Monetary-fiscal policy coordination:

Lessons from Covid-19 for the climate and biodiversity emergencies

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Monetary-fiscal policy coordination: lessons from Covid-19 for the climate and biodiversity emergencies

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Abstract

The climate and biodiversity emergencies require structural economic shifts that will necessitate strategic coordination between macroeconomic policy authorities. The Covid-19 episode saw the implementation of monetary-fiscal policy coordination not seen since the 1970s to avert catastrophic damage to economies caused by pandemic-induced lockdowns. Recent developments suggest these were best understood as emergency short-term responses rather than marking a shift in the consensus that insists on a separation between monetary and fiscal policy spheres that might support a more coordinated policy approach to addressing environmental breakdown. We review the most prominent examples of coordination in high income and emerging market economies in the 2020-2021 period, focussing on the creation of fiscal space and targeted provision of liquidity to strategic sectors of the economy. We consider the lessons and opportunities these policy innovations raise for the development of a precautionary macroeconomic policy approach which seeks to reduce the threat of ecological tipping points, prevent catastrophic losses, and support the Net-Zero transition.

Keywords: green transition, climate finance, sustainable finance, monetary policy, fiscal policy, financial stability, Covid-19 pandemic, net-zero transition, climate change, biodiversity loss, central banking, quantitative easing.

JEL codes: Q54, Q57, E44, E52, E58, E61, E62, E63, G28

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1. Introduction

The climate and biodiversity emergencies facing the world have come to the forefront of financial and macroeconomic policy agendas in recent years (NGFS, 2019; Coalition of Finance Ministers, 2019; NGFS and INSPIRE, 2022). Notably, there have been calls for more policy coordination between central banks and other macroeconomic and industrial policy agencies to deal with the threat of climate change (Svartzman, Bolton, et al., 2021; Barkawi and Zadek, 2021; Robins et al., 2021; Mikheeva and Ryan-Collins, 2022) and global pandemics (Pereira da Silva, 2020; Padhan and Prabheesh, 2021).

However, in high income economies in particular, central banks and financial supervisors have been wary of overstepping their official mandates in deploying policies to support environmental transition (Weidmann, 2019; Baer et al., 2021; Smialek, 2023).[1] At the same time, fiscal and industrial policy has been accused of failing to provide sufficient financing or ambition to support the transition of energy and infrastructure systems required for to reach globally agreed targets on climate change (Claeys and Tagliapietra, 2020; Varoufakis and Adler, 2020; Kedward and Ryan-Collins, 2022).

On the one hand, these developments can be viewed as outcomes of the still dominant paradigm which sees macroeconomic policy mainly as a tool for short-term stabilisation and insists on separation between fiscal and monetary policy to achieve this (Bernanke, 2003). Rather than a coordinated 'mission-oriented' (Mazzucato, 2021) macroeconomic policy to support the achievement of long-term structural economic change required for the green transition, there has been a coalescing around the idea that policy should rely primarily on private financial markets to lead the green recovery (Kedward et al., 2022a). The assumption here is that higher public investment should be balanced against the risk of 'crowding out' the private sector (e.g., Blanchard, 2019) or inflation (Summers, 2021) and that central banks must retain their independence and market neutrality[2] to retain credibility for their primary mandate of achieving price stability (van 't Klooster and Fontan, 2020; Mauderer et al., 2021; Hansen, 2022). The recent inflation that has followed the Covid-19 pandemic and Russian invasion of Ukraine, although catalysed by supply-side shocks, has further encouraged central banks to double down on their inflation targeting mandate.

On the other hand, the Global Financial Crisis of 2007-09 and, more recently, the Covid-19 pandemic, have seen many examples of extraordinary fiscal-monetary coordination in the face of catastrophic threats to the macroeconomy and financial system. Most notably, central banks, in direct or indirect coordination with governments, deployed a variety of tools to pursue multiple objectives. These included supporting real economy firms of various sizes; providing a backstop for various capital market actors beyond regulated financial institutions (with or without conditionality);

[1] Emerging market and developing country economy central banks, often with broader mandates, have shown less reluctance to adjust policies to support the green transition in some cases, see e.g. Dikau and Ryan-Collins (2017) and Dikau and Volz (2021).

[2] An operating principle guiding the implementation of monetary policy which aims to minimize as much as possible distortionary effects of interventions on market price discovery mechanisms.

and, explicitly or implicitly, creating 'fiscal space' to enable governments to embark on major fiscal expansions.

The rapid emergence of post-pandemic inflation has caused a rapid tightening of monetary policy that has reversed many of these interventions. Yet, the question remains as to whether such coordination can also be extended to deal with longer-term global challenges such as the risks posed by climate change and biodiversity loss. Whilst the origins of Covid-19 are still contested, almost half of new diseases since 1940, including previous coronaviruses such as SARS, can be traced to environmental degradation (May et al., 2004; Keesing et al., 2010; Carlson et al., 2019) so such pandemics can be thought of more generally as potential risks associated with a failure to transition to more ecologically sustainable economies (McElwee et al., 2020).

In this paper, we provide a first systemic review of Covid-19 related fiscal-monetary policy coordination interventions by financial authorities to better understand the drivers and impacts of these actions. The research is based on analysis of databases collected by the IMF and BIS (IMF, 2021; Cantú et al., 2021), complemented by analysis of individual central banks' documentation and other media. Our analysis focusses on two dimensions of macroeconomic policy coordination: 1) the use of monetary policy to create greater fiscal space for governments to deal with pandemic via quantitative easing programs, yield curve control, reserves policy and implicit forms of monetary financing; and, 2), forms of liquidity support that targeted specific sectors of the economy most in need of support. We then analyse the differences between the Covid-19, climate change and biodiversity crises in relation to macroeconomic policy coordination. From this analytical comparison, we propose a 'precautionary' macroeconomic policy coordination rationale that justifies utilising some of the same types of proactive interventions to deal with longer-term environmental threats, in particular monetary-fiscal coordination to create fiscal space for major interventions and directed credit policies to meet the challenge of environmental breakdown.

The remainder of this paper is set as follows. Section 2 sets out the theoretical and historical literature on fiscal-monetary policy coordination to pursue structural economic change, demonstrating that the recent examples appear less radical when placed in longer historical context. Section 3 reviews the Covid-19 interventions from financial authorities. Section 4 considers their application to the twin environmental crises. Section 5 concludes.

2. Fiscal-monetary policy coordination: theoretical and historical overview

2.1 The 1930-1970s: The heyday of fiscal-monetary policy coordination

For the majority of the 1930s-1970s period, financial policy was explicitly coordinated with wider government economic policy objectives. In both advanced and emerging economies financial regulation, credit policy and monetary policy were commonly deployed to support economic development goals, steering or encouraging private finance towards priority sectors whilst restricting financing for speculative or other undesirable sectors (including private consumption and real estate) (Wade, 1990; Amsden, 2001; Bezemer et al., 2021; Mikheeva and Ryan-Collins,

2022). Successful industrialisation policies in the 20th century involved a targeted approach to structuring and directing finance which involved intensive policy coordination between central banks, ministries and finance and industrial policy, both in developing and developed countries (Loriaux et al 1997; Amsden 1989; Wade 1990; Weiss and Thurbon 2004; Thurbon 2016; Mikeeheva and Ryan-Collins). Studies of 'catching up' industrialisation in East Asian 'tiger' economies provide accounts of industrial and financial policy coordination (Johnson 1982; Amsden 1989; Amsden and Chu 2003; Wade 1990; Evans 1995), with financial policies typically understood as subordinated to economic planning objectives (Amsden 1989).

Such arrangements were also characteristic of the post-Second World War financial architecture and Bretton Woods institutions. Centralised control over economic policies was exercised by elected officials and fiscal, financial and monetary policy were coordinated to influence aggregate demand towards the achievement of reconstruction, Keynesian full employment and expanded welfare states (Lie 2019). This was also reflected in coordination between key financial agencies. Typically, ministries of finance were the leading agency but, from the 1930s–40s, central banks were also increasingly seen as playing an active role in supporting economic development (Epstein, 2006b; Goodhart, 2011; Vernengo, 2016; Ryan-Collins and Van Lerven, 2018).

Central banks played a key role in the design and execution of credit policies, including both price-based and quantity-based credit guidance policies (Monnet 2018; Bezemer et al 2021), in controlling foreign exchange via capital controls to support the international competitiveness of key national growth sectors (Thurbon, 2001) and in debt management to support expansive fiscal policies (Roubini and Sala-i-Martin, 1992; Reinhart et al., 2011; Ryan-Collins, 2017; Ryan-Collins and Van Lerven, 2018). On the latter, central bank holdings of government debt rose from around 5% of the total to close to 30% during World War II (Ryan-Collins and Van Lerven, 2018, p.9). Central banks continued to hold close to one-fifth of government debt until the late 1960s.

The 1940-1980 period of coordination coincided with the longest period of sustained low levels of government debt-to-GDP in the 20th century and the highest levels of GDP growth (Ryan-Collins and Van Lerven, 2018). In most advanced economies during this period, governments followed Keynesian-demand management policies targeting full employment often accompanied by national industrial policies and capital controls aimed at supporting rapid industrialisation and structural change of the ambitious and scale now widely called for today to support environmental transition (Mikheeva and Ryan-Collins 2022). This 'golden period' of capitalism also saw high levels of capital investment and manageable inflation up until the early 1970s (Epstein and Schor, 1991).

The period of more direct and coordinated financial policies lasted from around the 1930s, when governments started assuming larger roles in economic governance, until the 1970s, when proponents of liberalisation and the so-called Washington Consensus produced several influential publications arguing that 'repressive' financial policies were the cause of poor economic performance (McKinnon, 1973; Shaw, 1973). These argued that the state-directed allocation of capital results in a distortion of the price of capital and hence the sub-optimal allocation of resources (Bezemer et al 2021). These conceptual developments resulted in a shift in how we understand economic and financial governance and to the idea that the market should play a larger role in directing finance whilst fiscal and monetary policy should be conducted independently of each other.

2.2 1980-2007: Macroeconomic policy-sphere separation

Since the 1970s, macroeconomic policy has been viewed as primarily concerned with economic and financial stabilisation rather than industrial or economic development or transformation. In this 'New Consensus Macroeconomics' (NCM) (Arestis and Sawyer 2002), the concept of macroeconomic equilibrium and market-driven price adjustment is central. Long-run equilibrium is reached at the 'natural' rate of interest — the point at which desired savings align with investment demand (Lucas 1972; Kydland and Prescott 1977). Given nominal rigidities and labour market frictions limit this achievement in the short run, the central bank plays a key role in steering the economy towards the natural rate by adjusting the policy rate of interest on central bank reserves. By following an inflation-targeting monetary policy rule, it is theorised that the central bank can fine tune the economy towards potential output, i.e., long-run equilibrium (Blanchard and Galí 2007). Macroeconomic stability is hence seen to be a function of price stability achieved through monetary policy.

By contrast, fiscal policy is downgraded from its Keynesian role of aggregate demand stabilisation and the pursuit of growth that was in place in the 1930s-1970s, to a counter-cyclical tool for managing short-term business cycles (Bernanke 2003). With long-run GDP growth determined through supply side policies, especially labour market reform, fiscal policy is seen to potentially interfere with monetary policy objectives. Financing budget deficits by monetary institutions, rather than by savers, is considered to be potentially inflationary (Sargent and Wallace 1981; Fischer et al. 2002) and to distort the natural rate of interest, by 'crowding out' private actors and impeding the efficient allocation of capital (Fry 1980; Roubini and Sala-I-Martin 1995). Inflationary bias arises due to the 'time inconsistency' problem: governments will be prone to monetary financing of budget deficits and interest rate cuts for short-term political gain, generating inflation and self-fulfilling inflationary expectations (Kydland and Prescott 1977; Barrow and Gordon 1983). Unconstrained competitive financial markets, which are assumed to price capital in line with capital scarcity, permit credit to flow to those able to pay the highest risk-adjusted interest rates and use resources most productively (Alexander et al 1995, 15).

To avoid the dangers of this so-called 'fiscal dominance', the relationship between central banks and governments has been constitutionally and operationally codified since the 1990s to institutionalise the inflation-targeting macroeconomic paradigm (Jácome et al 2012). A 'Holy Trinity' of central banking has emerged, embedding price stability as the *primary goal*, the short-term interest rate as the *operational instrument*, and central bank independence as the *institutional arrangement* (Braun and Downey 2020). Over the course of 1990 to 2008, the 'Holy Trinity' was widely accepted to be the technically optimal approach to monetary policy (Goodfriend 2007). Such a technocratic stance originates from the NCM view that monetary policy only affects nominal, rather than real, variables in the long run (Bernanke et al 1999), hence justifying the a-politicisation of the central bank.

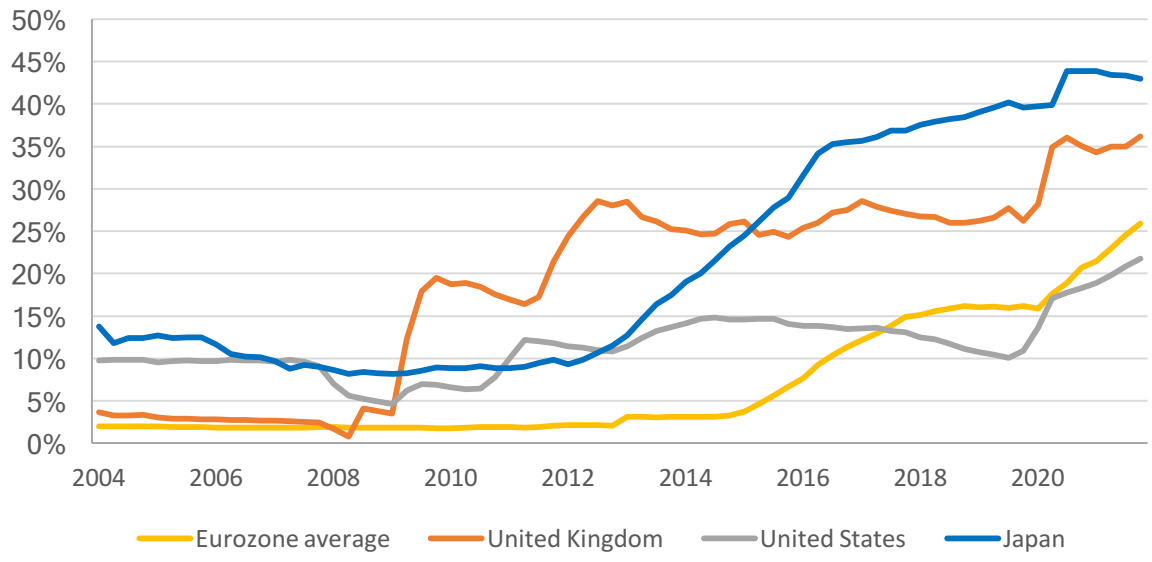
To prevent macroeconomic policies becoming subject to government failure, an externally imposed rules-based framework is therefore preferred, with discretionary interventions undesirable (Blinder 2004). Thus, fiscal policy is constrained by the 'discipline' of budget deficit targets, and central banks are limited by tight mandates oriented towards price stability above and beyond other goals, including industrial policy and economic development objectives. The direct monetary financing of

government spending was prohibited by legislation in most economies in the 1990s and 2000s. Overall, up until the Global Financial Crisis, the fiscal-monetary policy mix had, mostly, been replaced by 'monetary dominance' (Sargent and Wallace 1981) in most advanced economies. There has also been a shift towards granting financial regulators and supervisors greater operational independence from governments for similar reasons (Quintyn and Taylor 2002), a process that gained momentum after the GFC.

2.3 The GFC and Covid-19: A return to policy coordination?

The NCM view on the strict separation of monetary and fiscal policy has come under renewed strain as central banks have expanded their toolkits in the aftermath of the GFC; and more recently in response to the global Covid-19 pandemic which we discuss in depth in section 3. Far beyond a narrow remit of inflation-targeting, many central banks have acted in their capacity as lender of last resort in their provision of liquidity to the global financial system, market maker of last resort in their support of systemically important asset markets and have provided a monetary backstop to sovereign debt in the form of large-scale government bond purchases on secondary markets (Figure 1) (Tooze 2018; Cavallino and De Fiore 2020). The most striking cases are in the UK and Japan, where central bank holdings of sovereign debt have increased from under 10% in 2009 to around 40% by 2022 (Figure 1).

Figure 1: Proportion of total government debt held by domestic central banks in major high-income economies, 2004-202



Source: IMF Sovereign Debt Investor Base for Advanced Economies[3]

At the same time, the aftermath of the GFC saw central banks and supervisors being given much wider and stronger financial stability responsibilities, in particular in addressing systemic (economy-

[3] [April 2020 update] available at https://www.imf.org/~/media/Websites/IMF/imported-datasets/external/pubs/ft/wp/2012/Data/_wp12284.ashx; (original paper: Arslanalp and Tsuda, 2014)

wide) financial risks with the emergence of macroprudential policy as well as a focus on sector-based risk dynamics (Clement, 2010; Baker, 2013). Whilst previously financial supervision had focused on microprudential policy — that is the risks to individual financial institutions —, the GFC led to a greater focus on systemic risks and macroprudential policy, as defined by the Nov.2010 Basel 3 rules (Kranke and Yarrow, 2019).

Some scholars and senior policy makers have made the case for more explicit forms of monetary-fiscal coordination as an appropriate but temporary response to conditions of very low interest rates or liquidity trap-conditions and high levels of private and public debt (McCulley and Poszar, 2013; Turner, 2016; Blanchard and Pisani-Ferry, 2020; Elga Bartsch et al., 2020). Bartsch et al. (2020) discuss how monetary and fiscal coordination can create policy space for each other: monetary policy, by lowering borrowing costs and providing a monetary backstop to prevent destabilising dynamics in the market for sovereign debt; and fiscal policy, by providing a fiscal backstop to losses incurred on monetary policy portfolios, thus allowing monetary policy to take appropriate risks. In this context, temporary monetary financing may be appropriate to an inflation-targeting framework, by helping the central bank to regain policy space in order to resume conventional interventions. Proponents of this view have stressed that political interference and loss of monetary policy credibility are key risks to consider; coordinated policy may only be suitable for economies with well-established and highly credible monetary institutions. The most prominent proposals have advocated for such policies to be time-limited, with strong institutional guardrails, and a clear exit strategy (Yashiv, 2020; Blanchard and Pisani-Ferry, 2020; Elga Bartsch et al., 2020)

In contrast, a number of calls have been made to use central banks 'unconventional' policy tools, quantitative easing (QE) in particular, to support the green transition, given the fiscal constraints facing governments (Murphy and Hines, 2010; Dafermos et al., 2018; Ferrari and Nispi Landi, 2020). These propositions contributed to a revival of the debate around the roles and mandates of central banks. There has been a recognition by some leading central banks in high income economies (in particular the ECB) of the need to shift from a pure short-term financial risk concern, illustrated by stance of market neutrality, towards a broader appreciation of assets' impacts and risk/performance in terms of their longer impact on a green transition (ECB, 2022b).

Over the last few years, many official agencies have analysed the aforementioned forms of fiscal-monetary policy coordination and considered how such coordination can be improved in the future, both between monetary and macroprudential policies (European Parliament, 2020; Banque de France, 2021), and between fiscal and monetary policies (European Parliament, 2020). However, the focus has been mainly on how such coordination can be achieved without threatening existing mandates and central bank independence rather than how coordination can be deployed in practice in pursuit of broader societal objectives, beyond Covid-19. Could the unprecedented level of coordination that occurred during the pandemic also be turned towards broader, longer-term risks, in particular environmental risks (including cliamte change), of which Covid-19 was clearly an example and of which governments were already struggling to deal with before Covid-19? To answer this question, we first analyse the key examples of Covid-19 fiscal-monetary coordination and then consider their wider application.

3. Analysis of Covid-19 responses

In our analysis of Covid-19 policy responses, we explore instances of policy coordination where monetary and credit policy toolkits were used to support broader government pandemic responses.

This policy coordination spans two dimensions that we consider having moved substantially beyond the traditional, consensus understanding of the role of central banks as macroeconomic policymakers. First, the use of monetary policy tools to facilitate fiscal space — a development which, even if implicit or outright denied at the time, can be understood as a temporary move beyond monetary dominance in a period of crisis when central bankers in many jurisdictions found their traditional policy space trapped at an effective lower bound. Second, the use of monetary policy tools to incentivise or direct flows of credit to targeted non-financial sectors — a development that has challenged the aforementioned operating principle of 'market neutrality' when intervening directly in private credit creation. We focus in particular on central bank asset purchases, lending operations, reserve policy, and interest rate changes, and analyse howdiver these policy changes were deployed in ways that went beyond the traditional consensus understanding of the role of monetary policy.

We use the BIS' *'Global database on central banks' monetary responses to Covid-19'* (Cantú et al., 2021) as our primary source of information, supplemented by insights from the IMF policy tracker *'Policy Response to Covid-19'* (IMF, 2021). The BIS database covers the monetary policy announcements of 40 central banks spanning advanced economies and emerging economies spanning Asia, Latin America, and Europe Middle East and Africa (EMEA).[4] It covers a period from February 2020, the start of the pandemic, to December 2021. The IMF policy tracker summarises the Covid-19 economic responses taken by of 197 countries, grouped into three categories 'Monetary and macro-financial', 'Fiscal' and 'Exchange rate and balance of payments'.[5] It covers the period from the start of the pandemic to July 2, 2021 (last update of the tracker). Both are based on publicly available information or provided by public bodies to IMF country teams.

3.1 Monetary policy responses and the facilitation of fiscal space

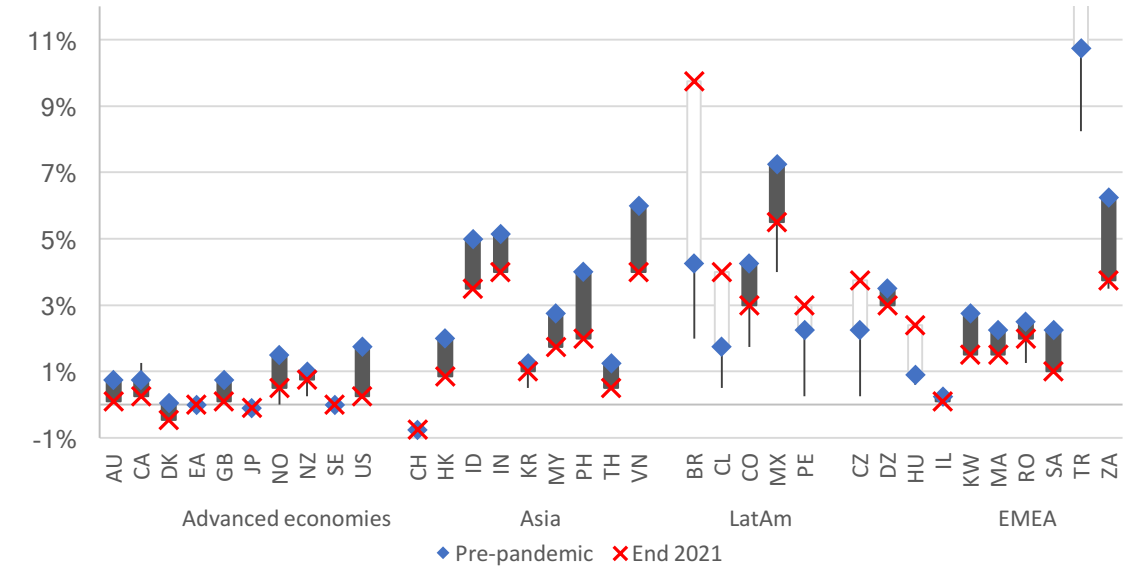
As virus-containment 'lockdown' measures triggered shocks to both supply and demand at the global level, governments around the world delivered unprecedented fiscal packages to resolve the public health crisis and mitigate historically large recessions (IMF, 2020a). On average fiscal deficits rose by 9% of GDP over the course of 2020, whilst global public debt to GDP ratios reached record levels at 100% (IMF, 2020b). Central banks across varied geographies reacted swiftly to lower interest rates and expanded — or in some areas introduced — sovereign asset purchases from March 2020 onwards. Figure 2 depicts the net change in interest rates with higher

[4] Advanced economies: Australia (AU), Canada (CA), Switzerland (CH), Denmark (DK), Euro Area (EA), United Kingdom (GB), Japan (JP), Norway (NO), New Zealand (NZ), Sweden (SE), and the USA (US). Asia group: China (CN), Hong Kong SAR (HK), Indonesia (ID), India (IN), Korea (KR), Malaysia (MY), the Philippines (PH), Singapore (SG), Thailand (TH), and Vietnam (VN). Latin America group: Argentina (AR), Brazil (BR), Chile (CL), Colombia (CO), Mexico (MX), Peru (PE). EMEA group: United Arab Emirates (AE), Czech Republic (CZ), Algeria (DZ), Hungary (HU), Israel (IL), Kuwait (KW), Morocco (MA), Poland (PL), Romania (RO), Russia (RU), Saudi Arabia (SA), Turkey (TR), South Africa (ZA).

[5] We do not consider foreign exchange interventions in the present study.

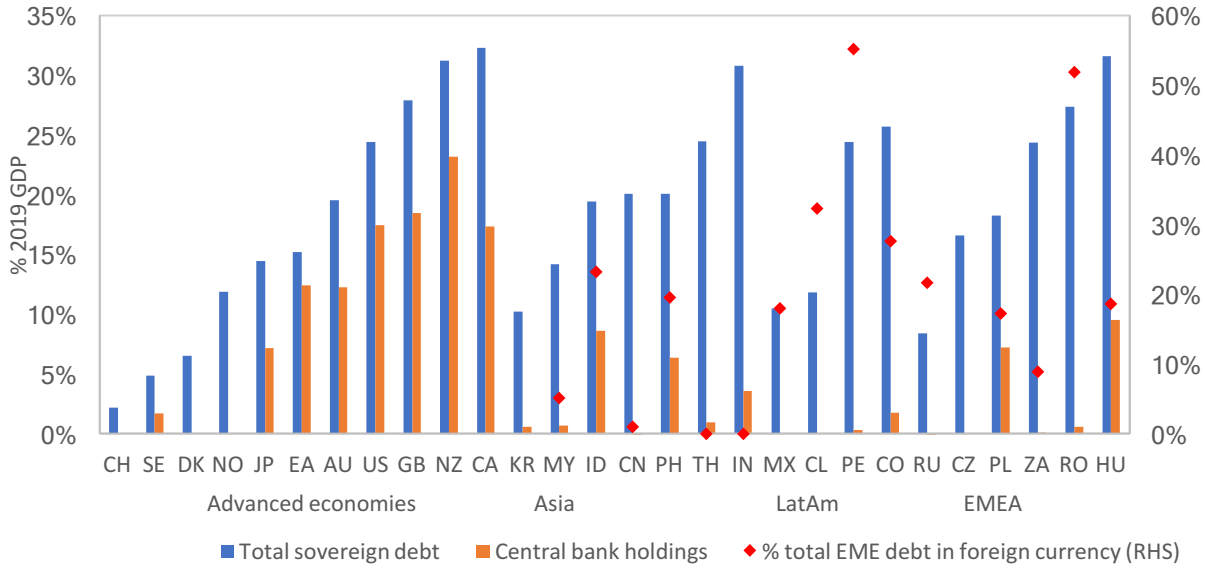
and lower bounds, whilst Figure 3 charts the increase in sovereign debt issuance and central bank sovereign asset holdings, as a percentage of 2019 GDP — both over the course of the pandemic. Figure 4 shows asset purchases facilities for both public and private securities by announced size.

Figure 2. Change in policy rates, pre-pandemic to end-2021[6]



Source: BIS data, authors' own analysis

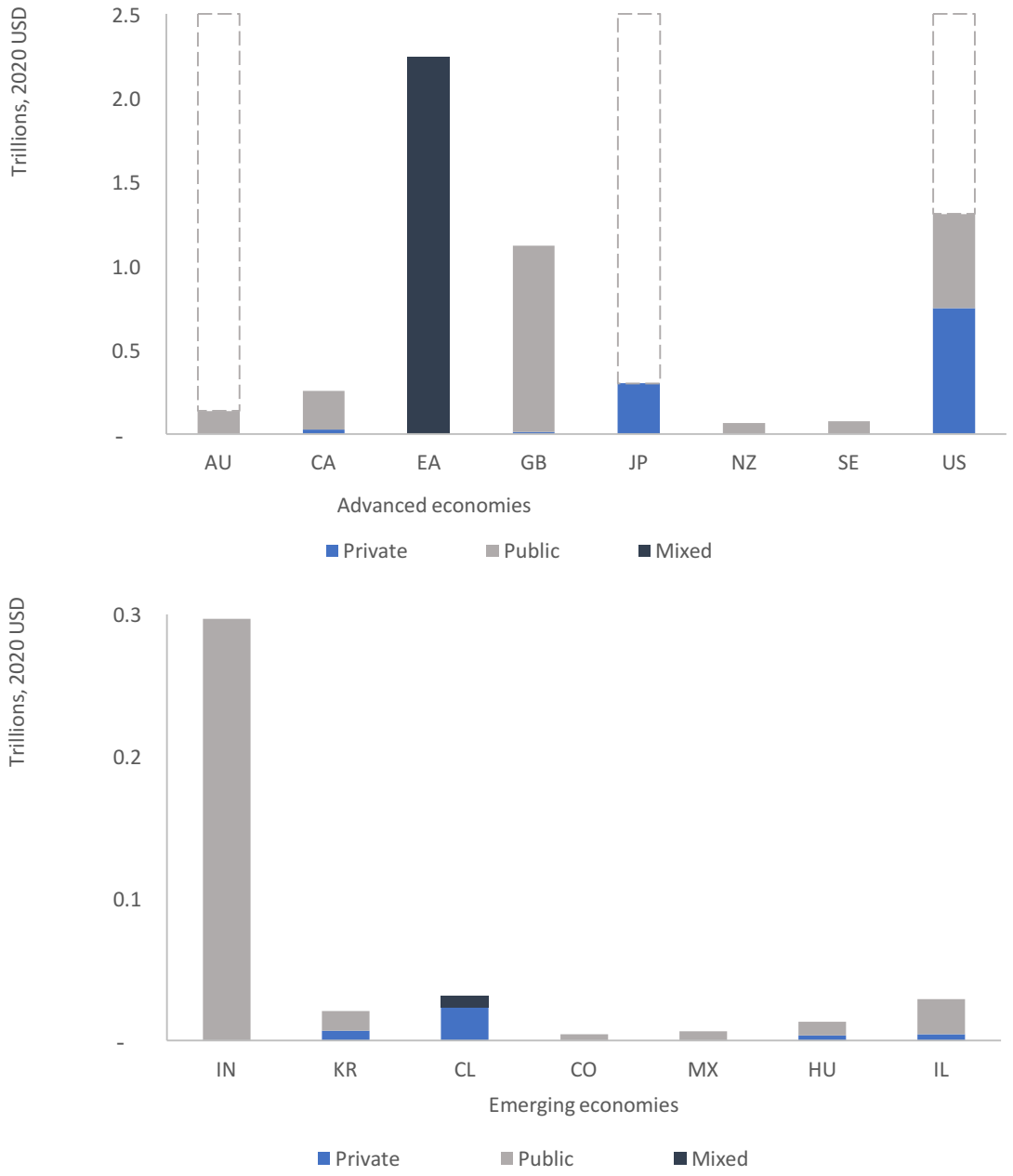
Figure 3. Percentage increase in sovereign debt and central bank holdings, Q4 2019 to Q4 2021 and % share of foreign currency denominated debt for emerging market economies at end Q4 2021 (RHS)



Source: IMF Sovereign Debt Investor Base database, IFS statistics, authors' own analysis

[6] Note – Chart excludes Argentina (policy rate ended 2021 at 40%). Turkey's policy rate reached a high of 19% and finished 2021 at 16%.

Figure 4. Announced size of asset purchase facilities[7]



Source: BIS data, own analysis

As noted by numerous economic commentators, it is hard to argue that central bank interventions did not substantially facilitate the creation of new fiscal space under these unprecedented circumstances (E Bartsch et al., 2020; Stubbington and Giles, 2021). Lower policy rates ensured that public borrowing costs declined across most economies and were pushed lower by the pace and scale of sovereign asset purchases, which far surpassed actions taken during the 2008 financial crisis. These effects were most profound in advanced economies, where the stock of

[7] Australia, Japan, and the USA announced programmes essentially unlimited in size.

negative-yielding debt reached a new record of $17.05 trillion by November 2020 (Stubbington, 2020).

Some central banks have vehemently denied accusations of monetary financing, arguing that large scale asset purchases are intended to be temporary and have been undertaken in pursuit of inflation-targeting objectives and not with the explicit objective of funding governments (Bailey 2020; Carstens 2020; Vlieghe 2020; BIS 2020). Yet the unprecedented scale and pace of asset purchases has closely tracked sovereign bond issuances in many major economies. In the Eurozone, for example, at the height of the turmoil, whilst Eurozone member governments issued new government debt on primary markets in massive quantities, the Eurosystem was simultaneously purchasing bonds of almost the same volume and duration on secondary markets, prompting one European Parliament-commissioned study to state that "… in some sense, monetary financing is effectively carried out already, even though it is not called so officially…" (Fiedler et al., 2020).

Furthermore, some central banks explicitly targeted the yield curve on government debt. For example, in March 2020, the Reserve Bank of Australia committed to purchasing as many government bonds as needed to hold 3-year yields at 0.25%, later revised to 0.1% (RBA, 2020). Whilst the European Central Bank has not explicitly pursued yield curve control, its Pandemic Emergency Purchase Programme (PEPP) had more flexibility than the existing QE programme in how purchases are distributed amongst member states. Its purpose is stated as "*preventing a tightening of financing conditions* that is inconsistent with countering the downward impact of the pandemic on the projected path of inflation" (ECB 2020, emphasis added). Indeed, sovereign debt spreads in the Eurozone remained low and stable following an initial sharp spike in March 2020, leading some to speculate that the ECB was covertly but actively seeking to manage euro-area borrowing costs (Bloomberg 2021).

Sovereign asset purchases also moved beyond 'market neutrality'. The ECB abandoned its market neutral 'capital key'[8] when distributing purchases among member states, instead aiming to prevent 'a tightening of financing conditions'. These interventions are significant in that they herald the use of asset purchases to actively manage sovereign borrowing costs, even if not explicitly acknowledged as such (Randow and Neumann, 2021).

An interesting observation from the data (Figure 3) is that it was advanced economies who were most involved in this 'covert' monetary financing, despite their primary mandates largely being more strictly and narrowly defined in terms of price stability. Meanwhile, emerging economy asset purchases made up a significantly smaller proportion of GDP and thus created less fiscal space, despite their more recent developmental role in supporting broader government policy (Loriaux et al., 1997; Epstein, 2006a; Mikheeva and Ryan-Collins, 2022). This can be partially explained by the fact that some EMEs have large proportions of their sovereign debt denominated in foreign currencies such as the dollar or euro (see Fig. 3, RHS). Aside from being unable to print foreign currencies to purchase this sovereign debt, many EME central banks also had to use more of their

[8] Distributes asset purchases of sovereign bonds based on a member states' respective share of total population and gross domestic product.

policy space to take prudential action to protect domestic currencies from capital outflows, including through the provision of FX swap lines and repo facilities (Cantù et al., 2021).

Having said this, it is notable that EME central banks were able to decisively cut rates and introduce asset purchases even in the face of sudden currency depreciations and heightened capital outflows. It has been argued that coordinated fiscal-monetary policy responses in EMEs during the pandemic turmoil were in a large part enabled by the rapid and massive quantitative easing by major advanced economy central banks, in particular the US Federal Reserve, as these interventions limited US dollar appreciation and dampened potential global financial market disruptions (Aguilar and Cantù, 2020).

This perspective suggests that the sovereign ability of economies to facilitate substantial fiscal space through fiscal-monetary coordination during the pandemic remained the privilege of advanced economies. EMEs — subject to structurally subordinated local currencies and external vulnerabilities — largely remained 'takers' of global liquidity conditions rather than 'makers' of monetary policy decisions based on domestic contexts (Prates, 2020; Alami et al., 2021). The Fed's decision to drastically raise interest rates in the face of rising inflation in the U.S. is leading to a reversal of these dynamics and the danger of capital flight and currency depreciation from EMEs, reducing their capacity to meet the same global inflationary pressures and making them less resilient to future environmental shocks.

3.2 Targeted liquidity provision and credit steering to non-financial or strategic sectors

Across advanced and emerging economies, central banks used their balance sheets to provide liquidity support and encourage continued credit provision to the real economy. The majority of lending operations (60%) were non-targeted in nature and aimed at expanding system-wide liquidity to maintain smooth financial market functioning. As well as lowering interest rates on lending operations, central banks also expanded liquidity of existing facilities by widening eligible collateral and increasing eligible counterparties.

The US Federal Reserve, for example, provided lending programmes that were more targeted towards specific financial asset classes, such as money market mutual funds and investment grade debt. By contrast, the ECB, Bank of Japan and Bank of England established large programmes targeted more narrowly towards incentivising loan extensions to small and medium-sized enterprises (SMEs), as indeed did most economies (Table 1). Some of this targeting took place through the creation of refinancing facilities for state investment banks. For example, the Reserve Bank of India established operations to support the lending of the Small Industries Development Bank of India (SIDBI), amongst other public financial institutions.

In other jurisdictions, central bank facilities were established in explicit partnership with fiscal programmes. In the USA, most notably, the Main Street Lending Program and Paycheck Protection Program Liquidity Facility received large capital injections from the US Treasury, effectively establishing the fiscal and monetary authorities in a risk-sharing partnership — an instance of explicit fiscal-monetary coordination. The Central Bank of Brazil had a similar arrangement in

place, where 85% of its emergency funding line designed to support firms paying wages, was backed by the Ministry of Finance, with banks assuming the remaining risk on loans.

Selected EMEs also used reserve policy to incentivise lending to SMEs, either by adjusting compliance criteria (i.e., making SME loans count as part of banks' adherence to reserve requirements, as occurred in Brazil) or by cutting required reserve ratios for specialist lenders to SMEs, as in China.

Table 1. Use of lending operations and reserve policy to target specific sectors

Country	Lending operations				Reserve policy	
	To private sector			To public sector	Private sector	
	SMEs	Strategic priority	Fiscal backing		SMEs	Strategic
Argentina	✓	✓			✓	
Brazil	✓		✓		✓	
China	✓				✓	
Hungary	✓					
India	✓	✓		✓		✓
Indonesia		✓				
Israel	✓					
Japan	✓					
Malaysia	✓	✓				
Mexico	✓					
Philippines				✓	✓	
Russia	✓					
Saudi Arabia	✓					
Singapore	✓		✓			
South Africa	✓		✓			
South Korea	✓					
Thailand	✓					
Turkey		✓				
United Kingdom	✓			✓		
USA	✓		✓			

Source: BIS data, compiled by the authors

Table 2. Strategic priority sectors targeted by lending operations and reserve policy

Country	Name of policy tool	Target sectors
Argentina	New Credit Line for MSMEs' Productive Investment and Special Treatment for Key Provincial Sectors	Agriculture, hospitality, culture and leisure
India	Special refinance facilities to specialist SIBs: NABARD, SIDBI, NHB	Agriculture, SMEs, housing
	Credit line extension to Exim Bank to enable access to USD swap lines	Exporters and importers
	On Tap Targeted Liquidity Facilities	Emergency Health, Contact-Intensive Sectors
Indonesia	Lower reserve requirements for banks financing priority sectors	Export-import sectors, hospitality, automotives, textiles, electronics, wood/paper
Malaysia	Financing facility for High Tech SMEs operating in National Investment Aspirations (NIAs) sectors	Advanced manufacturing & services sectors (e.g., aerospace), R&D in priority sectors
Turkey	Advance Loans against Investment Commitments to priority sectors	Various selected primary production, manufacturing, and advanced technology

Source: BIS data, compiled by the authors

Table 3. Private sector security asset purchase programmes

Country	Corporate	Covered/ABS	Equities	Other
Canada	✓	✓	·	✓
Chile	·	✓	·	✓
Colombia	·	✓	·	·
Eurozone	✓	✓	·	·
United Kingdom	✓	·	·	·
Hungary	✓	✓	·	·
Israel	✓	·	·	·
Japan	✓	·	✓	·
Korea	✓	·	·	·
Thailand	✓	·	·	·
USA	✓	·	·	·

Source: BIS data, compiled by the authors

A subset of EMEs used lending operations and reserve policy to incentivise targeted lending towards national strategic priority sectors, including export and import sectors, agriculture, healthcare, manufacturing, and R&D (Table 2). For example, the Bank of Negara Malaysia established its RM1 billion financing facility for high tech SMEs with the explicit aim "to strengthen Malaysia's competitive positioning in the global value chains, preserve the supply chain ecosystem

and safeguard high-skilled jobs" (BNM, 2021). The Central Bank of the Republic of Turkey's targeted rediscount credit facility aimed to "(i) support highly efficient investments that will reduce imports and boost exports, (ii) lower external dependency as well as reducing the current account deficit problem and (iii) support sustainable growth" (CBRT, 2020). Meanwhile, Argentina's central bank — albeit acting under extreme inflationary circumstances — accompanied its productive investment-targeted credit line with the stipulation that "leading banks must lend out 7.5% of their stock of private deposits' to the designated priority sectors" (BCRA, 2021). This policy effectively amounts to a form of coercive credit guidance.

The explicit sector targeting undertaken by these EME central banks can be contrasted with instances of fiscal-monetary coordination by major central banks, that retained a more market neutral stance. For example, the Bank of England's Covid Corporate Financing Facility, established jointly with the Treasury, purchased any commercial paper that fell within its maturity and investment grade eligibility criteria — leading to criticism that the scheme's blanket inclusion of corporates without conditionalities to prevent shareholder pay-outs, worker layoffs, and environmental damages was in direct contradiction of the UK government's 'build back better' pledge (Barmes et al., 2020). In other cases, environmental conditionalities were enforced in return for government financing, for example of the airline industry in France, Austria and Germany which all implemented policies to discourage short-haul flights which could be taken via trains (Bates, 2021).

Instead of targeting strategic sectors, many central banks aimed to support private sector financing conditions more broadly through corporate asset purchase programmes (Table 3). The US Federal Reserve, purchasing private sector debt for the first time, extended its criteria to include recently downgraded junk bonds, municipalities, and exchange-traded funds (ETFs). The Bank of Japan also created a new facility targeting specifically ETFs and Real Estate Investment Trusts (REITS). The ECB announced a flexible purchasing strategy for its Pandemic Emergency Purchase Programme (PEPP) with the aim of maintaining favourable financing conditions across asset classes. By targeting financial asset classes, rather than sectoral financing conditions, it has been argued that these central banks were using their balance sheets in the capacity of 'investor of last resort' (Torres, 2020).

It might be tempting to ascribe these different approaches to supporting the private sector to differing mandates between these groups of central banks. EME central banks, after all, including those featured in Table 2, have maintained a more developmental role into recent times (Amsden, 2001; Epstein, 2006a). Yet a systematic study of central bank mandates has shown that 40% have explicit remits to support government policy priorities — including in the USA, Eurozone, and UK (Dikau and Volz, 2021).

Another interpretation points to the increased importance of smoothly functioning asset markets for broader macroeconomic stability in advanced economies with collateral-intensive financial systems as the explanation of these interventions (Gabor, 2016; Dafermos, Gabor and Michell, 2021). Regardless of this, the presence of large-scale targeted lending operations across a variety of advanced and emerging economies, most of which provided extensive support to SMEs, shows that the principle of coordinating fiscal and monetary policy to target specific sectors is possible under present mandates. The selection of sectors remains a policy choice.

4. From policy coordination during Covid-19 to tackling environmental crises

4.1 Identifying a policy inconsistency

Many of the tools presented in the previous section have been proposed by academics and campaigners calling for central banks to support governments in accelerating the green transition (Campiglio et al., 2018; D'Orazio and Popoyan, 2019; Jourdan and Kalinowski, 2019; Dafermos, Gabor, Nikolaidi, et al., 2021). For instance, liquidity provision and refinancing operations could be designed to target priority green sectors, just as these tools were widely used to support SMEs during the pandemic (van 't Klooster and Van Tilburg, 2020; Colesanti Senni, 2021). Similarly, quantitative easing programmes could be 'greened' by tilting purchase criteria towards green sectors and away from transition-incompatible sectors (Dafermos et al., 2020; Dafermos et al., 2022); QE programmes could also facilitate the creation of fiscal space for green investment through the purchase of green bonds issued by governments or public agencies (Van Tilburg and Simic, 2020). It has also been proposed that collateral frameworks, prudential, and macroprudential policies can be adjusted to account for climate-related risks (Schoenmaker and Van Tilburg, 2016; Oustry et al., 2020; Philipponnat et al., 2020; Miller and Dikau, 2022).

Many of these proposals are designed to function within existing central bank mandates, and hence are predominantly justified by a 'prudential' logic that prioritises financial stability concerns (e.g., Oustry et al., 2020). However, it has also been argued that a timely Net Zero transition is the secenario that will best enable supervisors to deliver on their financial stability mandates (Robins et al., 2021). This is because the effectiveness of prudential policy in mitigating climate risks will become progressively more impaired the further away from 1.5 degree pathways that climate mitigation progress strays (Chenet et al., 2021). To even achieve the primary goals of safeguarding price and financial stability, therefore, implies a need for more coordination with broader government Net Zero policy (Barkawi and Zadek, 2021; Svartzman, Bolton, et al., 2021). This may require a shift from 'prudential' to 'promotional' green central banking strategies that are more explicitly aligned with industrial and wider societal policy goals to ensure democratic legitimacy (Baer et al., 2021; Kedward et al., 2022b)

For the most part, however, and despite the examples illustrated in Section 3, central banks have not embraced the rational for policy coordination for the green transition. As the pandemic came to end and the Ukraine war commenced, central banks turned their attention to rising inflation. The response has been rapid increases in interest rates and Quantitative Tightening (QT) programs. Given the higher cost of capital for renewable energy firms which have higher up-front investment costs, such policies discriminate against such firms and the wider energy transition (Tilburg, 2022; Kedward, 2022) and favours larger encumbent fossil-fuel incumbent firms.

We therefore identify a tension between central banks' swift readiness to accept the need for extensive fiscal-monetary coordination to deal with the macroeconomic fallout of the pandemic (i.e. immediate and ongoing disorder) and their reticence in acknowledging a similar need for policy coordination to pre-emptively address the financial and macroeconomic risks posed by climate change and other environmental risks, such as biodiversity loss. For the remainder of this section,

we explore the similarities and differences between the Covid-19 pandemic, climate change and biodiversity loss ('environmental breakdown') and critically reflect upon the extent to which these diverging policy stances are warranted.

4.2 Comparing Covid-19 and broader environmental threats

At first glance, the Covid-19 pandemic and environmental threats such as climate change and biodiversity loss appear to be characteristically distinct phenomena in terms of their materialised or expected macroeconomic and financial consequences; most notably, in terms of time scale and financial materiality (Table 4). The pandemic materialised suddenly as a public health and socioeconomic disruption, and its consequences on financial markets were immediately apparent. Government lockdowns caused simultaneous supply and demand shocks that triggered widespread negative reactions in financial markets, including a collapse in market liquidity, adverse asset repricing and surges in government bond yields and spreads. Such instant evidence of 'financial materiality' proved ample justification for swift and extensive interventions by central banks, beyond conventional designations of institutional scope and purposes — as discussed in Section 3.

Table 4. Comparison of the challenges posed by the pandemic, climate change, and biodiversity loss

<table>
<tr><th></th><th>COVID-19</th><th>CLIMATE CHANGE</th><th>BIODIVERSITY LOSS</th></tr>
<tr><td>TIME SCALES</td><td>Immediate threat. Expectation of reversion to equilibrium over the near term.</td><td>Latent threat. Multi-decadal shifts towards unknown states, with potential tipping points. Irreversibilities.</td><td>Latent threats but with potential for sudden, near-term tipping dynamics towards unknown states. Irreversibilities.</td></tr>
<tr><td>PRECEDENT</td><td>Historical precedent, but not recently at global scale.</td><td colspan="2">Unprecedented within human history.</td></tr>
<tr><td>SPATIAL SCALES</td><td colspan="3">Global phenomena with locally specific causes and manifestations</td></tr>
<tr><td>PROBABILITY OF OCCURRENCE OF ADVERSE SCENARIOS</td><td>High and increasing probability of another pandemic like Covid-19</td><td>Irreversible impacts already occurring and locked in; IPCC assess as 'likely' that emissions will exceed 1.5°C under current NDCs.[9]</td><td>Negative impacts occurring already in some locations.
Further grave impacts on people from accelerating nature loss now 'likely'.[10]</td></tr>
<tr><td>SEVERITY OF ECONOMIC IMPACTS</td><td colspan="3">Very high under the worst scenarios, high potential for systemic (cascading) consequences. Estimation of loss subject to radical uncertainty.</td></tr>
</table>

[9] (IPCC, 2022a; IPCC, 2022b)

[10] (Lenton, 2013; IPBES, 2019)

EVIDENCE OF FINANCIAL MATERIALITY	Immediate and severe impacts on market liquidity, sovereign bond yields/spreads, and asset prices.	Emerging evidence of CRFR exposures from forward-looking scenario analysis. No clear evidence of green/dirty asset risk differentials. But no doubt from CBs and supervisors that it shall become material.	Nascent awareness of potential materiality, risk methodologies under development. But no doubt from CBs and supervisors that it shall become material.
AWARENESS OF / PREPARATION FOR POTENTIAL THREAT BY FINANCIAL INSTITUTIONS AND AUTHORITIES	None.	Increasing awareness; significantpreventative interventions obstructed by high uncertainty of risk assessment results.	Nascent awareness among selected financial institutions and central banks. No action thus far.

Source: Authors.

By contrast, the various crises associated with environmental breakdown are characterised by their latency: threats for which current multi-decadal trajectories towards extremely severe impacts are well-established but for which the macrofinancial materiality to spur mitigating action lies beyond current political and business horizons. Aside from examples of transition-related repricing effects in isolated sectors (for example, coal power in Europe), financial materiality related to climate-related physical or transition risks has not yet become significant at a systemic level (NGFS, 2022).[11] Awareness of biodiversity-related financial risks is even more nascent, and its materiality far less evident in market pricing (Dasgupta, 2021; Kedward et al, 2022b; NGFS and INSPIRE, 2022).

However, notwithstanding the obvious difference that one pandemic crisis has already materialised whilst other environmental threats are continuing to unfold, there are more similarities in these threats to macroeconomic and financial stability than is currently acknowledged by policymakers.

The Covid-19 pandemic was ultimately a global phenomenon with localised effects, with cascading systemic consequences resulting from globalised interconnections of people, goods, energy, and nature (Kedward et al., 2020). The macroeconomic consequences of climate change and biodiversity loss impacts are also likely to be amplified by such globalised interconnections (Goldin, 2014), as well as interacting and reinforcing global biophysical perturbations. Recent evidence suggests such “complex, compounding environment-economic-social risks” (Ranger et al., 2021, p.1376) are becoming more frequent but are not included in fiscal or macro-financial risk management frameworks (ibid., Moretti et al., 2021; Schonauer et al., 2021). One recent study estimated that the amplification effect of these types of events can peak at over 150%, i.e. the GDP impacts of the compound shock can be 50% larger than the sum of the individual shocks (Ranger et al., 2021). Moreover, the fact that multiple tipping points and irreversible phenomena are at stake when it comes to climate change or biodiversity collapse suggests there is a case for considering these as more serious threats than the Covid-19 crisis.

[11] NB: the war in Ukraine triggered huge shocks on energy markets that are deemed similar to some extent with the type of abrupt technology or policy shocks that can be expected with a late and sudden environmental transition.

Another characteristic common to these three challenges is the fact that nation-based policy actions may have limited ability to address causes and consequences of such disasters beyond their national borders.

Further important parallels pertain to precedence, probability and severity of occurrence, and preparedness (Table 4). Current environmental crises and their potential future impacts are widely acknowledged to be unprecedented within human history; whilst global pandemics have occurred with frequency over recorded history, the particular social and macroeconomic challenges posed by Covid-19 were arguably unprecedented within the history of modern, globalised capitalism. The future occurrence of another pandemic like Covid-19 is estimated to be high (38% likelihood over a lifetime) and increasing (the likelihood may double over the coming decades) (Marani et al., 2021).

Similarly, the IPCC sees the chances of adverse consequences of transgressing 1.5°C of warming as 'likely', under the trajectories implied by current Nationally Determined Contributions (NDCs); whilst the IPBES has also judged that adverse impacts from accelerating nature loss to be 'likely' (IPBES, 2019; IPCC, 2022b). For both climate change and biodiversity loss, a number of irreversible physical impacts are already locked in, contributing to high chances of future threats to macroeconomic and financial stability (IPCC, 2018; IPBES, 2019).

Importantly, despite the scientific community reaching a consensus on the likelihood of occurrences, a common problem to all three types of threat is the fact that the timing, magnitude, and distribution of impacts is impossible to probabilistically estimate in a meaningful sense. Assessing macroeconomic and financial-related risks is even more subject to 'radical uncertainty', given the complex interconnections between biophysical systems and human reactions, and the high potential for systemic, cascading consequences (Bolton et al., 2020; Kedward et al., 2020; Chenet et al., 2021).

This might explain why, despite scientific consensus on the likelihood of a major pandemic occurring this century, financial policymakers — as well as governments more broadly — remained overall woefully underprepared to deal with the macroeconomic consequences of Covid-19. It took until the disorder had occurred, and financial materiality became swiftly apparent, for policy action to be taken. The under-preparedness of governments and firms for the event of a global pandemic has been widely accepted as a contributing factor to the severity of the resulting social and macroeconomic consequences (Moretti et al., 2021).

Similarly, whilst awareness of the potential macro-financial consequences of climate change and biodiversity loss is rapidly advanced among the central banking community (e.g., (Bailey, 2020; Van Toor et al., 2020; Schnabel, 2020; Svartzman, Espagne, et al., 2021; Brainard, 2021; Elderson, 2021), the policy tools of central banks and financial supervisors have yet to be deployed to address the well-identified *causes* of environmental change, as they intersect with the financial system. This is in a large part due to concerns over stretching institutional mandates (Breeden, 2022), a narrative which persists among central bankers despite the fact that many central banks have explicit or implicit mandates empowering them to support government policy on sustainability.

Moreover, research by the central banking community on the case for environmental financial policies has also made repeated calls for more evidence on the materialisation of environmental risks as a prerequisite to further intervention (NGFS, 2022; NGFS and INSPIRE, 2022; Woods,

2022). This call for more evidence would appear to be in tension with Mark Carney's (2015) seminal speech on the 'tragedy of the horizon': *"Once climate change becomes a defining issue for financial stability, it may already be too late"*. This position also stands in contrast to the use of massive Quantitative Easing and other liquidity programs outlined in section 3 undertaken during the Covid-19 pandemic (and indeed during the Great Financial Crisis) which were not based on any kind of detailing modelling of but rather by a "trial and error" or "learning-by-doing" approaches where outcomes were subject to uncertainty but precautionary action was taken to prevent more catastrophic damages (Kalinowski and Chenet, 2021; Chenet et al., 2021)

A more precautionary policy stance rejects a view of climate change and biodiversity as exogeneous risks that can be subject to probabilistic measurement and then addressed with a carefully calibrated interventions. Rather they are viewed as endogenous risks that are being driven in part by the current policy stance and incentive structure of the financial system and non-financial firms (IPCC 2022b).

Overall, there is less separating the challenges posed by Covid-19 and broader environmental threats than is currently perceived. The same urgency underpinning Covid-19 interventions should also be deployed for environmental breakdown — albeit under a precautionary and resilience-based rather than reactionary logic. In the face of substantial radical uncertainty and irreversibility of approaching environmental threats and environmental tipping points (Lenton, 2013), policy coordination to pre-emptively prevent environmental breakdown occurring is warranted as the most prudent means of safeguarding price and financial stability under current mandates.

4.3 The threat of inflation and shifting to a precautionary, coordinated macroeconomic policy approach.

Sadly, the evidence so far suggests the high inflation caused by the supply shocks of Covid-19 and the Russia-Ukraine war — once again unforeseen by central banks — is having the opposite effect on macroeconomic and financial policy. Monetary policy makers are ramping up interest rates despite the disproportionately damaging effects such a policy has on green investment and innovation given these sectors' higher cost of capital (Voldsgaard et al., 2022) and even as the US and EU undertakes massive fiscal expenditures to support green transition (in the form of the Inflation Reduction Act and the European Green Deal and Recovery Plan). Meanwhile, commitments to phase out fossil fuels in high-income economies have come under considerable pressure as prices shoot up due to self-imposed embargos on Russian gas and oil, as was seen at the COP27 inn Sharm El Sheikh.

Here, again, a longer-term, precautionary approach may be needed given that progress towards green transition goals is the best indicator of future macroeconomic and financial stability. The ECB's recent decision to deepen the green tilting of its corporate bond purchase programme even as at unwinds its Quantitative Easing program, is a welcome development in this regard (Webb, 2023). However, central banks could also consider a dual interest rate policy to ensure that rate hikes do not inadvertently derail the green transition by offering a preferential discount rate for green lending (Jourdan and van Tilberg, 2022). Such dual interest rates have already been in use in the Eurozone for some time (Lonergan, 2020).

Ministries of finance could also go further to support the green transition. Governments could levy higher windfall taxes to prevent price-gouging and regulate essential prices such as energy bills or provide a minimum quantity of free energy for every household until prices normalise, just as they provided furlough during the pandemic. This may lead to a temporary rise in public deficits, but this should be offset by the growth it should support from maintaining consumption levels.

High-income economy macroeconomic policymakers also need to be cognisant of the impact of raising interest rates on the fiscal space of emerging and developing economies, which, as discussed in Section 3, are vulnerable to shifts in exchange rates and capital flight. Global interventions such as the development of green SDRs (UNDP, 2021) or support for green sovereign debt instruments and restructuring should be pursued (Zadek, 2020). In tandem, emerging economy central banks could reconsider the case for capital controls to preserve their capacities to implement domestic monetary policy protected from the vagaries of global financial market fluctuations. Such capital controls could also potentially be differentiated to encourage inwards green investment and discourage environmentally-harmful capital inflows (Moro, 2021).

More broadly, central banks and finance ministries need to be giving greater attention to the allocation of credit into the economy and the extent to which it is supporting or undermining a green transition (Kedward et al., 2022b). Credit guidance tools were commonly used in the post-war period, as discussed in Section 2, and were also utilised on a temporary basis to support economies during Covid-19. This may require an implicit abandonment of market neutrality but it should be understood as an alignment with internationally agreed policy goals and treaties (Zamarioli et al., 2021), re-inforcing central banks' commitment to public purpose and justifying their ongoing operational independence (Smale and Zadek, 2020; Barkawi and Zadek, 2021; Robins et al., 2021). The recent recognition by the ECB (Schnabel, 2021; ECB, 2022a) of the need to go beyond market neutrality to consider climate change is an encourage development. Other central banks should follow suit, with full encouragement and support from governments.

5. Conclusion

Macroeconomic policy makers were ill-prepared for the catastrophic impacts of the Covid-19 outbreak. Despite this, central banks coordinated extensively with other government policymakers in an "emergency reaction mode" to address the macroeconomic fallout and financial instability caused by the pandemic and resulting freezing of economic activity. In some instances, such as in the provision of liquidity or credit to targeted parts of the economy, such fiscal-monetary coordination was explicit. In other areas, such as in the *de facto* monetisation of large portions of government debt, it was more implicit, but its beneficial effects in terms of creating fiscal space are clear. A key takeaway is that this fiscal-monetary coordination was enacted swiftly and comprehensively without the need for fundamental reform of current institutional mandates.

The pandemic has some key differences with the longer-term threats of climate change and biodiversity loss. Most obviously the financial and macroeconomic materiality of the global lockdowns that it engendered were clear and immediately present. This no doubt lowered the political barriers to interventions by central banks, giving them a license to intervene and coordinate with wider government objectives to stabilize economies on a scale not seen since wartime. Three years later, though, there has been something of retrenching to a stricter interpretation of their mandates, undoubtedly catalysed by the rapid rises in inflation that have followed the Ukraine-Russian war. This could particularly impact on calls for monetary policy to create fiscal space for the type of large-scale public investment needed to support a green transition as central banks will be more likely to sell off government debt to support monetary tightening than the opposite, just as they did in the 1970s.

Whilst demand-side inflationary dynamics do need to be dealt with, policy coordination could be a key tool to ensure such interventions do not derail a green transition. Strategic forms of taxation – i.e. on dirty forms of energy - and more targeted interventions in credit markets of the type seen during the Covid-19 pandemic could address price pressures whilst still boosting green investment and innovation. The vulnerabilities of emerging market and developing country economies to interest rate adjustments in the Global North also need careful consideration.

The Covid-19 pandemic and resulting global economic crisis demonstrated the vast power of coordinated macroeconomic policy to rescue economies from collapse. Coordination is now required on an equally massive but longer-term scale to prevent the occurrence of further global environmental shocks arising from climate change and biodiversity loss.

References

Aguilar, A. and Cantù, C. 2020. *Monetary policy response in emerging market economies: why was it different this time?* [Online]. Bank for International Settlements. Available from: https://www.bis.org/publ/bisbull32.pdf.

Alami, I., Alves, C., Bonizzi, B., Kaltenbrunner, A., Koddenbrock, K., Kvangraven, I. and Powell, J. 2021. *International Financial Subordination: A Critical Research Agenda*. University of Greenwich.

Amsden, A.H. 2001. *The rise of" the rest": challenges to the west from late-industrializing economies*. Oxford University Press, USA.

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 from: https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2021/04/working-paper-356-Baer-et-al.pdf.

Bailey, A. 2020. The time to push ahead on tackling climate change. Available from: https://www.bankofengland.co.uk/speech/2020/andrew-bailey-speech-corporation-of-london-green-horizon-summit.

Baker, A. 2013. The new political economy of the macroprudential ideational shift. *New Political Economy*. **18**(1), pp.112–139.

Banque de France 2021. *Is macroprudential policy resilient to the pandemic* Financial. (E. Assouan, V. Fourel, J. Idier, D. Rougès, A. Schilte, & E. Vidon, eds.). Paris: Banque de France.

Barkawi, A. and Zadek, S. 2021. *Governing Finance for sustainable prosperity* [Online]. Zurich: Council on Economic Policies. [Accessed 29 April 2021]. Available from: https://www.cepweb.org/governing-finance-the-case-for-a-new-playbook/.

Barmes, D., Kazi, D. and Youel, S. 2020. *The COVID Corporate Financing Facility. What are the conditions for the billion £ bailouts?* [Online]. Positive Money UK. [Accessed 24 June 2022]. Available from: http://positivemoney.org/wp-content/uploads/2020/07/CCFF-Final-version.pdf.

Bartsch, E, Bénassy-Quéré, A., Corsetti, G. and Debrun, X. 2020. *It's All in the Mix: How Monetary and Fiscal Policies Can Work or Fail Together* [Online]. London: Centre for Economic Policy Research. Available from: https://voxeu.org/content/it-s-all-mix-how-monetary-and-fiscal-policies-can-work-or-fail-together.

Bartsch, Elga, Boivin, J., Fischer, S., Hildebrand, P. and Wang, S. 2020. *Policy revolution* [Online]. Available from: www.suerf.org/policynotes.

Bates, M. 2021. Trade-offs for take-off: domestic aviation in a post-pandemic world. *Oxera*. [Online]. [Accessed 27 February 2023]. Available from: https://www.oxera.com/insights/agenda/articles/trade-offs-for-take-off-domestic-aviation-in-a-post-pandemic-world/.

BCRA 2021. New Measures to Benefit Productive Sectors. [Accessed 24 June 2022]. Available from: http://www.bcra.gov.ar/Noticias/medidas-bcra-beneficio-sector-productivo-i.asp.

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.

Blanchard, O. 2019. Public Debt and Low Interest Rates. *American Economic Review*. **109**(4), pp.1197–1229.

Blanchard, O. and Pisani-Ferry, J. 2020. Monetisation: Do not panic. *VoxEU.org*. [Online]. [Accessed 3 July 2022]. Available from: https://voxeu.org/article/monetisation-do-not-panic.

BNM 2021. BNM's Fund for SMEs High Tech Facility - National Investment Aspirations Frequently Asked Questions (FAQ). [Accessed 24 June 2022]. Available from: https://www.bnm.gov.my/documents/20124/2294076/FAQ-HTF-ENG.pdf.

Bolton, P., Després, M., Pereira da Silva, L., Samama, F. and Svartzman, R. 2020. *The green swan: Central banking and financial stability in the age of climate change* [Online]. Bank for International Settlements. Available from: https://www.bis.org/publ/othp31.pdf.

Brainard, L. 2021. The Role of Financial Institutions in Tackling the Challenges of Climate Change. Available from: https://www.federalreserve.gov/newsevents/speech/brainard20210218a.htm.

Breeden, S. 2022. Balancing on the net-zero tightrope — speech by Sarah Breeden. Available from: https://www.bankofengland.co.uk/speech/2022/april/sarah-breeden-thecityuk-international-conference.

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.

Cantú, C., Cavallino, P., Fiore, F. De and Yetman, J. 2021. *A global database on central banks' monetary responses to Covid-19*. Basel.

Carlson, C.J., Zipfel, C.M., Garnier, R. and Bansal, S. 2019. Global estimates of mammalian viral diversity accounting for host sharing. *Nature Ecology & Evolution*. **3**(7), pp.1070–1075.

CBRT 2020. TCMB - Press Release on Advance Loans against Investment Commitment (2020-32). [Accessed 24 June 2022]. Available from: https://www.tcmb.gov.tr/wps/wcm/connect/EN/TCMB+EN/Main+Menu/Announcements/Press+Releases/2020/ANO2020-32.

Chenet, H., Ryan-Collins, J. and van Lerven, F. 2021. Finance, climate-change and radical uncertainty: Towards a precautionary approach to financial policy. *Ecological Economics*. **183**, pp.106957–106957.

Claeys, G. and Tagliapietra, S. 2020. A trillion reasons to scrutinise the Green Deal Investment Plan. *Bruegel*. [Online]. Available from: https://www.bruegel.org/2020/01/a-trillion-reasons-to-scrutinise-the-green-deal-investment-plan/.

Clement, P. 2010. The term'macroprudential': origins and evolution. *BIS Quarterly Review, March*.

Coalition of Finance Ministers 2019. *Helsinki Principles | Coalition of Finance Ministers* [Online]. Coalition of Finance Ministers. [Accessed 4 July 2022]. Available from: https://www.financeministersforclimate.org/helsinki-principles.

Colesanti Senni, C. 2021. The Case for Climate Objectives in Central Banks' Targeted Refinancing Operations. *Council on Economic Policies Blog*. [Online]. Available from: https://www.cepweb.org/the-case-for-climate-objectives-in-central-banks-targeted-refinancing-operations/.

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*. **42**(1–2), pp.238–251.

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 from: 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]. SUERF The European Money and Finance Forum. Available from: 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 from: https://neweconomics.org/uploads/files/Decarbonising-is-easy.pdf.

Dafermos, Y., Nikolaidi, M. and Galanis, G. 2018. Climate Change, Financial Stability and Monetary Policy. *Ecological Economics*. **152**, pp.219–234.

Dasgupta, P. 2021. *The economics of biodiversity: The dasgupta review*. London: HM Treasury.

Dikau, S. and Ryan-Collins, J. 2017. *Green Central Banking in Emerging Market and Developing Country Economies* [Online]. New Economics Foundation. Available from: https://eprints.soas.ac.uk/24876/1/Green-Central-Banking.pdf.

Dikau, S. and Volz, U. 2021. Central bank mandates, sustainability objectives and the promotion of green finance. *Ecological Economics*. **184**, p.107022.

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.

ECB 2022a. *ECB takes further steps to incorporate climate change into its monetary policy operations* [Online]. Frankfurt: European Central Bank. [Accessed 5 July 2022]. Available from: https://www.ecb.europa.eu/press/pr/date/2022/html/ecb.pr220704~4f48a72462.en.html.

ECB 2022b. How are we decarbonising our corporate bond holdings?

Elderson, F. 2021. Integrating the climate and environmental challenge into the missions of central banks and supervisors. Available from: https://www.ecb.europa.eu/press/key/date/2021/html/ecb.sp210923~0c7bd9c596.en.html.

Epstein, G. 2006a. *Central Banks as Agents of Economic Development* [Online]. World Institute for Development Economic Research (UNU-WIDER). Available from: https://EconPapers.repec.org/RePEc:unu:wpaper:rp2006-54.

Epstein, G. 2006b. Central banks as agents of economic development, Research Paper. *UNU-WIDER*. (No. 2006/54).

Epstein, G.A. and Schor, J.B. 1991. Macropolicy in the rise and fall of the golden age *In*: Stephen A. Marglin and J. B. Schor, eds. *The Golden Age of Capitalism: Reinterpreting the Postwar Experience*. Oxford: Oxford University Press.

European Parliament 2020. *Monetary-Fiscal Nexus after the Crisis — Study for the Committee on Economic and Monetary Affairs*. Luxembourg: Policy Department for Economic, Scientific and Quality of Life Policies, European Parliament, Luxembourg.

Ferrari, A. and Nispi Landi, V. 2020. *Whatever it takes to save the planet? Central banks unconventional green policy*. Frankfurt am Main.

Fiedler, S., Gern, K.-J. and Stolzenburg, U. 2020. Blurred boundaries between monetary and fiscal policy. *Monetaryfiscal nexus after the crisis: Compilation of papers. Luxembourg: European Parliament*., pp.5–28.

Gabor, D. 2016. The (impossible) repo trinity: the political economy of repo markets. *Review of international political economy*. **23**(6), pp.967–1000.

Goldin, I. 2014. The Butterfly Defect: Why globalization creates systemic risks and what to do about it. *Journal of Risk Management in Financial Institutions*. **7**(4), pp.325–327.

Goodhart, C.A.E. 2011. The changing role of central banks. *Financial History Review*. **18**(2), pp.135–154.

Hansen, L.P. 2022. Central banking challenges posed by uncertain climate change and natural disasters. *Journal of Monetary Economics*. **125**, pp.1–15.

IMF 2021. Policy Response to Covid-19. *Policy Tracker*. [Online]. [Accessed 18 July 2021]. Available from: https://www.imf.org/en/Topics/imf-and-Covid19/Policy-Responses-to-COVID-19.

IPBES 2019. *The global assessment report on Biodiversity and Ecosystem Services: Summary for Policymakers* [Online]. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). Available from: https://ipbes.net/sites/default/files/2020-02/ipbes_global_assessment_report_summary_for_policymakers_en.pdf.

IPCC 2022a. *Climate Change 2022: Impacts, Adaptation and Vulnerability* [Online]. Available from: https://www.ipcc.ch/report/sixth-assessment-report-working-group-ii/.

IPCC 2022b. *Climate Change 2022: Mitigation of Climate Change* [Online]. Intergovernmental Panel on Climate Change Working Group III contribution to the Sixth Assessment Report. [Accessed 28 June 2022]. Available from: https://www.ipcc.ch/report/ar6/wg3/.

IPCC 2018. Summary for Policymakers. *In*: *Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.* Geneva, Switzerland: World Meteorological Organization.

Jourdan, S. and Kalinowski, W. 2019. *Aligning Monetary Policy with the EU's Climate Targets* [Online]. Veblen Institute and Positive Money Europe. Available from: https://www.veblen-institute.org/IMG/pdf/aligning_monetary_policy_with_eu_s_climate_targets.pdf.

Jourdan, S. and van Tilberg, R. 2022. The ECB can help fix the energy price crisis: Play the long game. *Energy Monitor*. [Online]. [Accessed 3 July 2022]. Available from: https://www.energymonitor.ai/finance/banking/the-ecb-can-help-fix-the-energy-price-crisis-play-the-long-game.

Kalinowski, W. and Chenet, H. 2021. *The Case for a "Whatever it takes" Climate Strategy* [Online]. Paris: Veblen Institute. Available from: https://www.veblen-institute.org/IMG/pdf/whatever_it_takes_climate_policy.pdf.

Kedward, K. 2022. Forget greenflation, central banks need to tackle fossilflation. *Green Central Banking*. [Online]. [Accessed 27 February 2023]. Available from: https://greencentralbanking.com/.

Kedward, K, Gabor, D. and Ryan-Collins, J. 2022a. Aligning finance with the green transition: From a risk-based to an allocative green credit policy regime. *IIPP Working Paper*. (IIPP WP 2022-11).

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 from: https://doi.org/10.1007/978-3-030-84288-8_7.

Kedward, K, Ryan-Collins, J. and Chenet, H. 2022b. Biodiversity loss and climate change interactions: financial stability implications for central banks and financial supervisors. *Climate Policy*. (Online 2022).

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). Available at: https://www.ucl.ac.uk/bartlett/public-purpose/wp2020-09

Keesing, F., Belden, L.K., Daszak, P., Dobson, A., Harvell, C.D., Holt, R.D., Hudson, P., Jolles, A., Jones, K.E., Mitchell, C.E., Myers, S.S., Bogich, T. and Ostfeld, R.S. 2010. Impacts of biodiversity on the emergence and transmission of infectious diseases. *Nature*. **468**(7324), pp.647–652.

van 't Klooster, J. and Fontan, C. 2020. The Myth of Market Neutrality: A Comparative Study of the European Central Bank's and the Swiss National Bank's Corporate Security Purchases. *New Political Economy*. **25**(6), pp.865–879.

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 from: https://www.positivemoney.eu/2020/09/green-tltros/.

Kranke, M. and Yarrow, D. 2019. The Global Governance of Systemic Risk: How Measurement Practices Tame Macroprudential Politics. *New Political Economy*. **24**(6), pp.816–832.

Lenton, T.M. 2013. Environmental tipping points. *Annual Review of Environment and Resources*. **38**, pp.1–29.

Lonergan, E. 2020. European Central Bank has one item left in its toolkit: dual rates. *Financial Times*.

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.

Marani, M., Katul, G.G., Pan, W.K. and Parolari, A.J. 2021. Intensity and frequency of extreme novel epidemics. *Proceedings of the National Academy of Sciences*. **118**(35), p.e2105482118.

Mauderer, S., Döhrmann, D. and Gerigk, J. 2021. Climate change: What role for central banks? *Revue d'economie financiere*. (144).

May, R.M., McLean, A.R., Pattison, J., Weiss, R.A., Bell, D., Roberton, S. and Hunter, P.R. 2004. Animal origins of SARS coronavirus: possible links with the international trade in small carnivores. *Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences*. **359**(1447), pp.1107–1114.

Mazzucato, M. 2021. *Mission economy: A moonshot guide to changing capitalism*. Penguin UK.

McCulley, P. and Poszar, Z. 2013. Helicopter Money: or how I stopped worrying and love fiscal-monetary cooperation. *Global Society of Fellows*. **7**.

McElwee, P., Turnout, E., Chiroleu-Assouline, M., Clapp, J., Isenhour, C., Jackson, T., Kelemen, E., Miller, D.C., Rusch, G., Spangenberg, J.H., Waldron, A., Baumgartner, R.J., Bleys, B., Howard, M.W., Mungatana, E., Ngo, H., Ring, I. and Santos, R. 2020. Ensuring a Post-COVID Economic Agenda Tackles Global Biodiversity Loss. *One Earth*. **3**(4), pp.448–461.

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 from: https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2022/03/Preventing-a-climate-Minsky-moment.pdf.

Moretti, D., Boucher, D. and Giannini, F. 2021. Managing fiscal risks: Lessons from case studies of selected OECD countries. *OECD Journal on Budgeting*. **21**(1).

Moro, A. 2021. Can Capital Controls Promote Green Investments in Developing Countries? *SSRN Electronic Journal*.

Murphy, R. and Hines, C. 2010. *Green quantitative easing: Paying for the economy we need*. Norfolk.

NGFS 2019. *A call for action: climate change as a source of financial risk* [Online]. Network for Greening the Financial System. Available from: https://www.banque-france.fr/sites/default/files/media/2019/04/17/ngfs_first_comprehensive_report_-_17042019_0.pdf.

NGFS 2022. *Capturing risk differentials from climate-related risks. A Progress Report: Lessons learned from the existing analyses and practices of financial institutions, credit rating agencies and supervisors — Technical document*.

NGFS and INSPIRE 2022. *Central banking and supervision in the biosphere: An agenda for action on biodiversity loss, financial risk and system stability*. Final Report of the NGFS-INSPIRE Study Group on Biodiversity and Financial Stability.

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 from: https://publications.banque-france.fr/sites/default/files/medias/documents/wp-790_0.pdf.

Padhan, R. and Prabheesh, K.P. 2021. The economics of COVID-19 pandemic: A survey. *Economic analysis and policy*. **70**, pp.220–237.

Pereira da Silva, L.A. 2020. *Green Swan 2 – Climate change and Covid-19: reflections on efficiency versus resilience* [Online]. Available from: https://www.bis.org/speeches/sp200514.pdf.

Philipponnat, T., Lallemand, B., Fox, P. and Ford, G. 2020. *Breaking the climate-finance doom loop* [Online]. Brussels: Finance Watch. Available from: https://www.finance-watch.org/wp-content/uploads/2020/06/Breaking-the-climate-finance-doom-loop_Finance-Watch-report.pdf.

Prates, D. 2020. Beyond Modern Money Theory: a Post-Keynesian approach to the currency hierarchy, monetary sovereignty, and policy space. *Review of Keynesian Economics*. **8**(4).

Randow, J. and Neumann, J. 2021. ECB Is Capping Bond Yields But Don't Call It Yield Curve Control. *Bloomberg.com*. [Online]. [Accessed 23 June 2022]. Available from: https://www.bloomberg.com/news/articles/2021-01-20/ecb-is-capping-bond-yields-but-don-t-call-it-yield-curve-control.

Ranger, N., Mahul, O. and Monasterolo, I. 2021. Managing the financial risks of climate change and pandemics: What we know (and don't know). *One earth (Cambridge, Mass.)*. **4**(10), pp.1375–1385.

Reinhart, C., Kirkegaard, J.F. and Sbrancia, M.B. 2011. Financial repression redux. *Finance and Development*., pp.22–26.

Robins, N., Dikau, S. and Volz, U. 2021. Net-zero central banking: A new phase in greening the financial system.

Roubini, N. and Sala-i-Martin, X. 1992. Financial repression and economic growth. *Journal of development economics*. **39**(1), pp.5–30.

Ryan-Collins, J. 2017. Breaking the taboo: a history of monetary financing in Canada, 1930–1975. *The British Journal of Sociology*. **68**(4), pp.643–669.

Ryan-Collins, J. and Van Lerven, F. 2018. Bringing the helicopter to ground: a historical review of fiscal-monetary coordination to support economic growth in the 20th century. *UCL Institute for Innovation and Public Purpose Working Paper Series IIPP WP*. **8**.

Schnabel, I. 2021. From market neutrality to market efficiency. [Accessed 28 June 2022]. Available from: https://www.ecb.europa.eu/press/key/date/2021/html/ecb.sp210614~162bd7c253.en.html.

Schnabel, I. 2020. When markets fail – the need for collective action in tackling climate change. Available from: https://www.ecb.europa.eu/press/key/date/2020/html/ecb.sp200928_1~268b0b672f.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.

Schonauer, A., Thoma, J., Caldecott, B., Spuler, F. and Honneth, J. 2021. *Financial Supervision beyond the Business Cycle. Towards a new paradigm* [Online]. Berlin: 2 degrees investing initiative. [Accessed 3 July 2022]. Available from: https://inspiregreenfinance.org.

Shaw, E.S. 1973. *Financial Deepening in Economic Development*. New York, NY: Oxford University Press.

Smale, R. and Zadek, S. 2020. *Aligning Global Finance with Nature's Needs: A Framework for Systemic Change* [Online]. Finance for Biodiversity Initiative. Available from: https://mava-foundation.org/wp-content/uploads/2020/10/201020-Aligning-Global-Finance-with-Natures-Needs.pdf.

Smialek, J. 2023. Powell Says Fed Will Not Be a 'Climate Policymaker'. *The New York Times*. [Online]. [Accessed 27 February 2023]. Available from: https://www.nytimes.com/2023/01/10/business/economy/powell-fed-climate.html.

Stubbington, T. 2020. Negative-yielding debt total hits record $17.05tn. *Financial Times*. [Online]. Available from: https://www.ft.com/content/378acc52-b1a5-4d58-8a87-8ea052b2c610.

Stubbington, T. and Giles, C. 2021. Investors sceptical over Bank of England's QE programme. *Financial Times*. [Online]. Available from: https://www.ft.com/content/f92b6c67-15ef-460f-8655-e458f2fe2487.

Summers, L.H. 2021. Opinion: The Biden stimulus is admirably ambitious. But it brings some big risks, too. *The Washington Post*.

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.

Svartzman, R., Espagne, E., Gauthey, J., Hadji-Lazaro, P., Salin, M., Allen, T., Berger, J., Calas, J., Godin, A. and Vallier, A. 2021. *A "Silent Spring" for the Financial System? Exploring Biodiversity-Related Financial Risks in France* [Online]. Banque de France. Available from: https://publications.banque-france.fr/en/silent-spring-financial-system-exploring-biodiversity-related-financial-risks-france.

Thurbon, E. 2001. Two paths to financial liberalization: South Korea and Taiwan. *The Pacific Review*. **14**(2), pp.241–267.

Tilburg, R. van 2022. ECB must step in to tackle fossil- and climate-flation. *www.euractiv.com*. [Online]. [Accessed 27 February 2023]. Available from: https://www.euractiv.com/section/energy-environment/opinion/ecb-must-step-in-to-tackle-fossil-and-climate-flation/.

Torres, C. 2020. Meet Fed's Nine New Offspring, Each With Different Market Role. *Bloomberg.com*. [Online]. [Accessed 24 June 2022]. Available from: https://www.bloomberg.com/news/articles/2020-04-16/meet-fed-s-nine-new-offspring-each-with-different-market-role.

Turner, A. 2016. *Between debt and the devil: Money, credit, and fixing global finance*. Princeton, New Jersey: Princeton University Press.

UNDP 2021. An Unprecedented Opportunity to Boost Finance for Development | United Nations Development Programme. *UNDP*. [Online]. [Accessed 4 July 2022]. Available from: https://www.undp.org/library/dfs-unprecedented-opportunity-boost-finance-development.

Van Tilburg, R. and Simic, A. 2020. *The New Unconventional* [Online]. Sustainable Finance Lab. [Accessed 27 June 2022]. Available from: https://sustainablefinancelab.nl/wp-content/uploads/sites/334/2020/04/SFL-The-New-Unconventional-2.pdf.

Van Toor, J., Piljic, D. and Schellekens, G. 2020. *Indebted to nature Exploring biodiversity risks for the Dutch financial sector* [Online]. De Nederlandsche Bank. Available from: https://www.dnb.nl/media/4c3fqawd/indebted-to-nature.pdf.

Varoufakis, Y. and Adler, D. 2020. The EU's green deal is a colossal exercise in greenwashing. *The Guardian*.

Vernengo, M. 2016. Kicking Away the Ladder, Too: Inside Central Banks. *Journal of Economic Issues*. **50**(2), pp.452–460.

Voldsgaard, A., Egli, F. and Pollitt, H. 2022. Can we avoid green collateral damage from rising interest rates? *UCL IIPP Blog*. [Online]. [Accessed 3 July 2022]. Available from: https://medium.com/iipp-blog/can-we-avoid-green-collateral-damage-from-rising-interest-rates-1259ea94c9ea.

Wade, R. 1990. *Governing the Market: Economic Theory and the Role of Government in East Asian Industrialization*. Princeton, New Jersey: Princeton University Press.

Webb, D. 2023. ECB deepens green tilt in corporate bond purchase programme. *Responsible Investor*. [Online]. [Accessed 9 March 2023]. Available from: https://www.responsible-investor.com/ecb-deepens-green-tilt-in-corporate-bond-purchase-programme/.

Weidmann, J. 2019. Climate change and central banks *In*: *Welcome address at the Deutsche Bundesbank's Second Financial Market Conference, Frankfurt am Main*.

Woods, S. 2022. Climate capital — speech by Sam Woods. [Accessed 28 June 2022]. Available from: https://www.bankofengland.co.uk/speech/2022/may/sam-woods-speech-on-the-results-of-the-climate-bes-exercise-on-financial-risks-from-climate-change.

Yashiv, E. 2020. 35 Breaking the taboo: The political economy of COVID-motivated helicopter drops. *Europe in the Time of Covid-19*., p.240.

Zadek, S. 2020. Greening Sovereign-Debt Restructuring | by Simon Zadek. *Project Syndicate*. [Online]. [Accessed 4 July 2022]. Available from: https://www.project-syndicate.org/commentary/Covid19-sovereign-debt-restructuring-green-by-simon-zadek-2020-08.

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