

Aligning finance with the green transition: From a risk-based to an allocative green credit policy regime

Katie Kedward

Policy Fellow

UCL Institute for Innovation and Public Purpose

Daniela Gabor

Professor of Economics and Macro-finance

University of West England

Josh Ryan-Collins

Associate Professor in Economics and Finance

UCL Institute for Innovation and Public Purpose



UCL Institute for
Innovation and
Public Purpose

WORKING PAPER

WP 2022/11

About the Institute for Innovation and Public Purpose

The UCL Institute for Innovation and Public Purpose (IIPP) aims to develop a new framework for creating, nurturing and evaluating public value in order to achieve economic growth that is more innovation-led, inclusive and sustainable.

We intend this framework to inform the debate about the direction of economic growth and the use of mission-oriented policies to confront social and technological problems. Our work will feed into innovation and industrial policy, financial reform, institutional change, and sustainable development.

A key pillar of IIPP's research is its understanding of markets as outcomes of the interactions between different actors. In this context, public policy should not be seen as simply fixing market failures but also as actively shaping and co-creating markets. Re-focusing and designing public organisations around mission-led, public purpose aims will help tackle the grand challenges facing the 21st century.

IIPP is housed in The Bartlett, a leading global Faculty of the Built Environment at University College London (UCL), with its radical thinking about space, design and sustainability.

This IIPP Working Paper Series is published electronically at <https://www.ucl.ac.uk/bartlett/public-purpose/publications/working-papers>.

ISSN 2635-0122

This report can be referenced as follows:

Kedward, K., Gabor, D. and Ryan-Collins, J. (2022). *Aligning finance with the green transition: From a risk-based to an allocative green credit policy regime*. UCL Institute for Innovation and Public Purpose, Working Paper Series (IIPP WP 2022-11). <https://www.ucl.ac.uk/bartlett/public-purpose/wp2022-11>.

Aligning finance with the green transition: From a risk-based to allocative green credit policy regime

Katie Kedward, Daniela Gabor and Josh Ryan-Collins

Abstract

The green transition requires a substantive shift in financial flows that will not occur without policy interventions. We map out and critically assess the dominant, 'risk-based' approach which relies on changing the relative prices of green /dirty assets. Since it outsources the pace and nature of decarbonisation to private capital, the risk approach is poorly equipped to deal with the shift towards market-based finance, is vulnerable to arbitrage and regulatory capture, and is unable to deal with uncertainty or carbon lock-in dynamics. We propose an 'allocative green credit policy' regime that is organised around green industrial policy objectives and democratically agreed green missions. This draws on post-war credit policy regimes as it involves both quantitative and priced-based interventions in credit and institutional capital markets but also deals with the specific challenges posed by market-based finance. We discuss the implications of such a regime for central bank independence, inflation targeting and the management of stranded assets.

Keywords: green transition, climate finance, green finance, credit policy, financial regulation, monetary policy, political economy, critical macro finance, market-based finance, shadow banks

JEL codes: Q54, Q57, E44, E58, E61, G28, P16

Acknowledgements: The authors would like to thank the Laudes Foundation and Partners for a New Economy for financial support. Thanks to Alex Barkawi and Olga Mikheeva for comments on earlier drafts. The paper also benefited from comments received from policy practitioners and academic participants in an online roundtable discussion held on 26 April 2022, hosted by the UCL Institute for Innovation and Public Purpose and the New Economics Foundation, entitled "Aligning Financial flows with the net-zero transition."

1. Introduction

The green transition¹ requires a fundamental transformation of our economies, and with it, of financial flows. Clean energy-related investment alone will need to reach \$4 trillion annually by 2030 from around \$1 trillion now to achieve net zero by 2050 (IEA 2021). Rising energy prices, exacerbated by the invasion of Ukraine, have made the task of energy decarbonisation, and the question of financing renewables, even more pressing. In parallel, the higher inflation rates that may potentially underpin the green transition also pose serious questions for macro-financial policies (Schnabel 2022).

The macro-financial aspects of structural transformation remain disputed. Historically, central banks coordinated with ministries of finance and other government agencies to proactively steer credit and support major structural change of the type required by the climate crisis, complementing active fiscal and industrial policy regimes (Monnet 2018; Mikheeva and Ryan-Collins 2022; Bezemer et al. 2021). Such coordination is absent today. Fiscal authorities typically focus on carbon prices, including via carbon contracts for difference, while the green turn in central banking is usually, albeit not exclusively, motivated by financial stability concerns (Schnabel 2021; Bank of England 2021b). In some cases, central banks aim to mobilise private capital, as for example the Bank of Japan's green lending framework (Nishimura 2021).

A growing scholarship has developed analytical lenses to examine these dynamics. Baer et al. (2021) distinguish between 'promotional' interventions to directly influence the allocation of capital and 'prudential' interventions seeking to protect private finance from extreme climate events that would morph into climate Minsky moments (Carney 2015). They identify a 'promotional gap' in Europe, whereby European green technocrats prioritise prudential tools that expand the climate-related information available to market actors, and account for this gap through two institutional dynamics: path-dependent reliance on market mechanisms, and a strong allegiance to the independence of technical delegated authorities supervising markets (see also Dikau and Ryan-Collins 2017).

Other scholars have distinguished between 'market-fixing' and 'market-shaping' approaches to green financial policy (Ryan-Collins 2019; Kedward et al. 2020; Chenet et al 2021). Central banks in high income countries remain wedded to the former, prioritising the reduction of information gaps to improve market pricing. But such an approach, scholars argue, is ill-suited for the radical uncertainty posed by climate change, which instead requires the state to steer financial markets more actively. Emphasising the same logic, Dafermos (2021) argues that central banks and regulators typically prefer the 'risk exposure' to what he terms the 'systemic risk' approach because the former conceives of central banks as neutral guardians of private exposures to climate risks, whereas the latter stresses the active contribution that central banks make to the climate crisis, by, for instance, hardwiring a carbon bias in their monetary policy operations through their commitment to the principle of market neutrality (see also Dafermos et al. 2022).

¹ Which we define as a structural transition away from carbon-intensive/environmentally damaging activities towards low carbon/sustainable production and modes of living.

Although institutionally rich, these accounts neglect the extent to which decarbonisation strategies reflect the broader institutional context that configures the relationship between private finance, central banks and fiscal/industrial authorities. In particular, decarbonisation policies need analytical anchoring in the context of the modern *market-based* financial system. Market-based finance involves systemic interactions between banks, the traditional creators of private credit, and institutional investors and other financial actors operating through capital markets (Hardie and Howarth 2013). Banks now borrow on international money markets, against collateral securities, or securitise their loans. In turn, institutional capital – institutional investors and their asset managers – have become important sources of funding via both traditional capital and alternative markets.

The critical macro-finance literature is a useful approach to consider this challenge since it plays close analytical attention to the dynamic interaction between financial market structure and macro-economic policy tools (see Gabor 2020, Dutta et al 2020). The growing importance of market-based finance, it argues, has tested the limits of the macro-institutional architecture of the past 40 years, whereby central banks targeted inflation under a regime of monetary dominance that subordinated fiscal policy (see Schnabel 2021) and prioritised a micro-prudential approach to financial regulation. The collapse of Lehman Brothers brought a series of policy innovations to stabilise market-based finance, including outright central bank purchases of government bonds to preserve its new macro-financial role. It also accelerated the rise of the de-risking state, understood as a new mode of macro-financial governance that deploys monetary, fiscal and regulatory interventions to change the risk/return profile of existing and new financial asset classes with the explicit aim of mobilising the glut of private institutional capital to close financing gaps². This includes 'climate de-risking' interventions that seek to change the risk/return profile on existing and new assets through, for instance, green bonds or green taxonomies (NGFS 2019; Dafermos et al. 2021; Gabor 2021).

We draw on this lens to analytically distinguish between a risk-based approach to decarbonisation and allocative green credit policy³ (Table 1). The risk approach to decarbonizing private finance stresses market signals, both by enhancing price discovery and by correcting relative prices. Its overarching logic, framed by the macro-financial status-quo of monetary dominance, is to outsource the pace and nature of decarbonization to private finance. In its weak version, that currently dominates policy debates, it stresses risk exposures and relies on informational mechanisms that include better disclosure of climate-related financial risks (TCFD 2017; NGFS 2019), and the development of sustainability taxonomies alongside scenario analysis and climate stress testing. These together will, it is believed, improve the effectiveness of price signals, weakened by market failure to price climate risks, and lead to the rapid reallocation of capital in

² The growing portfolio glut reflects several macro-financial choices of the past 30 years including the weakening of multinational taxation regimes, the withdrawal of the welfare state from public health and pension provision and enhanced banking sector regulation that has encouraged reallocations towards institutional capital that has received less regulatory attention (see Gabor 2020; 2021 for discussion). On the monetary side, the unconventional monetary policies introduced post-Lehman Brothers have encouraged investors to search for yield outside 'traditional' assets like government bonds, and to move into new asset classes, including private equity funds.

³ We use the term 'credit policy' as a shorthand for policies that influence the allocation of flows of bank credit and institutional capital.

alignment with the green transition (Christophers 2017; Chenet et al. 2021). In its stronger version, the risk approach includes incentive mechanisms that target relative prices, by de-risking green assets, as for instance the Bank of Japan's incentives for banks' green loans, or the European Central Bank's growing interest in green long-term refinancing operations (T-LTROs).

Despite its growing prominence and prioritization within mainstream policy circles, especially over the past five years, the risk-based approach has not succeeded in materially shifting financial flows away from transition-incompatible activities and towards the rapid build-out of urgently needed green solutions. Indeed, bank credit to carbon-intensive sectors, including to firms expanding fossil fuel reserves, has continued to *increase* in the five years since the Paris Agreement was signed (Rainforest Action Network 2021), even in the Eurozone where climate policy is generally regarded to have been among the most ambitious (ECB 2020, p.73). Meanwhile, several years after the launch of the market-led TCFD in 2017, climate-related financial disclosures have yet to shift investment allocation for the majority of financial institutions (Christophers 2019; Hook and Vincent 2020; Ameli et al. 2021).

In this paper, we reflect upon the intellectual limitations of the risk-based approach that gives rise to these unsuccessful outcomes, including its vulnerability to regulatory capture, and inability effectively address radical uncertainty and carbon lock-in dynamics. We especially explore the prominence of market-based finance as an increasingly significant creditor to incumbent, transition-incompatible sectors and the regulatory arbitrage opportunities created by current blind-spots in the risk-based approach.

Table 1. Articulating the differences between risk-based and green credit policy approaches to decarbonising finance

	Risk-based approach		Credit allocation policies	
Paradigms vis-à-vis green transition	Monetary dominance; Market-led decarbonisation		Fiscal dominance; State-led green industrial strategy	
Purpose	Prudential – financial stability		Promotional – supporting industrial policy	
Focus	Enhancing price discovery; Correcting price signals (de-risking)		Steering credit to green sectors; Restricting credit to dirty sectors	
Mechanisms	Informational	Incentive	Incentive	Coercive
Policy targets	Transparency and disclosure	Relative prices through de-risking interventions	Sector-specific green targets on price and conditions of credit	Sector-specific green targets on quantity of credit, or credit growth (+ conditions)
Scope	Banks + standard financial assets (loans + bonds + equity)		Banks + whole ecosystem of institutional capital (+ private equity + repos)	

Source: Authors

To address these challenges, we outline an alternative '*allocative green credit policy*' framework, driven less by financial markets, and more by the industrial and economic policy 'mission' (Mazzucato 2021) of structurally transforming energy, food, housing and transport systems for the green transition. The state uses its market-shaping capacity to accelerate the green transition, with green industrial strategy goals prioritised above narrowly nudging relative prices. This is an explicitly more interventionist approach, informed by the historical credit policy experiences of the

post-war period. It prioritizes the drastic reduction of dirty finance through coercive price and quantity-based mechanisms, and the promotion of financing where it is part of a clearly defined industrial strategy or internationally agreed objectives. Our framework extends recent analyses of credit policy (e.g. Bezemer et al. 2021; Dikau and Volz 2021; McDonagh 2021; Smoleńska and van 't Klooster 2022) to evaluate the challenges posed by market-based finance, and proposes possible credit policy tools to target institutional capital (or 'shadow banking'), as well as regulated financial institutions. In particular, we reflect upon the appropriate role for both quantity-based mechanisms, such as maximum lending ceilings (for undesirable sectors) and minimum lending floors (for strategic industries), as well as price-based interventions.

To clarify, we propose that a green credit policy framework will be more effective than a market-led risk-based approach in accelerating the decarbonisation of finance. However, this is not to say that we deny the significance or relevance of systemic climate-related financial risks. On the contrary, we show how explicitly allocative credit policy, grounded in green industrial policy goals, will be more effective in addressing endogenous systemic financial risks.⁴ In this sense, our proposal also follows on from recent work arguing for central banks and financial supervisors to align their policy toolkits with government Net Zero targets as the most prudent means of managing risks to financial stability (Robins et al. 2021; Barkawi and Zadek 2021).

The rest of the paper is structured as follows. Section 2 maps and articulates the mechanisms of the emerging risk-based approach to decarbonising finance. Section 3 challenges this risk approach, illustrating its intellectual limits. Section 4 outlines a new case for green credit policy in the context of an alternate macro-financial regime. Section 5 proposes a typology of allocative credit policies and explores the effectiveness of various tools in targeting both bank credit and market-based finance. Section 6 discusses the institutional challenges in implementing this framework and reflects upon further areas for research. Section 7 concludes.

2. The emerging status quo: the risk approach

The market-led, risk-based approach that currently dominates emerges from the current macro-economic status quo, which prioritises 'monetary dominance'. This can be defined as the (operational) independence of inflation-targeting central banks from fiscal authorities alongside fiscal and industrial conservatism, with fiscal policy viewed primarily as (at best) a tool for short-term macro-economic stabilisation (Bernanke 2003).⁵ The state is expected to assist private finance in its efforts to lead the green transition, given the twin assumptions of limited fiscal capacity and the superiority of private credit markets in efficiently allocating capital (Bezemer et al. 2021; Gabor 2021). State support is required to guide the trillions of dollars of private finance, for

⁴ By 'systemic', we mean impacting on the entire macro-financial system rather than simply the financial stability of individual banks. See for example Chenet et al (2021), Monnin (2018; 2021) and Dafermos (2022) for perspectives that emphasize a more interventionist role for the state in incorporating systemic climate-related financial risks in to policy frameworks.

⁵ The massive fiscal expansions that occurred during the Covid-19 crisis, apparently accommodated by central bank Quantitative Easing programs, have led some to question monetary dominance (Bartsch et al. 2020). However, the Covid-crisis has not, as yet, lead to any major or permanent institutional shifts in macro-economic policy frameworks. For example, fiscal rules pertaining to the size of the budget deficit or debt-to-GDP ratio have been reimposed in high-income economies, alongside price stability remaining the dominant objective of monetary policy.

instance the USD 130 trillion of the Glasgow Financial Alliance for Net Zero, away from dirty into green activities, whose higher risks relative to returns and intensive capital requirements deter investment.

Under this macro-financial regime, risk-based policy pursues decarbonisation through a two-pillar approach: enhancing price discovery (market-fixing) and correcting price signals (de-risking). Both ultimately delegate the pace and direction of the green transition, and the capital reallocation challenge it encompasses, to the private sector.

Market-fixing strategies aim to improve the clarity and provision of climate-related information and to encourage the internalisation of climate-related risks into market pricing. It is assumed not only that climate-related risks are measurable, but that private actors will act on disclosures of such information in their capital allocation decisions. This will mitigate systemic risks as actors rationally managing their individual risk exposures. It is no coincidence that such a risk-based narrative has become dominant amongst central banks concerned with the climate crisis. Risk disclosure and transparency is fundamental to the international Basel III regulatory framework and has consequently become a central pillar of the emerging consensus on climate risk management (e.g. see NGFS 2019). Such risk-based logic is also in line with the narrow 'prudential' motivations of these institutions' primary mandates (Baer et al. 2021; Chenet et al. 2021). Accordingly, the green strategies of central banks and regulators in high-income countries have prioritised the development of forward-looking scenario-based risk analysis methodologies and incorporating private-sector led climate risk disclosure initiatives into supervisory expectations (e.g. Bank of England 2019; ECB 2020; NGFS 2020).

De-risking strategies complement market-fixing strategies by adjusting the risk/return profile of financial assets to closer align these with the preferences of market-based financial actors (Gabor 2021). Here, the de-risking state socialises a series of risks (liquidity, political, demand or exchange rate) to mobilise private finance for public purposes, under the conservative macro-economic assumption that there is not enough fiscal space for public investment, combined with the market constraint that the high risks of capital-intensive green projects deter private investors. Carbon contracts for difference, central to the EU's RePower Europe plans for instance, are a fiscal de-risking tool to mobilise private investment in renewable energy. Similarly, in the Global South, a 'Wall Street Consensus' led by the World Bank encourages states to achieve the SDGs by entering into de-risking partnerships with institutional capital aimed at creating investible assets in social and other infrastructure (Gabor 2021; Musthaq 2021). More recently, there have been calls to extend de-risking strategies to nature conservation, most notably by treating 'natural capital assets' as public infrastructure in the creation of new blended finance-based 'new asset classes for nature' (Deutz et al. 2020; Paulson 2020; Lankes 2021). These interventions should be appreciated within the context of a broader macro-financial shift in support of regulatory, monetary and fiscal de-risking of a variety of assets, including climate, infrastructure, housing and government bonds (Dafermos et al. 2020).

These informational and incentive mechanisms aim for an 'orderly' reallocation of private financial flows. Yet, unlike the credit guidance policies common during the 20th century, the risk approach does not overtly seek to target sector-specific prices or quantities of capital in alignment with a particular decarbonization pathway. The use of market-fixing strategies effectively defers sectoral

allocation decisions to the private sector, who are assumed to objectively evaluate climate risk information and efficiently reallocate capital accordingly (i.e., a 'differential transition' - see Smoleńska and van 't Klooster 2022). Policy interventions are instead designed only to encourage this effort by increasing (decreasing) the relative price of dirty (green) credit created on bank balance sheets or in asset markets through signalling and demand effects.

For instance, aligning asset purchase portfolios and collateral frameworks with climate transition plans effectively uses the central bank's balance sheet, as a significant buyer and market maker of sovereign and corporate bonds, to directly influence but not fix the market price of credit. The central bank's purchasing power can lower yields and hence borrowing costs for those companies and sectors that are deemed eligible for these programmes, whilst increasing it – in relative terms – for those that are excluded. Demand effects are second order because central banks' corporate bond and collateral portfolios are small as a proportion of assets held by global financial institutions (Hauser 2021, p.8).⁶ In turn, central banks have emphasised the importance of signalling effects in communicating to markets central banks' views about green versus dirty assets (e.g. Bank of England 2021; Weidmann 2021).

Importantly, risk-based policy retains its institutional commitment to monetary dominance, even where new green mandates would legitimise greater central bank alignment with government transition plans. For instance, in a review of climate change implications for monetary policy, the Network for Greening the Financial System (NGFS) assessed potential monetary and credit policy options through the lens of a perceived trade-off between climate mitigation/risk protection and monetary policy effectiveness (NGFS 2021). The review identified policies reliant upon market mechanisms as potentially the most impactful (e.g. pricing adjustments to collateral haircuts and targeted refinancing operations), despite acknowledging potential operational difficulties.

To clarify the analytical purchase of our macro-financial understanding of the risk approach, consider the case of the Bank of England, one of the first large central banks with an explicit environmental mandate. Intuitively, its decarbonisation strategy seems to go beyond a risk approach: in November 2021, for example, it announced plans to 'green' its corporate bond purchase scheme (CBPS). However, our macro-financial lens places this development firmly within the risk approach, for two reasons. First, the escalation strategy is explicitly guided by market neutrality, deploying price-based incentive mechanisms at intra-sectoral level to avoid overt allocative interventions (Dafermos et al. 2022) that could be described as industrial policy. In practice, this means that the Bank would tilt reinvestments *within* but not *across* sectors – for example, by buying the 'best-in-class' fossil-related corporate bonds (as measured by a scorecard

⁶ By the Bank of England's own calculations, its £20 billion corporate bond purchase scheme (CBPS) accounts for just 6.5% of the sterling corporate bond market, 0.5% of all sterling traded assets, and just 0.01% of assets held by global financial institutions (Hauser 2021). At over ten times its size, this would make the ECB's corporate sector purchase programme – one of the largest of its kind in the world – account for around 0.11% of total institutional assets globally.

of multiple climate metrics⁷) rather than committing to exclude the sector all together (Bank of England 2021 a).

Second, as inflation began to rise, the subordination of the de-risking approach to the primary objective of price stability prompted the Bank to abandon its decarbonisation plans in February 2022, committing to unwind its corporate bond portfolio by the end of 2023 for quantitative tightening purposes. The Bank's strategy hence preserves the macro-financial architecture of monetary dominance, with its institutional separation between monetary, fiscal and industrial policy. This matters, we argue, because it subordinates, and can easily sacrifice decarbonization to the price stability objective. Instead, consistent with a risk approach, the Bank has effectively washed its hands of its policy role in accelerating the decarbonisation of private finance, outsourcing its pace and the direction to private capital.

Climate responses across the world also demonstrate the risk approach in action. The Swedish government, for example, will guarantee up to 80% of the principal of long-term loans to large-scale green industrial projects. France has a long-standing zero-interest housing loan scheme, delivered through domestic banks (who receive subsidies in compensation), which in recent years has extended to green housing retrofits: *l'éco prêt à taux zero*.⁸ The Bank of England and the ECB have engaged with proposals for green targeted refinancing operations and differentiated capital requirements – with the latter under review at both central banks (Cox 2020; Baranovic et al. 2021; PRA 2021). However, both have argued that evidence of an established risk differential between green and dirty activities is necessary to justify the use of such policies (e.g. PRA 2021). By June 2022, no central bank or regulator in high income countries has adopted policies to explicitly penalise dirty assets.

Similarly, despite accepting that the operational principle of market neutrality hardwires a carbon bias in monetary policy operations (e.g. Schnabel 2021),⁹ many central banks have been reluctant to abandon market neutrality altogether; a decision to preserve the appearance of independence against (conservative) charges that green monetary/regulatory policies are incompatible with operational independence (e.g. Gros 2020). The overt questioning of market neutrality hence serves to construct legitimacy for de-risking interventions rather than hard credit allocation policies. The most salient example in this regard is the Bank of Japan (BoJ), who in 2021 became the first major central bank to launch a green targeted refinancing operation, allowing banks to access long-term zero interest refinancing for green lending until at least 2031. Despite acknowledging the limitations of market neutrality in principle, the BoJ has been explicit in

⁷ The climate scorecard will take into account (1) the latest level of the firm's carbon intensity, measured by CO₂e emissions per million pounds revenue; (2) backward-looking measures of past change in absolute emissions, measured as a weighted moving average over the past 3 years; (3) how firms' climate-related financial disclosures compare to sector standards; (4) the presence (or not) of emissions reduction targets, with extra credit for those validated by a third party.

⁸ See <https://www2.sfgas.fr/web/site-public/ecopret-a-taux-zero>

⁹ Since 2010, central banks have organised unconventional corporate bond purchases under market neutrality, reproducing relative market shares to avoid privileging any particular bond issuers. Yet in practice 'following the market' means that central banks replicate existing market failures in (mis)pricing climate risk, thereby implicitly subsidizing carbon issuers (say Shell) when purchasing corporate bonds. A similar subsidy arises within the collateral framework underpinning conventional interest rate policies, where central banks accept collateral at market prices.

emphasising that loan allocation decisions will be left entirely to banks – including the interpretation of whether a loan is ‘green’ or not (Clarke 2022). The BoJ instead trusts that climate risk disclosure frameworks (most notably the private-sector–led TCFD) would work as the disciplining mechanisms against greenwashing (Nishimura 2021). This reassertion of a market-neutral role is particularly striking from the central bank that has intervened most extensively – both in terms of size and scope – in domestic financial markets, in particular equity markets, through its various quantitative easing programmes.

Overall, these examples suggest that even at its most ambitious, decarbonization under monetary dominance amounts to risk-based policy that targets only the relative price of green/dirty credit. From this perspective, central banks aim primarily to influence market prices through demand and signalling effects triggered by adjustments to the relative quantities of dirty/green corporate bonds held in unconventional portfolios, or to the terms on which these bonds are accepted as collateral. Critically, as exemplified in the Bank of Japan’s case, the criteria for setting such adjustments across sectors are not in alignment with a government strategy to promote or discourage certain activities. Instead, the sectoral allocation decision is largely handed over to market-derived estimates of climate risk, with private finance still seen as best able to allocate capital once such risks are considered. In this way, the risk-based approach delegates the specific pace and nature of the transition to private finance. Quantity-based credit allocation policies are rejected (or not even considered) as viable policy options. Whether this is due to an ongoing adherence to the view that such intervention would lead to the inefficient allocation of investment (distortion critique) (Bezemer et al. 2021) or whether it is more to do with concerns over central bank independence and the strict institutional separation of monetary and fiscal spheres (‘mission creep’) is unclear.

3. Challenging the risk approach

The risk approach, valuable as it may be as a policy innovation, suffers from conceptual and practical flaws that limit its effectiveness in either supporting rapid decarbonisation or addressing systemic climate risks. The market-fixing and de-risking pillars neglect, first, structural issues constraining the provision of green credit, and second, the dynamics of market-based finance, where opportunities for arbitrage and regulatory circumvention will undermine the efficacy of relative price adjustments. Thirdly, pricing mechanisms are increasingly understood to be blunt tools to energize orderly structural transformations – unable to account for the radical uncertainty and non-linearities associated with ecological threats and green innovation (among other things). Fourth, there are important but neglected political economy questions surrounding the reliance on private sector–led decarbonisation and the problem of ‘greenwashing’. We address each of these in turn.

3.1 Structural impediments: the rise of market-based finance

There are several reasons why signalling and demand effects, while an important step towards decarbonisation, are unlikely to trigger a financial system-wide reallocation of capital or even a

systematic incorporation of climate risk factors, as the NGFS (2021) predicts. The focus on central bank asset purchases and collateral frameworks means that only a subset of financial assets will be targeted, namely the highest-rated sovereign, corporate and covered bonds and asset-backed securities, and the most senior tranches of highly rated securitised bank loan portfolios. This subset of asset classes, in turn, provides financing mostly to established, well-capitalised companies able to access large-scale capital market financing. Yet in market-based financial systems, credit creation occurs both on banks' balance sheets and via capital markets (Gabor 2016, Coeure 2016). Aligning private finance with the goals of the green transition thus needs frameworks for decarbonising institutional capital – pension funds, insurance companies, family offices and their asset managers, including alternative asset managers like Blackrock– that have collectively generated a global portfolio glut, typically described in decarbonisation debates as the trillions of institutional investors looking for investible projects (Gabor 2021).

The portfolio glut matters for the decarbonisation of finance in two ways. First, investors managing the glut of institutional capital often argue that green projects are often non-investible, in that their risk/return profile is inconsistent with investor preferences or mandates. But regulatory, monetary or fiscal de-risking cannot systematically improve the investment appeal of these assets. Indeed, many green industries are qualitatively different sectors from their carbon-intensive incumbents. As a result, market actors leading green innovation are often excluded from the sorts of finance targeted by the risk-based approach until much later in the innovation cycle (Mazzucato and Semieniuk 2018). The renewable energy industry, for example, is more geographically fragmented, sensitive to local conditions, lacks consolidation (i.e., 'Majors'), and is not (yet) producing a globally-traded, dollar-denominated commodity – compared to the fossil fuel industry (Ameli et al. 2021). Renewables are consequently treated by financial investors as a developing asset class rather than as an equivalent to fossil fuel incumbents that only requires pricing incentives to stimulate capital reallocation (Ameli et al. 2019; Donovan et al. 2020). Scaling up both demand and supply of finance for green innovation is likely to require a supportive policy environment that is much broader than targeting just price incentives (Aghion et al. 2014; Hall et al. 2017).

Second, and equally important, dirty penalising policies must include the complex ecosystem of institutional capital to avoid carbon assets moving onto opaque balance sheets, such as private equity funds. For example, the Private Equity Stakeholder Project documented that the top 10 US private equity firms have increasingly been absorbing fossil assets divested by large fossil fuel companies and investors (Seidman et al. 2022). This example illustrates that, paradoxically, while large investors like pension funds may be ostensibly divesting from fossil assets, their indirect support for high carbon activities, including the exploitation of fossil fuels, continues via their private equity allocations. This points to the larger question of the extent to which climate de-risking strategies concentrated on decarbonising the central bank's balance or regulated commercial banks' portfolios can effectively reduce market-based financing for dirty capital market activity, both of banks and shadow banks.

To trace this, it is important to map the distinctive instruments through which market-based finance extends green and dirty credit (Figure 1). Institutional capital - including pension funds, insurance companies, Sovereign Wealth funds, or family offices and their asset managers - can

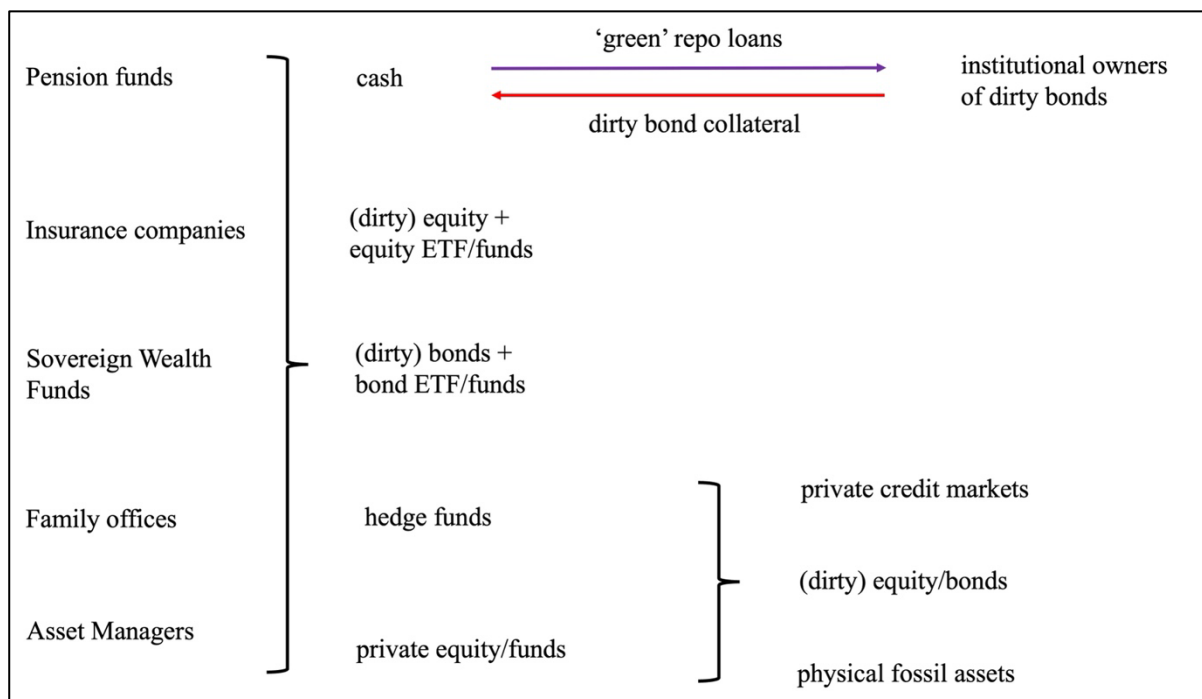
allocate dirty financing via equity (and equity ETFs/funds) and bonds (and bond ETFs/funds) or indirectly via alternative asset managers like hedge funds and private equity funds. For instance, Fidelity's Corporate bond fund invests 80% of its assets in investment-grade foreign and domestic corporate bonds, and the rest in liquid sovereign bonds & cash, tapping into institutional demand for shorter duration and limited interest rate sensitivity.

Alternative asset managers in turn finance dirty activities via private credit markets, dirty equity/bonds or by acquiring physical fossil assets. Private credit markets – by which we refer to loans extended to companies by private equity funds and other alternative asset managers - are increasingly important for companies in higher credit risk middle and low-income countries, particularly in Asia (Aramonte and Avalos 2021). It is estimated that private credit markets reached USD 1.53 trillion assets under management by 2022, of which USD 438 billion in dry powder (outstanding credit capacity). Pension funds are the largest ultimate lender via private markets, contributing 70% of total commitments to private equity and private credit, alongside other institutional investors and high net worth individuals. For instance, the private equity company Blackstone, the world largest alternative asset manager, runs the Blackstone Private Credit Fund with a loan portfolio of USD 36 billion in June 2022.

Finally, when placing cash via the repo market, institutional capital can also provide indirect financing to holders of dirty bonds (and thus ease financing conditions for dirty issuers), by accepting those bonds as collateral. The International Capital Markets Association has proposed to approve green labelling for repos where the cash proceeds obtained are deployed for 'green' activities, even if dirty bonds are used as collateral. With this, 'green' repos are in practice financing dirty bonds.

Taken together, the rise of market-based finance over recent decades has created multiple alternative sources of credit and capital that rival the banking sector in size and scope, but which are not subject to the same regulatory regime. Its significance lies in the potential for dirty sectors to continue to access finance even if banks successfully transition their balance sheets. To address this, a green regulatory regime must explicitly target such market-based dirty credit flows, via price- or quantity-based mechanisms.

Figure 1. Avenues by which market-based finance allocates finance to dirty activities



Source: Authors' illustration

3.2 Regulatory arbitrage

The risk-based approach is vulnerable to the arbitrage and regulatory circumvention opportunities it creates for financial actors outside the purview of the regulated banking sector. In particular, higher relative interest rates for dirty credit and the signalling effect of central bank portfolio adjustments are unlikely to hinder the investment intentions of institutional lenders (so-called 'shadow banks') mapped above, including hedge funds, private equity, and off-balance sheet financing structures, that create credit independent of supervisory and regulatory oversight. Rather, the opposite is likely to be true: higher relative interest rates for dirty credit are likely to attract yield-hungry shadow lenders, who in many cases are not subject to the same shareholder or regulatory pressures regarding climate risk disclosure.

Indeed, such dynamics are now widely acknowledged to be at play in the oil and gas lending space across North America and Europe. As banks pull out, large-scale exploration and production debt deals are now being underwritten by private equity and hedge funds, who are also purchasing loan portfolios at significant discounts from traditional banks (Porter and Deveau 2021). Moreover, the predictable cashflows and respectable credit ratings of mature oil and gas companies make them well-suited to raising finance through off-balance sheet securitisation structures, which are growing in popularity (Kang 2021; Allison 2021). While these developments do point to a higher cost of capital for the oil and gas sector, these relative repricing effects have not been enough to curtail investment appetite, especially as we move into a commodity boom cycle.

3.3 Radical uncertainty

The risk-based approach encourages the internalisation of climate risks into asset prices through, for example, disclosure initiatives and the use of climate-aligned ratings provided by objective third parties. The Bank of England's Green corporate QE plans, for example, align eligibility criteria with the UK government's pathway towards mandatory climate disclosures, albeit by accepting a plethora of private-sector-led disclosure frameworks. Similarly, ECB Board Member Jens Weidmann argued that QE programmes should be greened only through mandatory disclosure and reporting obligations and the use of climate-aligned credit ratings, rather than political steering (Weidmann 2021). Yet this policy stance, which effectively conceptualises climate risk challenges as a series of information-based market failures, has been criticised on several theoretical grounds.

On the one hand, the physical and transition risks related to climate change and other environmental threats are subject to radical uncertainty – incalculable 'unknown unknowns' that cannot be reliably internalised into market prices (Chenet et al. 2021; Svartzman et al. 2021). On the other hand, as scholars from the evolutionary economics tradition have argued, pricing mechanisms (e.g. uniform carbon prices) are somewhat blunt tools to stimulate investment in green innovation – which is subject to complex non-linear dynamics such as path dependency and 'lock-in' effects, network externalities, technological inertia, and institutional feedbacks (Aghion et al. 2014; Hall et al. 2017; Grubb et al. 2021). To break through these types of structural constraints requires patient, high risk and committed finance for which the private sector is generally not well adapted (Deeg and Hardie 2016; Mazzucato and Semieniuk 2018).

The reliance of policymakers on improving market information also neglects an important temporal trade-off between measuring risks and actually taking action to manage them. Some environmental risks – particularly those related to nature loss – may become financially material before disclosure and scenario modelling analysis frameworks become fully operational (Kedward et al. 2020). The pursuit of ever more perfect information therefore cannot be a prerequisite to taking policy actions under conditions of radical uncertainty (Chenet et al. 2021).

3.4 Regulatory capture and greenwashing

It is also important to consider climate disclosure frameworks and ratings providers against the motives of the actors who shape these initiatives. The most prominent risk disclosure frameworks¹⁰ have been developed almost exclusively by coalitions of multinational firms acting through non-profit entities (Knox-Hayes and Levy 2014; McGee 2014; Abbott et al. 2016). Similarly, ESG ratings providers are all private sector-led: recent market consolidation seeing many of the original specialised providers, such as Sustainalytics, Vivid Economics, and Vigeo Eiris, purchased by large index providers, consultancies, and asset managers in recent years (Azizuddin 2021).

¹⁰ Which include the Task Force on Climate-related Financial Disclosures (TCFD), the Carbon Disclosure Project (CDP), the Value Reporting Foundation (VRF), the Carbon Disclosure Standards Board (CDSB), the Global Reporting Initiative (GRI), and the emerging Task Force on Nature-related Financial Disclosures (TNFD).

It is notable that there has been little to no formal involvement of central banks or financial regulators in the construction and ongoing supervision of these initiatives. To the extent that the risk-based approach inherently positions them as the primary mechanisms for capital reallocation, the private sector actors behind these initiatives arguably have attained 'de facto' regulatory power in defining new standards for what is deemed 'green investment-worthy' (Petry et al. 2021). This regime also blurs the division of responsibilities of banks and regulators when assessing the viability and feasibility of assumptions underpinning risk evaluation exercises (Smoleńska and van 't Klooster 2022). NGFS research has more recently recognised some of these concerns (NGFS 2022), leading Bundesbank board member Sabine Mauderer to call for central banks to apply their own in-house climate risk analysis to complement, rather than rely on, traditional private sector-led approaches.¹¹

Indeed, it has been argued that this policy stance is explicitly resistant to the involvement of the democratic state, prioritising instead market-led frameworks for individualised private decision-making in response to climate change – in other words, 'neoliberal climate governance' (McGee 2014) or 'non-state, market-driven environmental governance' (Auld et al. 2009). The recent experience with market-led taxonomies such as ESG taxonomies points to systemic greenwashing (In and Schumacher 2021). Similarly, allowing the private repo lobby discretion over the definition of 'green repos' has led to dirty securities financing transitions described as green as long as the cash proceeds obtained through the repo loan are deployed for 'green' activities. In practice, a market-based instrument for financing dirty bond credit can be labelled green.

Regulatory capture presents new 'greenwashing' risks that may undermine the effectiveness of the risk-based approach. Private sector-led methodologies are arguably subject to perverse incentives to underestimate risks to avoid potential adverse consequences on cost of capital (Smoleńska and van 't Klooster 2022). Underacknowledged by financial policymakers is the fact that the involvement of prominent private sector actors in the formulation of these initiatives involves substantial new conflicts of interest (Azizuddin 2021; Eaglesham 2022). The Taskforce for Nature-related Financial Disclosures, for example, is being developed by representatives from multinationals¹² heavily implicated in the use and trade of deforestation-linked agricultural commodities, such as Nestlé, Olam, and Bunge – the latter of which has been identified as the global corporation most implicated in soy-related deforestation in Brazil (Trase 2020).¹³ Criticisms of the proximity of vested interests have also plagued the development of public regulatory initiatives, such as the EU sustainable taxonomy (Rauhala 2022), and the contracting of Blackrock in the development of EU prudential climate rules – a decision later lambasted by the European Ombudsman (O'Reilly 2020).

¹¹ As quoted in NGFS press release: <https://www.ngfs.net/en/communique-de-presse/ngfs-publishes-two-new-documents-climate-related-risk-differentials-and-credit-ratings>

¹² See <https://tnfd.global/about/taskforce-members/>

¹³ See also <https://trase.finance/entities/b7c1989f-8a2f-34ea-80e8-d5baa06291fb>

3.5 Summary

Overall, these arguments indicate that the risk-based regime is not likely to be effective in systematically aligning the allocation of capital with climate risk considerations. The narrow scope of the proposed policy tools both ignores the particular financing challenges posed by sectors driving green innovation and neglects the realities of 21st century market-based finance, where much private credit creation takes place independently of the provision of central bank liquidity. Meanwhile, the reliance on information-based mechanisms to internalise climate risks into asset pricing ignores the radical uncertainty associated with the green transition, and danger of regulatory capture by vested interests in the absence of broader public oversight over their development and implementation. Alternative macro-financial institutional configurations are instead needed to deal with the specific challenges of reallocating capital in support of the green transition.

4. Towards an alternative macro-financial regime: the renewed case for allocative credit policy

The green transition requires engaging in the twin challenges of simultaneously accelerating the growth of green innovation across new and existing sectors, whilst also managing the orderly decline of 'transition-incompatible' sectors to avoid economic and financial instability. Instead of conceptualising the green transition as a static efficiency optimisation problem requiring only price corrections – as is implicit within the risk-based framework – alternative approaches frame decarbonisation as a 'wicked problem' (Rittel and Webber, 1973) involving dynamic structural change, encompassing multiple sectors and agents, supply and demand dynamics, lock-in effects, and uniquely predicated upon the complexities of rapidly deploying and diffusing technological innovation.

Heterodox schools of thought, including political economy, systems thinking, and evolutionary economics, recognise that there are no optimal pathways to such structural change, but that multiple possible outcomes that can be influenced by how the state proactively interacts with other economic actors (Geels and Schot 2007; Kattel et al. 2018). From this perspective, the green transition is framed not as a strategy for de-risking private investment, nor a green version of Keynesian demand-side stabilisation but instead as a comprehensive industrial strategy aimed at nurturing the enabling conditions for a rapid structural economic transition (Mazzucato and McPherson 2018). Instead of a 'de-risking state' that accompanies private capital into green(washed) activities, this perspective articulates a 'market-shaping' role for public policy, predicated by public investment in strategic priority sectors and policy coordination between fiscal, industrial, financial, and regulatory spheres (Mazzucato et al. 2020; Kedward and Ryan-Collins 2022). It should also involve clear mechanisms for disciplining both green industrial winners and financiers of dirty assets (Gabor 2021).

This requires a new macro-financial framework for central banking and financial regulation. Such a framework would be characterised not by a narrow focus on short-term price stability and financial stability and operational independence, but by a broader suite of policy tools –

coordinated with other government departments – that are better aligned with democratically determined goals of the green transition and that will more effectively support long-term macro-financial stability. In particular, fiscal and industrial policy will be required to play necessarily leading and expansionary role in accelerating the green transition, with central banks increasingly required to play a 'promotional' (rather than 'prudential') role (Baer et al. 2021) – aligning financial regulation, credit, and monetary policies with green industrial strategy to ensure that the dynamics of private capital allocation do not undermine this policy effort (Kedward and Ryan-Collins 2022).

Moving beyond the current reliance on market-derived estimations of climate risk strictly in terms of financial materiality, the allocative credit policy framework instead places greater emphasis on environmental outcomes as evidence of materiality, and as justification for policy intervention.¹⁴ Given the limitations of risk-based mechanisms outlined in the previous section, we argue that sector-specific targets on both quantities and prices need to be the primary mechanisms to ensure the orderly reallocation of capital under conditions of radical uncertainty.

Allocative credit policies were widely used in high- and middle-income countries to support structural economic transitions and rapid industrialization in the post-World War II period, including as tools to restrict credit growth within speculative or undesirable sectors (Bezemer et al. 2021; Mikheeva and Ryan-Collins 2022). These were variously known as 'credit guidance', 'credit controls', 'credit ceilings', 'directed credit', 'window guidance' and 'moral suasion' (ibid.). For example, Japanese and Chinese window guidance involved banks being given quantity-based quotas for lending to particular sectors (Werner 2003) including for sustainable purposes (Dikau and Volz 2021). More recently, informal modes of state-bank coordination – including moral suasion – have been shown to have been relevant in ensuring sufficient bank participation in state-guaranteed credit programmes during the COVID-19 economic crisis in Europe (Massoc 2021).

In many countries, explicitly allocative credit policies were abandoned from the 1980s onwards as part of financial sector liberalisation. Justifying this shift were theoretical arguments that credit policies cause a mispricing of capital, thereby distorting the efficient allocation of credit and leading to lower levels of productive investment (McKinnon, 1973; Shaw, 1973; Mayer, 1975). The 'distortion critique' emerges from neoclassical theory, where credit is conceptualised as originating in the market for limited 'loanable funds' – i.e. scarcity - and determined by price signals under conditions of perfect competition. It provided the theoretical grounds for the World Bank and IMF to reject credit policies and endorse financial liberalisation and the privatisation of state investment banks (SIBs) from the 1980s onwards (Gelb, 1989; Caprio and Honohan 2001).

However, several critiques have shown how banks systematically ration credit, meaning the market-determined interest rate cannot then be viewed as a reliable indicator of efficient credit allocation (Stiglitz and Weiss, 1981; Wolfson, 1996; Dow, 1996; Ramskogler 2011). Quantity-rationed markets are not defined by a price equilibrium, but by quantity determination on the

¹⁴ For a discussion on the relevance of the double materiality perspective for central banks and financial supervisors, see Boissinot, J., Goulard, S., Le Calvar, E., Salin, M., Svartzman, R. and Weber, P.-F. 2022. Aligning financial and monetary policies with the concept of double materiality: rationales, proposals and challenges [Online]. London: LSE Grantham Research Institute on Climate Change and the Environment. [Accessed 30 June 2022]. Available from: <https://inspiregreenfinance.org>

supply side (the bank in this case), whatever the interest rate. In such a case, quantity variables – the amount of credit and where it is allocated in the economy – take on much greater importance in understanding the impact of finance on macro-economic variables (Werner 2005; Bezemer et al. 2021). Moreover, the systemic market failures to price climate risks combined with the failing of the de-risking credit policies outlined in section 2 above suggest that allocative credit interventions are necessary to support an orderly decarbonisation.

5. A typology of allocative green credit policies

A number of policy proposals have articulated how monetary and financial supervisory policies could be 'greened' (Campiglio et al. 2018; D'Orazio and Popoyan 2019) – including via refinancing operations, collateral policy, and unconventional bond purchases (Oustry et al. 2020; van 't Klooster and Van Tilburg 2020; Dafermos, Gabor, Nikolaidi et al. 2020; Dafermos, Gabor, Nikolaidi et al. 2021), and prudential and macro-prudential policies (Schoenmaker and Van Tilburg 2016; D'Orazio et al. 2019; Philipponnat 2020; Miller and Dikau 2022). Many of these proposals operate within existing central bank mandates and toolboxes, and hence have been predominantly justified by the need to manage risks posed to price, financial stability or to the environment. However, to the extent that these proposals function by targeting specific sectors, they should also be recognised as tools that could be deployed to influence the allocation of credit more directly.

We propose a typology of allocative credit policies to map out how different measures could be combined to align the 21st century, market-based financial system with the needs of the green transition (see Table 2). Allocative tools can either aim to stimulate green lending or penalise dirty lending, adjusting either the price or quantity of credit. These instruments can also be designed to act indirectly (by using incentive mechanisms) or directly (by using more coercive mechanisms). Direct (coercive) policies are designed to directly set sector-specific prices or quantities of credit. Indirect incentive-based policies aim to influence quantities of lending by adjusting the relative costs of providing capital to different sectors. As we argue below, both mechanisms can be deployed to support a green transition, but the suitability of each tool may vary according to institutional context and the degree of state control over local financial systems.

Our proposed allocative green credit policy would deploy both incentive and coercive tools, targeting the banking system and market-based finance with both price- and quantity-based tools, to ensure financial system alignment with green transition objectives. This credit policy ensures that credit creation is directed to priority sectors, dictated by the green industrial strategy and by the priorities of greening (social public) infrastructure, and obstructed for dirty sectors, defined by a public taxonomy. There are clear overlaps between the use of policies for credit allocation, macro-prudential, and monetary policy purposes. We distinguish allocative green credit policy by the use of discretionary (rather than risk-based) criteria to establish sectoral adjustments, reflecting the alignment of companies or sectors with green industrial/infrastructure policy goals.

2021). The think tank Finance Watch has proposed that capital risk weights for exposures to new fossil fuel reserves should be set at 1250% – an extremely punitive level that effectively forces banks to finance these activities entirely through equity whilst preventing the leverage effects usually resulting from bank lending (Philipponnat 2020).

Similarly, the use of discretionary, qualitative criteria may more effectively ensure that the use of central banks' balance sheets to adjust the cost of financing ultimately translates through to lending volumes – compared to the marginal signalling and demand effects under the risk-based approach. For instance, van 't Klooster and van Tilburg (2020) propose to link the volume of green refinancing credit to the percentage of new bank loans on the total balance sheet that are EU Taxonomy compliant, hence providing additional pressures on banks to green their whole portfolios rather than cherry-picking green projects whilst continuing to fund dirty activities. Another proposal is that central banks impose 'ceiling' and 'floor' refinancing rates for green and dirty lending, respectively, whereby the unsustainable rate eventually reaches a highly punitive level that effectively excludes the financing of such activities from the payments system (Cahen-Fourot 2022). Dafermos et al. (2022) propose to replace the Bank of England's 'carrots first, sticks later' approach to greening its corporate bond portfolio with a tilting strategy that reallocates purchases from dirty to green sectors without being restricted by the market neutrality principle, while excluding from the Bank's holdings the bonds of fossil fuel companies and the bonds issued by non-renewable electricity utilities with a poor climate performance. To the extent that such proposals subordinate price stability objectives to green transition goals, allocative green credit policy implies a shift away from monetary dominance to a more 'promotional' role for central banks (Baer et al. 2021). We explore these institutional implications in Section 6.

The second dimension by which allocative green credit policy expands on existing proposals is to acknowledge the importance of complementary policies specifically targeting market-based finance. As argued in Section 3, policies aiming to penalise dirty capital allocations will be ineffective without also addressing the complex ecosystem of institutional capital, where opaque balance sheet structures and lightly regulated operations create the terrain for regulatory circumvention and arbitrage. Given these structural considerations, the bulk of policies targeting market-based finance would be price-based, targeting especially the indirect ('backdoor') provision of capital to dirty activities through shadow lending institutions (Figure 1). This includes applying higher capital requirements for institutional holders of dirty equity, bonds, and related ETFs and for institutional allocations to hedge and private equity funds targeting dirty assets – building upon, for example, the new European prudential regime for investment management firms. Additionally, new financial regulation could restrict leverage for hedge funds and private equity fund holders of dirty assets, while also levying differentiated but punitive haircuts on repos collateralised with dirty assets – building upon, for example, the work of the Financial Stability Board on a haircuts framework for reducing systemic risks in shadow banking (see Gabor 2016). Importantly, punitive collateral haircuts for dirty assets must be implemented regardless of the ultimate use of cash proceeds, to prevent greenwashing via so-called 'green repos' – as discussed in the previous section.

5.2 Direct allocative credit policies

One limitation of indirect price-based policies is that adjusted incentives may not stimulate sufficient adjustments in the price or quantity of credit. Coercive credit allocation intervenes directly by setting the price or quantity of bank credit for particular sectors. Both high income and developmental states have a long history of using controls on interest rates, such as ceilings, floors, or subsidized rates, and quantitative targets on outright lending volumes to influence credit allocation (Loriaux et al., 1997; Werner 2003; Epstein 2006; Bezemer et al. 2021). The use of such tools for the green transition, however, has so far been confined to economies that maintain a high degree of state control over the financial system.

For direct price-based tools, for example, the central banks of Bangladesh and South Korea have both explicitly set lower interest rates for green activities (Dikau and Ryan-Collins 2017). More recently, the People's Bank of China launched a green targeted refinancing scheme stipulating that banks must lend to green activities at close to benchmark rates in order to qualify for discounted funding.¹⁵ Additionally, acceptance on the scheme is only granted after the loan is made – hence encouraging banks proactively seek eligible green lending opportunities.

The need to ensure that the transition is socially just as well as green provides further justification for a reconsideration of the need for direct interventions on interest rates within economies characterised by a high degree of financial liberalisation. Many of the most immediate decarbonisation steps to be taken by households and businesses, such as building retrofits and switching to electric vehicles, require large upfront capital expenditures. Recent proposals have called for credit policy intervention in the form of reduced rates on mortgages for energy efficiency properties and zero interest loans for housing retrofits, implemented alongside other credit guidance policies to ensure adequate supply of such green loans, and to avoid a two-tier system of lending that adversely affects households (Brown et al. 2020; Kumar 2021).

Quantitative credit allocation tools represent the most coercive policy options within our green allocative typology; yet, again, these instruments are already used for green purposes within some middle-income economies. For example, the Reserve Bank of India requires banks to allocate at least 40% of their loans to priority sectors, which includes renewable energy. Similarly, Bangladesh has a minimum bank lending ratio of 15% for sustainable financing. The Brazilian central bank has imposed outright portfolio restrictions on certain forms of financing – such crop expansion in the ecologically important zones (Resolution No. 3814/2009) and to borrowers who fail to comply with environmental regulations (Resolution No. 3545/2008). Econometric analysis has shown that these portfolio restrictions resulted in a material reduction in Brazilian deforestation over the period 2003 to 2011 (Assunção et al. 2020).

Within high-income economies, it is often forgotten that quantitative limits on credit allocation are already widely implemented by banks for macro-prudential purposes. Lending limits or outright

¹⁵ The PBOC's Carbon Emissions Reduction Facility (CERF) offers 60% of the loan principal to banks lending to green energy, environmental protection, and carbon emissions reduction technologies at a discounted 1-year rate of 1.75%. *'To qualify, financial institutions shall lend to all kinds of firms in industries that are key to carbon emission reduction at rates close to the LPR of the same maturity.'* See: <http://www.pbc.gov.cn/en/3688110/3688172/4157443/4385447/index.html>

exclusions on selected transition-incompatible activities, such as coal-fired power generation or the exploration and production of new oil and gas reserves, would be the most direct means of managing credit flows to legacy industries. The extension of existing public taxonomy initiatives to also classify activities that are 'always significantly harmful' and 'where urgent, managed exit/decommissioning is required' – as proposed by the EU Platform on Sustainable Finance (2022, p.8) – would legitimise such targeted, exclusion-based credit policies.

On the green-supporting side, minimum lending quotas and ratios could be applied to sectors that urgently need accelerated green credit. For example, to support industrial policy on the decarbonisation of buildings, banks could be required to ensure that a certain percentage of new mortgage lending is allocated to houses of a certain minimum energy efficiency rating, with the ratio increasing over time. Minimum lending quotas (i.e., targets on absolute volumes) could be applied to green housing retrofit loans, forcing banks to go out and seek lending opportunities. If combined with effective industrial policy, such a policy could have important spillover effects in terms of stimulating the growth of new retrofitting sectors.

State Investment Banks (SIBs) are another common means by which credit allocation policies have been historically implemented, particularly in the provision of finance to SMEs and to support innovation and economic development and transition (Mazzucato and Penna 2016; Mikheeva and Ryan-Collins 2022; Bezemer et al. 2021). Given their access to low borrowing costs and public guarantees, SIBs are able to offer discounted interest rates for priority sectors that then set a pricing benchmark for lending by private institutions. To the extent that SIBs also lend where the private sector will not, public lending is also a form of quantitative credit allocation. Far from crowding out private finance, such initiatives have had significant success in leveraging private sector involvement when deployed for green purposes (Deleidi et al. 2020; Mazzucato and Semieniuk 2018). The German KfW, for example, has mobilised €9 of private investment for every €1 of subsidised public lending (Schröder et al. 2011), whilst the UK's formerly public Green Investment Bank realised a leverage ratio of 3:1 for its public lending to green sectors (Matikainen 2017).

More coercive credit policies are also necessary to address the structural and regulatory blind spots raised by market-based finance. First, the mandatory exclusion of dirty assets from indexes marketed as ESG would ensure that index providers do not succumb to perverse (greenwashing) incentives as well as set the basis for an adequate regulation of dirty investments in passive funds (see Buller and Hayes 2022). Second, to address the indirect financing mechanisms identified in Figure 1, regulators of pension funds or insurance companies, the largest allocators to hedge and private equity funds, could set more explicit portfolio restrictions, such as outright bans on investments in funds that include fossil assets – as Californian legislators have already proposed for the USA's largest public pension funds.¹⁶ Third, the FSB and national securities markets authorities should consider a 100% haircut on securities issued by fossil fuel companies, to limit the potential for 'greenwashed' credit allocation via private repo markets. Such a punitive haircut effectively excludes the use of dirty assets as collateral in private repo markets, reducing its leverage appeal for institutional holders and contributing to relative asset repricing effects. Finally,

¹⁶ <https://www.ft.com/content/c9430eb5-201c-46e8-a10d-d9c098c9d4b4>

to ensure that dirty borrowers cannot access 'backdoor' financing through shadow lenders, regulators should also explore outright bans on the securitization of dirty loans on shadow/bank balance sheets, building upon current debates around simple, transparent and standardised securitisation in the framework of the EU's Capital Market Union.

If the policies discussed in this section are put into place, a best-case scenario is that the most transition-incompatible activities become virtually unable to access affordable debt financing – whether from regulated banks or market-based finance. This will in turn impact equity valuations. Yet, whilst legacy sectors are still revenue-producing there will still be private sector interest to hold and develop these assets outside of regulated capital market infrastructure. One salient example lies in the recent rush of private equity purchases of the most carbon-intensive fossil fuel reserves from the oil 'Majors'. For these types of profitable yet transition-incompatible assets, policymakers should consider the case for a 'bad bank' type public financial institution that can buy majority equity interest in order to manage an orderly wind down in ways that support the aims of a just transition.

6. Implications and conclusion

The allocative green credit policy aims to overcome the limitations of the market-led, risk-based approach in three main ways. First, it expands the scope of credit policy considerably to encompass the broader ecosystem of market-based finance – a critical measure to address the potential for regulatory circumvention and 'backdoor' credit creation via shadow intermediaries that may undermine the trajectory of the green transition. Second, it abandons the use of 'objective' risk-based criteria to guide sectoral adjustments, in favour of discretionary criteria that aim to align the direction of financial flows with green industrial policy goals – an approach that accounts for the challenges in quantifying 'radically uncertain' environmental risks. Third, and relatedly, the framework reasserts democratic oversight over the provision of green and dirty capital, in the context of a broader 'market-shaping' role of the State in accelerating the green transition through mission-oriented industrial policy (Mazzucato et al. 2020). This shift away from relying on private-sector-led 'ESG' initiatives offers potential to better resist vested corporate interests and its associated greenwashing risks.

Important questions emerge concerning the compatibility of allocative green credit policy within the narrow 'prudential' mandates of many high-income economy central banks and financial supervisors. Emphasising the challenges posed by radical uncertainty, some have argued that direct interventions in credit allocation can be justified within current mandates by the need for precautionary policy action to prevent the emergence of potentially catastrophic risks (Chenet et al. 2021). Others argued that aligning the private financial system with governments' Net Zero transition policies may be a more effective, and hence prudent, means of mitigating systemic climate risks (Robins et al. 2021; Barkawi and Zadek 2021). By establishing a clear trajectory for capital allocation in alignment with green transition plans, credit policy has the potential to actively shape an orderly transition by creating certainty for private sector actors.

It is important to also highlight that the proposed allocative green credit policy framework presents some trade-offs for policymakers to consider, with broader institutional implications. Using credit allocation policies to accelerate the growth and diffusion of new innovation-intensive industries whilst concurrently managing the decline of legacy sectors has no obvious historical precedent and may pose macro-financial stability risks.

First, dirty penalties may generate transition risks in certain sectors. This trade-off could be managed by deploying credit policy in careful coordination (e.g. on an 'escalating' basis) with a broader suite of industrial policy measures designed to mitigate the economic dislocations associated with transitioning sectors. This implies far more institutional coordination between financial and fiscal/industrial policy than is currently deemed appropriate under the existing macro-financial regime. Second, and relatedly, dislocations in legacy sectors may have inflationary consequences if new green sectors are not readily able to absorb excess labour and capital – dynamics that are already playing out in energy markets, albeit under geopolitical rather than transition-related circumstances. Central banks may have to consider to what extent they can tolerate short- or even medium-term periods of inflation to enable the green transition, calling into question the current inflation-targeting regime. More broadly, targeting quantities of credit through policy is arguably already incompatible with inflation-targeting, given this implies that price is no longer market determined. One solution to this might be to disaggregate measures of inflation and in other ways further refine central banks' inflation targets and policy tools. Further research is needed to address these questions.

Managing these trade-offs without falling into the trap of 'green technocracy' would suggest that central banks and financial regulators must shift from a 'prudential' to 'promotional' institutional role (Baer et al. 2021) to effectively manage radically uncertain environmental risks as well as ensure an orderly 'greening' of the financial system. The allocative green credit policy framework proposed in this paper should therefore be appreciated as part of a new macro-financial 'supercycle' for the green transition (Dafermos, Gabor and Michell 2020). Instead of the logic of market-fixing and de-risking, this new institutional structure prioritises direct coordination between fiscal, monetary, prudential, and industrial policy spheres, and the subordination of credit and monetary policy to support the needs of green industrial policy (see also Braun and Gabor 2022). From this perspective, credit policy must be 'brought back in from the wilderness' (Borio and Lowe 2004) to act as 'thwarting mechanisms' (Ferri and Minsky, 1991) that ensure both regulated banks and market-based finance is able to align with – or at the very least not undermine – democratically determined policy for a green structural transition.

Direct credit policy interventions will more effectively and more immediately ensure transition-related capital reallocation than the current risk-based approach. To operationalise the allocative credit policy framework, several enabling policy reforms will be required. First, a public taxonomy that determines harmful activities that are incompatible with government transition objectives, where capital allocation must be urgently restricted. National governments should also identify priority activities and sectors where finance urgently needs to be scaled up, to support broader green industrial policy goals. Second, mandatory disclosures – for both regulated lending institutions and broader institutional capital – of portfolio composition to priority and dirty activities, together with mandatory phase-out plans for the latter, where relevant, are required. Finally, we

would advocate the creation of new national public agencies comprised of representatives from central banks and relevant financial supervisory bodies and ministries of finance, industry and environment/climate that could coordinate the design and deployment of green credit policy, and monitor its ongoing effectiveness in supporting green industrial strategy.¹⁷

Whilst each of these enabling proposals represent not-insignificant reforms, policymakers should consider that these exercises may nevertheless be more achievable within the urgent timeframes remaining for transformative action, than the herculean evolution in metrics and risk modelling required to fulfil the risk-based regime currently in place.

¹⁷ See Mikheeva and Ryan-Collins (2022) for discussion of historical examples of these types of bodies and how they supported industrial transition in the post-war period. See also Krebel and van Lerven (forthcoming) for a discussion on how such an institution could be introduced within the UK context.

References

- Abbott, K.W., Green, J.F. and Keohane, R.O. (2016). Organizational Ecology and Institutional Change in Global Governance. *International Organization*, 70(2), pp.247–277.
- Aghion, P., Hepburn, C., Teytelboym, A. and Zenghelis, D. (2014). *Path dependence, innovation and the economics of climate change* [Online]. Centre for Climate Change Economics and Policy. Available at: <https://newclimateeconomy.report/2014/wp-content/uploads/sites/2/2014/11/Path-dependence-and-econ-of-change.pdf>.
- Allison, D. (2021). Oil and Gas Securitizations: A New Financing Tool in the Upstream Toolbox. *Hart Energy*. [Online]. Available at: <https://www.hartenergy.com/exclusives/oil-and-gas-securitizations-new-financing-tool-upstream-toolbox-197136>.
- Ameli, N., Drummond, P., Bisaro, A., Grubb, M. and Chenet, H. (2019). Climate finance and disclosure for institutional investors: why transparency is not enough. *Climatic Change*.
- Ameli, N., Kothari, S. and Grubb, M. (2021) Bartsch, E., Boivin, J., Fischer, S., Hildebrand, P. and Wang, S. 2020. Policy revolution. *SUERF Policy Note*. (202), pp.1–13.
- Aramonte, S. and Avalos, F. (2021). The rise of private markets.
- Assunção, J., Gandour, C., Rocha, Romero and Rocha, Rudi. (2020). The Effect of Rural Credit on Deforestation: Evidence from the Brazilian Amazon. *The Economic Journal*, 130(626), pp.290–330.
- Auld, G., Balboa, C., Bernstein, S. and Cashore, B. (2009). The emergence of non-state market-driven (NSMD) global environmental governance: a cross-sectoral assessment. In: M. A. Delmas and O. R. Young, eds. *Governance for the Environment: New Perspectives* [Online]. Cambridge: Cambridge University Press, pp.183–218. Available at: <https://www.cambridge.org/core/books/governance-for-the-environment/emergence-of-nonstate-marketdriven-nsmd-global-environmental-governance-a-crosssectoral-assessment/578E6DB773D1111190E9917A514B9F4C>.
- Azizuddin, K. (2021). ESG data market 'fertile ground for potential conflicts of interest', says European regulator. *Responsible Investor*.
- Baer, M., Campiglio, E. and Deyris, J. (2021). *It takes two to dance: Institutional dynamics and climate-related financial policies* [Online]. Grantham Research Institute on Climate Change and the Environment. Available at: <https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2021/04/working-paper-356-Baer-et-al.pdf>.
- Bank of England. (2019). *Enhancing banks' and insurers' approaches to managing the financial risks from climate change* [Online]. Available at: <https://www.bankofengland.co.uk/-/media/boe/files/prudential-regulation/supervisory-statement/2019/ss319.pdf?la=en&hash=7BA9824BAC5FB313F42C00889D4E3A6104881C44>.
- Bank of England. (2021a). Greening our Corporate Bond Purchase Scheme (CBPS). Available at: <https://www.bankofengland.co.uk/markets/greening-the-corporate-bond-purchase-scheme>.
- Bank of England. (2021b). *Options for greening the Bank of England's Corporate Bond Purchase Scheme* [Online]. Bank of England. Available at: <https://www.bankofengland.co.uk/-/media/boe/files/paper/2021/options-for-greening-the-bank-of-englands-corporate-bond-purchase-scheme-discussion-paper.pdf?la=en&hash=9BEA669AD3EC4B12D000B30078E4BE8ABD2CC5C1>.
- Baranovic, I., Busies, I., Coussens, W., Grill, M. and Hempbell, H. (2021). *The challenge of capturing climate risks in the banking regulatory framework: is there a need for a macroprudential response?* [Online]. European Central Bank. Available at: https://www.ecb.europa.eu/pub/financial-stability/macprudential-bulletin/html/ecb.mpbu202110_1~5323a5baa8.en.html.
- Barkawi, A. and Zadek, S. (2021). *Governing Finance for Sustainable Prosperity* [Online]. Council on Economic Policies. Available at: <https://www.cepweb.org/wp-content/uploads/2021/04/Barkawi-and-Zadek-2021.-Governing-Finance-for-Sustainable-Prosperity.pdf>.

- Bartsch, E., Boivin, J., Fischer, S., Hildebrand, P. and Wang, S. (2020). Policy revolution. *SUERF Policy Note*, (202), pp.1–13.
- Bernanke, B. (2003). A perspective on inflation targeting: why it seems to work. *Business Economics*, 38(3), pp.7–16.
- Bezemer, D., Ryan-Collins, J., van Lerven, F. and Zhang, L. (2021). Credit policy and the 'debt shift' in advanced economies. *Socio-Economic Review*, p.mwab041.
- Boissinot, J., Goulard, S., Le Calvar, E., Salin, M., Svartzman, R. and Weber, P.-F. (2022). Aligning financial and monetary policies with the concept of double materiality: rationales, proposals and challenges [Online]. London: LSE Grantham Research Institute on Climate Change and the Environment. [Accessed 30 June 2022]. Available from: <https://inspiregreenfinance.org>.
- Borio, C.E.V. and Lowe, P.W. (2004). Securing sustainable price stability: should credit come back from the wilderness? *BIS Working Paper No. 157*.
- Brown, D., Wheatley, H., Kumar, C. and Marshall, J. (2020). *A green stimulus for housing: The macroeconomic impacts of a UK whole house retrofit programme* [Online]. New Economics Foundation. Available at: https://neweconomics.org/uploads/files/Green-stimulus-for-housing_NEF.pdf.
- Buller, A. and Hayes, C. (2022). *The Passive Revolution* [Online]. Common Wealth. Available at: <https://www.commonwealth.co.uk/reports/the-passive-revolution>.
- Cahen-Fourot, L. (2022). Central banking for a social-ecological transformation. In: S. A. Kappes, L.-P. Rochon and G. Vallet, eds. *The future of central banking* [Online]. Edward Elgar. Available at: https://epub.wu.ac.at/8204/1/WP_40.pdf.
- Campiglio, E., Dafermos, Y., Monnin, P., Ryan-Collins, J., Schotten, G. and Tanaka, M. (2018). Climate change challenges for central banks and financial regulators. *Nature Climate Change*, 8(6), pp.462–468.
- Caprio, G. and Honohan, P. (2001). *Finance for Growth*. World Bank.
- Carney, M. (2015). *Breaking the Tragedy of the Horizon – climate change and financial stability*. London: Bank of England.
- Chamberlin, B. and Evain, J. (2021). *Indexing capital requirements on climate: what impacts can be expected?* [Online]. Institute for Climate Economics (I4CE). Available at: https://www.i4ce.org/wp-core/wp-content/uploads/2021/09/I4CE-rapport_Indexing-capital-requirements-on-climate.pdf.
- Chenet, H., Ryan-Collins, J. and van Lerven, F. (2021a). Finance, climate-change and radical uncertainty: Towards a precautionary approach to financial policy. *Ecological Economics*, 183, p.106957.
- 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), pp.754–774.
- Clarke, D. (2022). BoJ green loans scheme gets underway. *Green Central Banking*. [Online]. Available at: <https://greencentralbanking.com/2022/01/20/japan-green-loans-scheme/>.
- Cox, J. (2020). ECB to look at green TLTROs. *Global Capital*. (29 September 2020).
- Dafermos, Y. (2021). *Climate change, central banking and financial supervision: beyond the risk exposure approach* [Online]. SOAS Department of Economics. Available at: <https://www.soas.ac.uk/economics/research/workingpapers/file155297.pdf>.
- Dafermos, Y. (2022). Climate change, central banking and financial supervision: beyond the risk exposure approach In: S. Kappes, L.-P. Rochon and Vallet, G., eds. *The Future of Central Banking*. Cheltenham and Northampton, MA: Edward Elgar.
- Dafermos, Y., Gabor, D. and Michell, J. (2020). *Institutional Supercycles: An Evolutionary Macro-Finance Approach*. National Institute of Economic and Social Research.

- Dafermos, Y., Gabor, D. and Michell, J. (2021). The Wall Street Consensus in pandemic times: what does it mean for climate-aligned development? *Canadian Journal of Development Studies / Revue canadienne d'études du développement*, pp.1–14.
- Dafermos, Y., Gabor, D., Nikolaidi, M. and van Lerven, F. (2022). *An Environmental Mandate, now what? Alternatives for Greening the Bank of England's Corporate Bond Purchases* [Online]. SOAS University of London, University of Greenwich, University of the West of England. Available at: <https://eprints.soas.ac.uk/36190/>.
- Dafermos, Y., Gabor, D., Nikolaidi, M. and van Lerven, F. (2021). *Greening the UK financial system – a fit for purpose approach* [Online]. SUEF The European Money and Finance Forum. Available at: https://www.suerf.org/docx/f_55c6017b10a9755ef3681b09ccb01e94_21233_suerf.pdf.
- Dafermos, Y., Gabor, D., Nikolaidi, M., Pawloff, A. and van Lerven, F. (2020). *Decarbonising is easy: Beyond market neutrality in the ECB's corporate QE* [Online]. New Economics Foundation. Available at: <https://neweconomics.org/uploads/files/Decarbonising-is-easy.pdf>.
- Deeg, R. and Hardie, I. (2016). 'What is patient capital and who supplies it?' *Socio-Economic Review*, 14(4), pp.627–645.
- Deleidi, M., Mazzucato, M. and Semieniuk, G. (2020). Neither crowding in nor out: Public direct investment mobilising private investment into renewable electricity projects. *Energy Policy*, 140, p.111195.
- Deutz, A., Heal, G., Niu, R. and Swanson, E. (2020). *Financing Nature: Closing the global biodiversity financing gap*. [Online]. The Paulson Institute, The Nature Conservancy, and the Cornell Atkinson Center for Sustainability. Available at: https://www.paulsoninstitute.org/wp-content/uploads/2020/10/FINANCING-NATURE_Full-Report_Final-with-endorsements_101420.pdf.
- Dikau, S. and Ryan-Collins, J. (2017). *Green Central Banking in Emerging Market and Developing Country Economies* [Online]. New Economics Foundation. Available at: <https://eprints.soas.ac.uk/24876/1/Green-Central-Banking.pdf>.
- Dikau, S. and Volz, U. (2021). Out of the window? Green monetary policy in China: window guidance and the promotion of sustainable lending and investment. *Climate Policy*, pp.1–16.
- Donovan, C., Fomicov, M., Gerdes, L.K. and Waldron, M. (2020). *Energy Investing: Exploring Risk and Return in the Capital Markets*. CCFI & IEA.
- D'Orazio, P. and Popoyan, L. (2019). Fostering green investments and tackling climate-related financial risks: Which role for macroprudential policies? *Ecological Economics*, 160, pp.25–37.
- D'Orazio, P., Popoyan, L. and Monnin, P. (2019). Prudential Regulation Can Help in Tackling Climate Change. *Council on Economic Policies Blog*. [Online]. Available at: <https://www.cepweb.org/prudential-regulation-can-help-in-tackling-climate-change/>.
- Dow, S.C. (1996). Horizontalism: a critique. *Cambridge Journal of Economics*, 20(4), pp.497–508.
- Eaglesham, J. (2022). Wall Street's Green Push Exposes New Conflicts of Interest. *Wall Street Journal*. [Online]. Available at: <https://www.wsj.com/articles/wall-streets-green-push-exposes-new-conflicts-of-interest-11643452202>.
- ECB. (2020). *Guide on climate-related and environmental risks: Supervisory expectations relating to risk management and disclosure* [Online]. European Central Bank. Available at: <https://www.bankingsupervision.europa.eu/ecb/pub/pdf/ssm.202011finalguideonclimate-relatedandenvironmentalrisks~58213f6564.en.pdf>.
- Epstein, G. (2006). *Central Banks as Agents of Economic Development* [Online]. World Institute for Development Economic Research (UNU-WIDER). Available at: <https://EconPapers.repec.org/RePEc:unu:wpaper:rp2006-54>.
- Ferri, P. and Minsky, H.P. (1991). *Market Processes and Thwarting Systems* [Online]. Levy Economics Institute of Bard College. Available at: <https://www.levyinstitute.org/publications/market-processes-and-thwarting-systems>.
- Gabor, D. (2020). Critical macro-finance: A theoretical lens. *Finance and Society*, 6(1), pp.45–44.

- Gabor, D. (2016). The (impossible) repo trinity: the political economy of repo markets. *Review of International Political Economy*, 23(6), pp.967–1000.
- Gabor, D. (2021). The Wall Street Consensus. *Development and Change*.
- Geels, F.W. and Schot, J. (2007). Typology of sociotechnical transition pathways. *Research Policy*, 36(3), pp.399–417.
- Gelb, A.H. (1989). *Financial Policies, Growth and Efficiency*. World Bank Publications.
- Gros, D. (2020). *The Dangerous Allure of Green Central Banking*. Project Syndicate.
- Grubb, M., Drummond, P., Poncia, A., McDowall, W., Popp, D., Samadi, S., Penasco, C., Gillingham, K., Smulders, S., Glachant, M., Hassall, G., Mizuno, E., Rubin, E., Dechezleprêtre, A. and Pavan, G. (2021). *Induced innovation in energy technologies and systems: a review of evidence and potential implications for CO 2 mitigation* [Online]. HAL. Available at: <https://EconPapers.repec.org/RePEc:hal:journl:hal-03189044>.
- Hall, S., Foxon, T.J. and Bolton, R. (2017). Investing in low-carbon transitions: energy finance as an adaptive market. *Climate Policy*, 17(3), pp.280–298.
- Hardie, I. and Howarth, D. (eds.). (2013). *Market-Based Banking and the International Financial Crisis* [Online]. Oxford: Oxford University Press. Available at: <https://oxford.universitypressscholarship.com/10.1093/acprof:oso/9780199662289.001.0001/acprof-9780199662289>.
- Hauser, A. (2021). It's not easy being green – but that shouldn't stop us: how central banks can use their monetary policy portfolio to support orderly transition to net zero. Available at: <https://www.bankofengland.co.uk/-/media/boe/files/speech/2021/may/its-not-easy-being-green-but-that-shouldnt-stop-us-speech-by-andrew-hauser.pdf?la=en&hash=6859472C053CB4130189220C3141648C0AADF5C2>.
- Hook, L. and Vincent, M. (2020). Green business reporting rules at risk of pale response. *Financial Times*. [Online]. Available at: <https://www.ft.com/content/ad01f2c9-9eb0-4db6-9898-220c688d16c2>.
- IEA. (2021). *World Energy Outlook 2021* [Online]. International Energy Agency. Available at: <https://www.iea.org/reports/world-energy-outlook-2021/executive-summary>.
- In, S.Y. and Schumacher, K. (2021). Carbonwashing: ESG Data Greenwashing in a Post-Paris World. In: T. Heller and A. Seiger, eds. *Settling Climate Accounts: Navigating the Road to Net Zero* [Online]. Cham: Springer International Publishing, pp.39–58. [Accessed 28 April 2022]. Available at: https://doi.org/10.1007/978-3-030-83650-4_3.
- Kang, J. (2021). Energy firms facing insolvency bank on ABS. *Global Capital*. [Online]. Available at: <https://www.globalcapital.com/securitization/article/28wq9j3xc1dfikia45jwg/securitization/abs/energy-firms-facing-insolvency-bank-on-abs>.
- Kattel, R., Mazzucato, M., Ryan-Collins, J. and Sharpe, S. (2018). The economics of change: Policy and appraisal for missions, market-shaping and public purpose. *IIPP Working Paper*. 2018(06).
- Kedward, K. and Ryan-Collins, J. (2022). A Green New Deal: Opportunities and Constraints. In: P. Arestis and M. Sawyer, eds. *Economic Policies for Sustainability and Resilience*. [Online]. International Papers in Political Economy. Palgrave Macmillan, Cham. Available at: https://doi.org/10.1007/978-3-030-84288-8_7.
- Kedward, K., Ryan-Collins, J. and Chenet, H. (2020). Managing nature-related financial risks: A precautionary policy approach for central banks and financial supervisors. UCL Institute for Innovation and Public Purpose, Working Paper Series (IIPP WP 2020-09), p.37. Available at: <https://www.ucl.ac.uk/bartlett/public-purpose/wp2020-09>.
- van 't Klooster, J. and Van Tilburg, R. (2020). *Targeting a Sustainable Recovery with Green TLTROs* [Online]. Positive Money Europe and Sustainable Finance Lab. Available at: <https://www.positivemoney.eu/2020/09/green-tltros/>.

- Knox-Hayes, J. and Levy, D. (2014). The Political Economy of Governance by Disclosure: Carbon Disclosure and Nonfinancial Reporting as Contested Fields of Governance. In: A. Gupta and M. Mason, eds. *Transparency in Global Environmental Governance: Critical Perspectives*. Cambridge, MA: MIT Press.
- Kumar, C. (2021). *Great Homes Upgrade – an investment and policy package to futureproof UK housing* [Online]. New Economics Foundation. Available at: https://neweconomics.org/uploads/files/Great-Home-Upgrade-Policy-Briefing_September-2021_final.pdf.
- Lankes, H.P. (2021). *Blended finance for scaling up climate and nature investments* [Online]. One Planet Lab and Grantham Research Institute on Climate Change and the Environment. Available at: <https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2021/11/Blended-Finance-for-Scaling-Up-Climate-and-Nature-Investments-1.pdf>.
- Loriaux, M., Woo-Cummings, M., Calder, K., Maxfield, S. and Perez, S. (1997). *Capital Ungoverned: The Dismantling of Activist Credit Policies in Interventionist States*. Ithaca NY: Cornell University Press.
- Massoc, E.C. (2021). Having banks 'play along' state-bank coordination and state-guaranteed credit programs during the COVID-19 crisis in France and Germany. *Journal of European Public Policy*, pp.1–18.
- Matikainen, S. (2017). GIB going, going, gone! The future of the Green Investment Bank and sustainable investment in the UK. *LSE Grantham Research Institute on Climate Change and the Environment*. [Online]. Available at: <https://www.lse.ac.uk/granthaminstitute/news/gib-going-going-gone-the-future-of-the-green-investment-bank-and-sustainable-investment-in-the-uk/>.
- Mayer, T. (1975). Credit Allocation: A Critical View. *Government Credit Allocation: Where Do We Go From Here*, pp.39–92.
- Mazzucato, M. (2021). *Mission Economy: A Moonshot Guide to Changing Capitalism*. Penguin UK.
- Mazzucato, M., Kattel, R. and Ryan-Collins, J. (2020). Challenge-driven innovation policy: towards a new policy toolkit. *Journal of Industry, Competition and Trade*, 20(2), pp.421–437.
- Mazzucato, M. and McPherson, M. (2018). *The Green New Deal: A Bold Mission-Oriented Approach* [Online]. Institute for Innovation and Public Purpose, University College London. Available at: <https://www.ucl.ac.uk/bartlett/public-purpose/publications/2018/dec/green-new-deal-bold-mission-oriented-approach>.
- Mazzucato, M. and Penna, C.C. (2016). Beyond market failures: The market creating and shaping roles of state investment banks. *Journal of Economic Policy Reform*, 19(4), pp.305–326.
- Mazzucato, M. and Ryan-Collins, J. (2022). Putting value creation back into 'public value': from market-fixing to market-shaping. *Journal of Economic Policy Reform*, pp.1–16.
- Mazzucato, M. and Semieniuk, G. (2018). Financing renewable energy: Who is financing what and why it matters. *Technological Forecasting and Social Change*, 127, pp.8–22.
- McDonagh, N. (2021). Credit Guidance for a Desired Economy: An Original Institutional Economics Critique of Financialization. *Review of Radical Political Economics*, 53(4), pp.675–693.
- McGee, J. (2014). The Influence of US Neoliberalism on International Climate Change Policy. In: N. E. Harrison and J. Mikler, eds. *Climate Innovation* [Online]. Energy, Climate and the Environment Series. London: Palgrave Macmillan. Available at: https://doi.org/10.1057/9781137319890_8.
- McKinnon, R.I. (1973). *Money and capital in economic development*. Brookings Institution Press.
- Mikheeva, O. and Ryan-Collins, J. (2022). Governing finance to support the net-zero transition: Lessons from successful industrialisations. *Institute for Innovation and Public Purpose Working Paper Series*. (WP2022/1).
- Miller, H. and Dikau, S. (2022). *Preventing a 'climate Minsky moment': environmental financial risks and prudential exposure limits | Exploring the case of the Bank of England's prudential regime* [Online]. Grantham Research Institute on Climate Change and the Environment, LSE. Available at:

- <https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2022/03/Preventing-a-climate-Minsky-moment.pdf>.
- Monnet, E. (2018). *Controlling Credit: Central Banking and the Planned Economy in Postwar France 1948–1973*. Cambridge University Press.
- Monnin, P. (2018). Integrating Climate Risks into Credit Risk Assessment — Current Methodologies and the Case of Central Banks Corporate Bond Purchases. *Council on Economic Policies, Discussion Note*. 4.
- Monnin, P. (2021). *Systemic risk buffers-The missing piece in the prudential response to climate risks*.
- Musthaq, F. (2021). Development Finance or Financial Accumulation for Asset Managers?: The Perils of the Global Shadow Banking System in Developing Countries. *New Political Economy*. **26**(4), pp.554–573.
- NGFS. (2019). *A call for action: climate change as a source of financial risk* [Online]. 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.
- NGFS. (2021). *Adapting central bank operations to a hotter world: Reviewing some options* [Online]. Network for Greening the Financial System. Available at: https://www.ngfs.net/sites/default/files/medias/documents/ngfs_monetary_policy_operations_final.pdf.
- NGFS. (2022). *Credit Ratings and Climate Change - Challenges for Central Bank Operations* [Online]. Network for Greening the Financial System. Available at: https://www.ngfs.net/sites/default/files/medias/documents/credit_ratings_and_climate_change_-_challenges_for_central_bank_operations.pdf.
- NGFS. (2020). *Guide for Supervisors: Integrating climate-related and environmental risks into prudential supervision* [Online]. Network for Greening the Financial System. Available at: https://www.ngfs.net/sites/default/files/medias/documents/ngfs_guide_for_supervisors.pdf.
- Nishimura, H. (2021). BOJ climate change plan stirs debate over central bank role. *Nikkei Asia*. [Online]. Available at: <https://asia.nikkei.com/Spotlight/Environment/Climate-Change/BOJ-climate-change-plan-stirs-debate-over-central-bank-role>.
- O'Reilly, E. (2020). *Decision of the European Ombudsman in joint inquiry 853/2020/KR on the European Commission's decision to award a contract to BlackRock Investment Management to carry out a study on integrating environmental, social and governance (ESG) objectives into EU banking rules* [Online]. European Ombudsman. Available at: <https://www.ombudsman.europa.eu/en/decision/en/135363>.
- Oustry, A., Erkan, B., Svartzman, R. and Weber, P.F. (2020). *Climate-related Risks and Central Banks' Collateral Policy: a Methodological Experiment* [Online]. Banque de France. Available at: https://publications.banque-france.fr/sites/default/files/medias/documents/wp-790_0.pdf.
- Paulson, H. (2020). We need a new asset class of healthy soils and pollinators. [Accessed 28 April 2021]. Available at: <https://www.ft.com/content/f04fc37b-f5ba-4a17-b964-ebd7ee3e8f1f>.
- Petry, J., Fichtner, J. and Heemskerk, E. (2021). Steering capital: the growing private authority of index providers in the age of passive asset management. *Review of International Political Economy*, **28**(1), pp.152–176.
- Philipponnat, T. (2020). *Breaking the climate-finance doom loop* [Online]. Finance Watch. Available at: https://www.finance-watch.org/wp-content/uploads/2020/06/Breaking-the-climate-finance-doom-loop_Finance-Watch-report.pdf.
- Platform on Sustainable Finance. (2022). *The Extended Environmental Taxonomy: Final Report on Taxonomy extension options supporting a sustainable transition* [Online]. European Commission. Available at: https://ec.europa.eu/info/sites/default/files/business_economy_euro/banking_and_finance/documents/220329-sustainable-finance-platform-finance-report-environmental-transition-taxonomy_en.pdf.
- Porter, K. and Deveau, S. (2021). Shadow Lenders Pile Into U.S. Energy Debt After Bank Retreat. *Bloomberg*. [Online]. Available at: <https://www.bloomberg.com/news/articles/2021-06-25/shadow-lenders-pile-into-u-s-energy-debt-after-bank-retreat>.

- PRA. (2021). *Climate-related financial risk management and the role of capital requirements* [Online]. Prudential Regulation Authority. Available at: <https://www.bankofengland.co.uk/-/media/boe/files/prudential-regulation/publication/2021/october/climate-change-adaptation-report-2021.pdf?la=en&hash=FF4A0C618471462E10BC704D4AA58727EC8F8720>.
- Rainforest Action Network. (2021). Banking on Climate Chaos. *Rainforest Action Network*. [Online]. [Accessed 17 May 2021]. Available at: <https://www.ran.org/bankingonclimatechaos2021/>.
- Ramskogler, P. (2011). Credit Money, Collateral and the Solvency of Banks: A Post Keynesian Analysis of Credit Market Failures. *Review of Political Economy*, 23(1), pp.69–79.
- Rauhala, E. (2022). E.U. labels natural gas and nuclear energy 'green,' prompting charges of 'greenwashing'. *The Washington Post*. [Online]. Available at: <https://www.washingtonpost.com/world/2022/02/02/green-energy-gas-nuclear-taxonomy/>.
- Rittel, H.W. and Webber, M.M. (1973). Dilemmas in a general theory of planning. *Policy sciences*. 4(2), pp.155–169.
- Robins, N., Dikau, S. and Volz, U. (2021). *Net-zero central banking: A new phase in greening the financial system* [Online]. Grantham Research Institute on Climate Change and the Environment, London School of Economics. Available at: Grantham Research Institute on Climate Change and the Environment, London School of Economics.
- Ryan-Collins, J. (2019). *Beyond voluntary disclosure: why a 'market-shaping' approach to financial regulation is needed to meet the challenge of climate change* [Online]. SUERF: The European Money and Finance Forum. Available at: https://www.suerf.org/docx/f_a821a161aa4214f5ff5b8ca372960ebb_4805_suerf.pdf.
- Schnabel, I. (2022). A new age of energy inflation: climateflation, fossilflation and greenflation. *European Central Bank*. [Online]. [Accessed 27 April 2022]. Available at: https://www.ecb.europa.eu/press/key/date/2022/html/ecb.sp220317_2~dbb3582f0a.en.html.
- Schnabel, I. (2021). From green neglect to green dominance? Available at: https://www.ecb.europa.eu/press/key/date/2021/html/ecb.sp210303_1~f3df48854e.en.html.
- Schoenmaker, D. and Van Tilburg, R. (2016). What Role for Financial Supervisors in Addressing Environmental Risks? *Comparative Economic Studies*, 58(3), pp.317–334.
- Schröder, M., Ekins, P., Zulauf, M. and Lower, R. (2011). *The KfW experience in the reduction of energy use in and CO2 emissions from buildings* [Online]. UCL Energy Institute and LSE Housing and Communities. Available at: <https://sticerd.lse.ac.uk/dps/case/cp/kfwfullreport.pdf>.
- Seidman, D., Mehta-Neugebauer, R., Giachino, A. and Mendoza, A. (2022). *Private Equity's Dirty Dozen: 12 firms dripping in oil and the wealthy executives who run them* [Online]. Private Equity Stakeholder Project. Available at: https://pestakeholder.org/wp-content/uploads/2022/02/PESP_LS_PrivateEquityDirtyDozen_Feb2022-Final.pdf.
- Shaw, E.S. (1973). *Financial Deepening in Economic Development*. New York, NY: Oxford University Press.
- Smoleńska, A. and van 't Klooster, J. (2022). A Risky Bet: Climate Change and the EU's Microprudential Framework for Banks. *Journal of Financial Regulation*, 8(1), pp.51–74.
- Stiglitz, J. and Weiss, A. (1981). Credit Rationing in Markets with Imperfect Information. *American Economic Review*, 71(3), pp.393–410.
- Svartzman, R., Bolton, P., Despres, M., Pereira Da Silva, L.A. and Samama, F. (2021). Central banks, financial stability and policy coordination in the age of climate uncertainty: a three-layered analytical and operational framework. *Climate Policy*. 21(4), pp.563–580.
- TCFD (2017). *Recommendations of the Task Force on Climate-related Financial Disclosures* [Online]. Available at: <https://www.fsb-tcfd.org/wp-content/uploads/2017/06/FINAL-2017-TCFD-Report-11052018.pdf>.
- Trase.. (2020). *The state of forest-risk supply chains* [Online]. Available at: http://resources.trase.earth/documents/Trase_Yearbook_Executive_Summary_2_July_2020.pdf.

- Weidmann, J. (2021). Climate risks, financial markets and central banks' risk management. Available at:
<https://www.bis.org/review/r210603a.pdf>.
- Werner, R.A. (2005). *New paradigm in macroeconomics : solving the riddle of Japanese macroeconomic performance*. Houndmills, Basingstoke: Palgrave Macmillan.
- Werner, R.A. (2003). *Princes of the Yen: Japan's Central Bankers and the Transformation of the Economy*. ME Sharpe.
- Wolfson, M.H. (1996). A Post Keynesian Theory of Credit Rationing. *Journal of Post Keynesian Economics*, 18(3), pp.443–470.

The IIPP Working Paper series and Policy Reports

- IIPP WP 2017-01 [Mission-Oriented innovation policy: Challenges and opportunities](#). Mariana Mazzucato.
- IIPP WP 2017-02 [Thinking about technology policy: 'Market Failures' versus 'Innovation systems'](#). Richard R Nelson.
- IIPP WP 2017-03 [Technological capacity in the public sector: the Case of Estonia](#). Veiko Lember, Rainer Kattel, Piret Tõnurist.
- IIPP WP 2017-04 [Rethinking value in health Innovation: From mystification towards prescriptions](#). Mariana Mazzucato, Victor Roy.
- IIPP WP 2017-05 [Patient strategic finance: Opportunities for state investment banks in the UK](#). Mariana Mazzucato, Laurie Macfarlane.
- IIPP WP 2018-01 [State investment banks and patient finance: An international comparison](#). Laurie Macfarlane, Mariana Mazzucato.
- IIPP WP 2018-02 [Putting austerity to bed: Technical progress, aggregate demand and the supermultiplier](#). Matteo Deleidi, Mariana Mazzucato.
- IIPP WP 2018-03 [The bit and the rainforest: Towards the evolutionary theory of policy capacity](#). Erkki Karo, Rainer Kattel.
- IIPP WP 2018-04 [Financing green growth](#). Semieniuk Gregor, Mariana Mazzucato.
- IIPP WP 2018-05 [Mission-oriented innovation policy and dynamic capabilities in the public sector](#). Rainer Kattel, Mariana Mazzucato.
- IIPP WP 2018-06 [The economics of change: Policy and appraisal for missions, market shaping and public purpose](#). Rainer Kattel, Mariana Mazzucato, Josh Ryan-Collins, Simon Sharpe.
- IIPP WP 2018-07 [Movements with missions make markets](#). Charles Leadbeater.
- IIPP WP 2018-08 [Bringing the helicopter to ground: A historical review of fiscal-monetary coordination to support economic growth in the 20th century](#). Josh Ryan-Collins, Frank van Lerven.
- IIPP WP 2018-09 [Estonia's digital transformation: Mission mystique and the hiding hand](#). Rainer Kattel, Ines Mergel.
- IIPP WP 2018-10 [The people's prescription: Re-imagining health innovation to deliver public health](#). UCL Institute for Innovation and Public Purpose, Stop Aids, Just Treatment, Global Justice Now.
- IIPP WP 2018-11 [Credit where it's due: A historical, theoretical and empirical review of credit guidance policies in the 20th century](#). Dirk Bezemer, Josh Ryan-Collins, Frank van Lerven and Lu Zhang.
- IIPP WP 2019-01 [Supermultiplier, innovation and the ecosystem: A stock-flow dynamic model](#). Matteo Deleidi, Riccardo Pariboni, Marco Veronese Passarella.
- IIPP WP 2019-02 [A mission-oriented framework for the Scottish National Investment Bank](#). Mariana Mazzucato, Laurie Macfarlane.
- IIPP WP 2019-03 [A framework for mission-oriented innovation policy roadmapping for the SDGs](#). Mariana Mazzucato, Laurie Macfarlane.
- IIPP WP 2019-04 [A Mission-Oriented UK Industrial Strategy](#). UCL Commission for Mission-Oriented Innovation and Industrial Strategy (MOIIS).
- IIPP WP 2019-05 [Putting value creation back into 'public value': From market fixing to market shaping](#). Mariana Mazzucato, Josh Ryan-Collins.
- IIPP WP 2019-06 [The macroeconomic impact of government innovation policies: A quantitative assessment](#). Matteo Deleidi, Vincenzo De Lipsis, Mariana Mazzucato, Josh Ryan-Collins, Paolo Agnolucci.
- IIPP WP 2019-07 [Financial and legal barriers to the creation and operation of a British national investment bank](#). Rob Calvert Jump, Natalya Naqvi.
- IIPP WP 2019-08 [Public investment fiscal multipliers: An empirical assessment for European countries](#). Matteo Deleidi, Francesca lafrate, Enrico Sergio Levrero.
- IIPP WP 2019-09 [Socialising the risks and rewards of public investments: Economic, policy and legal issues](#). Andrea Laplane, Mariana Mazzucato.
- IIPP WP 2019-10 [Neither crowding in nor out: Public direct investment mobilising private investment into renewable electricity projects](#). Matteo Deleidi, Mariana Mazzucato, Gregor Semieniuk.
- IIPP WP 2019-11 [Social structures of accumulation in Greece, 1980-2014](#). Angeliki Papadopoulou, Giorgos Gouzoulis.

- IIPP WP 2019-12 [Innovation bureaucracies: How agile stability creates the entrepreneurial state.](#) Rainer Kattel, Wolfgang Drechsler, Erkki Karo.
- IIPP WP 2019-13 [Climate-related financial policy in a world of radical uncertainty: Towards a precautionary approach.](#) Hugues Chenet, Josh Ryan-Collins, Frank van Lerven.
- IIPP WP 2020-01 [The public economy: Understanding government as a producer.](#) June Sekera.
- IIPP WP 2020-02 [The entrepreneurial \(welfare\) state? Tackling social issues through challenge prizes.](#) Ville Takala, Emma Nordbäck and Tuukka Toivonen.
- IIPP WP 2020-03 [Determinants of income shares and the stable middle in post-socialist China.](#) Giorgos Gouzoulis, Collin Constantine.
- IIPP WP 2020-04 [Industrial policy: A long-term perspective and overview of theoretical arguments](#) Erik S. Reinert.
- IIPP WP 2020-05 [Gig work at the base of the pyramid: considering dependence and control.](#) Kate Roll.
- IIPP WP 2020-06 [Deindustrialisation reconsidered: Structural shifts and sectoral heterogeneity.](#) Fiona Tregenna, Antonio Andreoni.
- IIPP WP 2020-07 [Upward-scaling tipping cascades to meet climate goals: Plausible grounds for hope.](#) Simon Sharpe, Timothy Lenton.
- IIPP WP 2020-08 [When homes earn more than jobs: the rentierization of the Australian housing market.](#) Josh Ryan-Collins, Cameron Murray.
- IIPP WP 2020-09 [Managing nature-related financial risks: a precautionary policy approach for central banks and financial supervisors.](#) Katie Kedward, Josh Ryan-Collins, Hugues Chenet.
- IIPP WP 2020-10 [Welfare 5.0: Why we need a social revolution and how to make it happen.](#) Hilary Cottam.
- IIPP WP 2020-11 [Public value and platform governance.](#) Mariana Mazzucato, Josh Entsminger, Rainer Kattel.
- IIPP WP 2020-12 [COVID-19 and public-sector capacity.](#) Mariana Mazzucato, Rainer Kattel.
- IIPP WP 2020-13 [Theorising and mapping modern economic rents.](#) Mariana Mazzucato, Josh Ryan-Collins, Giorgos Gouzoulis.
- IIPP WP 2020-14 [Missioni Italia.](#) Mariana Mazzucato.
- IIPP WP 2020-15 [Schumpeter, the entrepreneurial State and China.](#) Leonardo Burlamaqui.
- IIPP WP 2020-16 [Public wealth funds: Supporting economic recovery and sustainable growth.](#) Dag Detter, Stefan Fölster, Josh Ryan-Collins.
- IIPP WP 2020-17 [The EIB and the new EU missions framework.](#) Mariana Mazzucato, Olga Mikheeva.
- IIPP WP 2020-19 [Creating and measuring dynamic public value at the BBC.](#) Mariana Mazzucato, Rowan Conway, Eleonora Maria Mazzoli, Eva Knoll, Sarah Albala.
- IIPP WP 2020-20 [The entrepreneurial State and public options: socialising risks and rewards.](#) Mariana Mazzucato, Henry Lishi Li.
- IIPP WP 2020-21 [A market-shaping approach for the biopharmaceutical industry: governing innovation towards the public interest.](#) Mariana Mazzucato, Henry Lishi Li.
- IIPP WP 2021/01 [Dynamic capabilities in the public sector: The case of the UK's Government Digital Service.](#) Rainer Kattel, Ville Takala.
- IIPP WP 2021/02 [Innovations in development finance and conditioning factors: BNDES and the fostering of sustainability-related industries in Brazil.](#) João Carlos Ferraz, Luma Ramos, Bruno Platteck.
- IIPP WP 2021/03 [Deciding how to decide: Risk-opportunity analysis as a generalisation of cost-benefit analysis.](#) Michael Grubb, Matthew Ives, Florian Knobloch, Jean-Francois Mercure, Femke J. M. M. Nijse, Hector Pollitt, Simon Sharpe, Jorge Vinuales.
- IIPP WP 2021/04 [New economics of assistive technologies: A call for a missions approach.](#) Sarah Albala, Catherine Holloway, Victoria Austin, Rainer Kattel.
- IIPP WP 2021/05 [Why ethics of quantification is needed now.](#) Andrea Saltelli, Antonio Andreoni, Wolfgang Drechsler, Jayati Ghosh, Rainer Kattel, Ingrid H. Kvangraven, Ismael Rafols, Erik S. Reinert, Andy Stirling, Ting Xu.
- IIPP WP 2021/06 [A dynamic theory of public banks \(and why it matters\).](#) Thomas Marois.
- IIPP WP 2021/07 [Altered States: Cartesian and Ricardian dreams.](#) Erik S. Reinert, Monica di Fiore, Andrea Saltelli, Jerome R. Ravetz.

- IIPP WP 2021/08 [Lessons from the past 21st century systems of state-owned enterprises: The case of Italy's IRI in the 1930s](#). Simone Gasperin.
- IIPP WP 2021/09 [Building state capacities and dynamic capabilities to drive social and economic development: The case of South Africa](#). Mariana Mazzucato, Mzukisi Oobo, Rainer Kattel.
- IIPP WP 2021/10 [Mission-oriented policies and the "Entrepreneurial State" at work: An agent-based exploration](#). Giovanni Dosi, Francesco Lamperti, Mariana Mazzucato, Mauro Napoletano, Andrea Roventini.
- IIPP WP 2021/11 [Heterogeneous investors, scale economies and the commercialisation of innovative renewable energy](#). Gregor Semieniuk, José Alejandro Coronado, Mariana Mazzucato.
- IIPP WP 2022/01 [Governing finance to support the net-zero transition: lessons from successful industrialisation](#). Olga Mikheeva, Josh Ryan-Collins.
- IIPP WP 2022/02 [A new data deal: the case of Barcelona](#). Fernando Monge, Sarah Barns, Rainer Kattel and Francesca Bria.
- IIPP WP 2022/03 [How can South Africa advance a new energy paradigm? A mission-oriented approach to megaprojects](#). Antonio Andreoni, Kenneth Creamer, Mariana Mazzucato, Grové Steyn.
- IIPP WP 2022/04 [Policy capacities for transformative innovation policy: A case study of UK Research Innovation](#). Julie McLaren, Rainer Kattel.
- IIPP WP 2022/05 [From financial risk to financial harm: Exploring the agri-finance nexus and drives or biodiversity loss](#). Katie Kedward and Josh Ryan-Collins.
- IIPP WP 2022/07 [Dynamic capabilities of the public sector: Towards a new synthesis](#). Rainer Kattel.
- IIPP WP 2022/08 [The self-financing state: An institutional analysis of government expenditure, revenue collection and debt issuance operations in the United Kingdom](#). Andrew Berkeley, Josh Ryan-Collins, Richard Tye, Asker Voldsgaard and Neil Wilson.
- IIPP WP 2022/09 [Expanding DARPA's model of innovation for biopharma](#). Mariana Mazzucato and Travis Whitfill.
- IIPP WP 2022/10 [The neo-Weberian state: From ideal type model to reality?](#) Geert Bouckaert.

All Working Papers are available to download at the Institute for Innovation and Public Purpose website: ucl.ac.uk/iipp

ucl.ac.uk/iipp

 [@IIPP_UCL](https://twitter.com/IIPP_UCL)

UCL Institute for Innovation and Public Purpose
11 Montague Street, London, WC1B 5BP

General enquiries:

iipp-research@ucl.ac.uk

Tel: +44 (0)20 3108 6961

