaimed leadership in climate change governance is a matter of incorporating climate change risk within macro-prudential stress testing (MPST) regimes (see Coombs, 2020; Morris 2018; Langley, 2013). The governmental technique of MPST dates from the global financial crisis, and is included in subsequent revisions to international standards for financial regulation and supervision. It is anticipatory in nature, and its global adoption by central banks, regulators and supervisors reflects a loss of confidence in firm-level, micro-prudential probabilistic techniques of risk management (most notably, value-at-risk, VaR). During a MPST exercise,

central banks and other authorities with financial stability mandates work with the principal private banks across a financial system in order to model their potential capacity to manage projected losses. Banks and financial market institutions participate in stress testing regimes in order to qualify for lender of last resort facilities and to conform to regulatory and supervisory regimes. Typically, central banks will devise scenarios of adverse and extreme events or conditions, each a combination of narrative and quantitative imaginaries of a macroeconomic future that will negatively impact the value of assets (e.g. loans, mortgages, bonds, equities, etc.). Projected losses are modelled according to these scenarios, and institutions found to lack resilience and to endanger aggregate financial stability are required to increase their capital reserves.

MPST has rapidly become an established central bank financial stability governance technique for pre-empting high-impact low-probability economic ‘tail risks’, or ‘black swans’. The incorporation of climate change risk into MPST suggests that high-impact low-probability ‘green swans’ are now also preoccupying certain central banks (BIS, 2020). Prior to the COVID-19 pandemic, the BoE (2019), for example, was preparing to conduct a (now delayed) experimental MPST exercise with UK banks and insurers that was due to run through to 2021. Similar to exercises undertaken by the Dutch central bank in 2018 and currently underway in France, the BoE’s MPST will seek to test the exposure of loan books and portfolios to the transition risks of climate change that could undermine current asset valuations. Since 2016, the BoE’s MPST regime has employed two distinct testing exercises - the Annual Cyclical Scenario (ACS) based on its assessment of current risks to financial stability; and, the Biennial Exploratory Scenario (BES) that figures stability threats that do not have empirical historical precedent. Both aim to assess capital adequacy, and the 2021 exercise falls under the BES category. It will comprise three different thirty-year exploratory scenarios, each oriented towards assisting with ‘sizing risks’. Each scenario will imagine a political-economic future of ‘earlier’, ‘later’ or ‘no’ UK policy change and economic restructuring in relation to Paris Agreement temperature and emissions targets, and their attendant climate-related and macro-economic variables. The more delayed the policy and economic response to climate change, the greater the magnitude of risks and the hypothetical shock to the financial system. Rather than assess the capital adequacy of banks and (re)insurers, however, the BoE will examine how they expect to adjust their business models in the context of these scenarios and their attendant risks, and hopes to ascertain the aggregate effect of these responses on the financial system and wider economy. The inclusion of the insurance industry in the BoE exercise is novel and

significant here, as banks often assume that they can rely on insurers to cover climate-related losses, but insurers may decide to curtail or reprice the coverage that they provide for banks.

Concluding remarks

MPST and associated rationalities of market-based risk management and institutional and system resilience presently provide, then, the touchstone for central banks that are beginning to enact climate change governance by widening their financial stability mandates. Attuning critical social scientists to this neoliberal governmental agenda and its accompanying techniques is important in two main respects. First, whilst proponents of MPST by central banks emphasize how it has a system-wide focus that creates the kind of transformative potential necessary to catalyse the private financing of a low-carbon transition, social scientists can identify and underline the inherent socio-technical limitations to what MPST can achieve. For example, shaped by the experience of the global financial crisis, the principal focus for MPST is banking resilience. Ironically, this may actually serve to place climate change risk beyond the governmental reach of central banks in a contemporary financial landscape that is marked by the wholesale financial circuits of ‘shadow banks’ (i.e. non-depository institutions, such as asset managers, pension funds, sovereign wealth funds, private equity funds, etc.). Indeed, there is currently a strong tendency for regulated banking and insurance sectors to use shadow banking as a ‘spatial fix’ for climate tail risks - such as catastrophes - that cannot or will not be bought, allocated or diversified in the regulated system (Taylor, 2020). Likewise, shadow banking circulations rest on the collateral needed to underpin trust and sustain short-term borrowing and market liquidity, but there are as yet no market conventions or regulatory provisions to incorporate climate change risk into assessments of the quality of underlying collateral (Gabor, 2020).

Second, critical social scientists can also highlight how the neoliberal foray of central banks into the governance of climate change is already having delimiting and de-politicising consequences for climate change governance. Considerable academic and activist energy is currently being expended to cajole central banks to tinker with MPST techniques, and to somewhat broaden their neoliberal technocratic agendas of financial stability and climate change risk. There is, for example, significant pressure on the ECB to consider the carbon credentials of the corporate assets that they purchase and support as investor of last resort (Khalaf and Arnold, 2020). At the same time, however, more radical and progressive proposals advocating for a very different role for central banks in climate change governance are

becoming increasingly side-lined and jettisoned from public debates. For example, central banks could more directly regulate the lending of private banks towards low-carbon sectors by, for instance, differentiating their reserve requirements according to the destination of lending (Campiglio, 2015). Alternatively, they could position themselves at the heart of a Green New Deal, enacting so-called ‘green QE’ and using sovereign asset purchase programmes to finance new investment for a low-carbon transition (Economist, 2019). Yet, there is little indication that central banks are willing to take up these more radical visions of their leadership in climate change governance.

This takes us back, then, to the centrality of central banks to the reproduction of contemporary capitalism and the Hobbesian character of their sovereign power. In Trevor Jackson’s (2020) terms, it may well be that the COVID-19 pandemic has shown that ‘control of central banks’ has to be ‘at the center of any transformative political strategy’. But, how is such control to be rested? During a recent webinar at the LSE Grantham Research Institute on Climate Change and the Environment, Adam Tooze (2020b) cited the anti-inflationary ‘Volcker shock’ instituted by the Fed in the late 1970s as evidence of the possibility of sudden paradigm shifts in central banking. This, he remarked, instantiated a ‘manifest social-political conflict in which central bankers adopted positions antagonistic to the interests of constitutive groups in society’. In effect, Volcker prioritized the interests of capital over labour (Epstein, 2019), and what is needed now is central bank action premised on reigning in the interests of contemporary capital in the name of people and planet. Tooze also drew parallels between the then Fed Chairman, Paul Volcker, and the current ECB President, Christine Lagarde: because Lagarde has also come to central banking from a career in politics rather than finance, she is apparently more able to lead a ‘green shock’ in central banking. But critical social scientists should be wary of placing too much faith in the ability of ostensibly enlightened technocrats to seize control of the machinery of central banking. Redirecting central banks’ resources and reach towards a genuinely transformative governmental agenda that acts on climate change (rather than its financial stability implications) will most likely necessitate the democratic transformation and fundamental repurposing of central banking itself (see Mann, 2010). For critical social scientists researching and engaging with debates over the potential leadership of central banks in climate change governance, it is essential that their interventions are animated by normative, politically prior and oppositional questions about what central banks could and should do. The climate governors of last resort are already taking up their positions, and how they are seeking to adapt and exercise their leadership is fast becoming part of the climate crisis problem.

References

- Adrian, T., Morsink, J. and Schumacher, L. 2020. Stress Testing at the IMF, International Monetary Fund Monetary and Capital Markets Department Series No. 20/04. Available at: <https://www.imf.org/en/Publications/Departmental-Papers-Policy-Papers/Issues/2020/01/31/Stress-Testing-at-the-IMF-48825>
- Bailey, A., Carney, M., Villeroy de Galhau, F. and Elderson, F. 2020. The world must seize this opportunity to meet the climate challenge, The Guardian, June 5. Available at: <https://www.theguardian.com/commentisfree/2020/jun/05/world-climate-breakdown-pandemic>
- Bloomberg. 2019. ECB Officials Push Back on Call to Lead Climate Change Fight. 28 November 2019. Available at : <https://www.bloomberg.com/news/articles/2019-11-28/ecb-officials-push-back-on-calls-to-lead-climate-change-fight>
- Bolton, P., Despres, M., Pereira da Silva, L.A., Samama, F and Svartzman, R. 2020. The Green Swan: Central banking and financial stability in the age of climate change. Bank for International Settlements. Available at: <https://www.bis.org/publ/othp31.pdf>
- Bowman, A., Erturk, I., Froud, J., Johal, S., Leaver, A., Moran, M., and Williams, K. 2012. ‘Central bank-led capitalism?’, *Seattle University Law Review*, 36, 2:455-487
- Brainard, L. 2019. Why climate change matters for monetary stability and financial stability, Remarks at “The Economics of Climate Change” a research conference sponsored by the Federal Reserve Bank of San Francisco, November 8. Available at: <https://www.federalreserve.gov/newsevents/speech/files/brainard20191108a.pdf>
- BoE, Bank of England 2019. *Discussion Paper: The 2021 biennial exploratory scenario on the financial risks from climate change*, December, London: BoE. <https://www.bankofengland.co.uk/-/media/boe/files/paper/2019/the-2021-biennial-exploratory-scenario-on-the-financial-risks-from-climate-change.pdf>
- Campiglio, E. 2015. Beyond carbon pricing: the role of banking and monetary policy in financing the transition to a low-carbon economy. *Ecological Economics*, 121(2): 220-230.
- Carney, M. 2016. ‘Resolving the Climate Paradox’, speech given at the Arthur Burns Memorial Lecture, Berlin, 22 September 2016. [pdf] Available at: www.bankofengland.co.uk/publications/Documents/speeches/2016/speech923.pdf

- Carney, M., Villeroy de Galhau, F. and Elderson, F. 2019. The financial sector must be at the heart of tackling climate change, *The Guardian*. April 17. Available at: <https://www.theguardian.com/commentisfree/2019/apr/17/the-financial-sector-must-be-at-the-heart-of-tackling-climate-change>
- Christophers, B., 2017. Climate change and financial instability: Risk disclosure and the problematics of neoliberal governance. *Annals of the American Association of Geographers*, 107(5), pp.1108-1127.
- Christophers, B. 2019. Environmental Beta or how institutional investors think about climate change and fossil fuel risk. *Annals of the American Association of Geographers* 109(3), 754-774.
- Coombs, N. 2020. What do stress tests test? Experimentation, demonstration and the sociotechnical performance of regulatory science, *The British Journal of Sociology*, 71, in press.
- Economist. 2019. Green envy: The rights and wrongs of central-bank greenery. December 14. Available at: <https://www.economist.com/leaders/2019/12/14/the-rights-and-wrongs-of-central-bank-greenery>
- Ekers, M. and Prudham, S. 2015. Editorial introduction: Towards the socio-ecological fix. *Environment and Planning A: Economy and Space* 47(12): 2438-2445.
- Epstein, G. 2019. *The Political Economy of Central Banking: Contested Control and the Power of Finance, Selected Essays of Gerald Epstein*. Edward Elgar Publishing.
- Gabor, D. 2020. Critical macro-finance: A theoretical lens. *Finance and Society*, 6(1): 45-55.
- Goodhart, C., Gabor, D., Vestergaard, J. and Ertürk, I. eds., 2014. *Central banking at a crossroads: Europe and beyond*. Anthem Press.
- Hall, R.B. 2008. *Central banking as global governance: Constructing financial credibility* (Cambridge University Press. Cambridge, UK.
- Harvey, D. 1982. Harvey, D., 1982. *The limits to capital* University of Chicago Press. Chicago, IL.
- HM Government. 2019. *Green Finance Strategy: Transforming Finance for a Greener Future*, July. Available at: <https://greenfinanceplatform.org/sites/default/files/downloads/policy-database/Green%20Finance%20Strategy-%20Transforming%20Finance%20for%20a%20Greener%20Future.pdf>
- Jackson, T. 2020. The sovereign Fed, *Dissent Magazine*, April 16. Available at: https://www.dissentmagazine.org/online_articles/the-sovereign-fed

- Khalaf, R. and Arnold, M. 2020. 'Lagarde puts green policy top of agenda in ECB bond buying', *Financial Times*, July 8th . Available at: <https://www.ft.com/content/f776ea60-2b84-4b72-9765-2c084bff6e32>
- Langley, P. 2013. Anticipating uncertainty, reviving risk? On the stress testing of finance in crisis, *Economy and Society* 42(1): 51-73.
- Langley, P. 2015. *Liquidity Lost: The Governance of the Global Financial Crisis*, Oxford: Oxford University Press.
- Mann, G. 2010. 'Hobbes' redoubt? Toward a geography of monetary policy', *Progress in Human Geography*, 34, 5: 601–625
- Mehrling, P. 2011. *The New Lombard Street: How the Fed Became the Dealer of Last Resort*, Princeton, NJ: Princeton University Press
- Morris, J.H, 2018. *Securing Finance, Mobilizing Risk: Money Cultures at the Bank of England*. Routledge.
- Network for Greening the Financial System. 2019. *A call for action: Climate change as a source of financial risk*. Network for Greening the Financial System. Available at: https://www.banque-france.fr/sites/default/files/media/2019/04/17/ngfs_first_comprehensive_report_-_17042019_0.pdf
- Network for Greening the Financial System .2020a. NGFS Climate Scenarios for Central Banks and Supervisors, June. Available at: https://www.ngfs.net/sites/default/files/medias/documents/ngfs_climate_scenarios_final.pdf
- Network for Greening the Financial System .2020b. *Guide to Climate Scenario Analysis for Central Banks and Supervisors*, June, Available at: https://www.ngfs.net/sites/default/files/medias/documents/ngfs_guide_scenario_analysis_final.pdf
- Rudebusch, G.D .2019. Climate Change and the Federal Reserve, FRBSF Economic Letter 2019-09, March. San Francisco: Federal Reserve Bank of San Francisco. Available at: <https://www.frbsf.org/economic-research/publications/economic-letter/2019/march/climate-change-andfederal-reserve>
- Taylor, Z.J. 2020. The real estate risk fix: Residential insurance-linked securitization in the Florida metropolis. *Environment and Planning A: Economy and Space*, p.0308518X19896579.

Tooze, A. 2020a. Shockwave, *London Review of Books* 48(8), April 16. Available at:

<https://www.lrb.co.uk/the-paper/v42/n08/adam-tooze/shockwave>

Tooze, A. 2020b. Central banks and climate change: the short and long view, Online Webinar, organised by SOAS Centre for Sustainable Finance and the LSE Grantham Research Institute on Climate Change and the Environment, 1st July 2020. Available at:

https://www.youtube.com/watch?time_continue=8&v=XWrYmsMfn40&feature=emb_logo

Wainwright, J. and Mann, G., 2018. *Climate Leviathan: A political theory of our planetary future*. London: Verso Books.