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AFTER HLEG: EU BANKS, CLIMATE CHANGE ABATEMENT AND THE PRECAUTIONARY PRINCIPLE

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ABSTRACT

The EU is making progress in reducing its carbon footprint. The creation of a High-Level Group on Sustainable Finance (HLEG) has supplemented recent market-led initiatives and provided some recommendations for future reform. This article argues that more remains to be achieved. In particular, in light of the fundamental structural uncertainties attached to climate change, precautionary approaches to the funding of GHG-intensive industries are worth contemplating. Such measures include raising the capital requirements on ass*ets with 'brown' credentials. The high dependence on* banks for external financing in the EU makes these reforms particularly appropriate for implementation within the bloc.

I. INTRODUCTION

The European Union has been at the forefront of climate change mitigation policies. Warnings about the unsustainability of current greenhouse gas (GHG) emissions continue to emanate from science, academia and governments.[1] There have been numerous recent global initiatives purposed to tackle the issue, resulting in the signing of several supra-national accords aimed at reducing the potential for excessive carbon pollution of the earth and its atmosphere.[2]

[1] In January 2018, the "Doomsday Clock" of the Atomic Scientists Science and Security Board was moved (by 30 seconds) to "two minutes to midnight", its closest position to midnight since 1953. This metaphorical device indicates the Atomic Scientist Board's estimation of the threat level to global order. They attributed this partially to the lack of action in "avoiding catastrophic temperature increases in the long run [which] requires urgent attention now. Global carbon dioxide emissions have not yet shown the beginnings of the sustained decline towards zero that must occur if ever-greater warming is to be avoided…the global response has fallen far short of meeting this challenge." See Atomic Scientists Science and Security Board, 'It is 2 minutes to midnight: 2018 Doomsday Clock Statement', Bulletin of the Atomic Scientists, 25 January 2018, p2.

[2] See for example, the Paris Climate Agreement, which has the central aim of capping future global warming by 2 degrees Celsius, was ratified in 2016 following the acceptance of its protocols by the vast majority of parties to the United Nations Framework Convention on Climate Change. See United Nations, Paris Agreement, 2015.

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The EU's positioning as a global leader in tackling climate change is unsurprising: the TFEU places emphasis upon both sustainable development and environmental protection.[3] The bloc's 2030 climate and energy framework (the latest version having been adopted in 2014) sets three key targets for the year 2030: (i) at least 40% cuts in GHG emissions (relative to 1990 levels); (ii) at least 27% share for renewable energy; (iii) at least 27% improvement in energy efficiency.[4] Indeed, the EU has committed to reducing its GHG emissions by 80 percent by 2050.[5]

For the most part, the EU has approached the problem of climate change as a challenge to be solved by the market. Consequently, in relation to the financial sector, EU initiatives tend to focus on demand-side reform, with efforts to restrict GHG emissions addressing activities undertaken by corporations or firms, rather than intervening to regulate the supply of credit or other financial instruments.[6] To this end, the EU has been proactive in facilitating the introduction of new financial products with 'green' credentials, taking a lead in developing such markets. This has been operationalised both via the issuance of green financial products by EU institutions such as the European Investment Bank (EIB) and through the development of regulatory standards to underpin the development of green finance markets, where instruments such as green bonds and green ABS may be traded. Regulatory developments culminated in the creation of a High-Level Group on Sustainable Finance (HLEG), which reported in January 2018.[7] On the basis of the HLEG's findings, the EU Commission updated its sustainable finance stream of the Capital Markets Union (CMU) Action Plan, commenting:

> [E]veryone in society must play a role. The financial system is no exception. Re-orienting private capital to more sustainable investments requires a comprehensive rethinking of how our financial system works. This is necessary if the EU is to develop more sustainable economic growth, ensure the stability of the financial system, and foster more transparency and long-termism in the economy.

In spite of these steps – and despite the progress made in sustainable financing at the EU level – this article argues that drawbacks to in relation to EU policy toward the financial sector and climate policy

[3] The Lisbon Treaty Article 3(3) states: 'The Union shall establish an internal market. It shall work for the sustainable development of Europe based on balanced economic growth and price stability, a highly competitive social market economy, aiming at full employment and social progress, and a high level of protection and improvement of the quality of the environment. It shall promote scientific and technological advance.' See TFEU OJ 2008/C 115/01.

[4] 2030 Climate & Energy Framework, https://ec.europa.eu/clima/policies/strategies/2030_en accessed 26 January 2018.

[5] European Commission, EU Action Against Climate Change: Leading Global Action To 2020 And Beyond (2009) which states at p10 that "[t]he adoption of the climate and energy package makes the European Union the first region of the world to have both committed to such ambitious targets and put in place the measures needed to achieve them."

[6] S Oberthilr and CR Kelly, EU Leadership in International Climate Policy: Achievements and Challenges (2008) 43 International Spectator 35.

[7] EU High-Level Group on Sustainable Finance, Financing a Sustainable European Economy: Final Report, January 2018.

remain. The fundamental flaw in the EU's approach in relation to the financial sector and climate change abatement is to entrust financial market mechanisms to deliver the EU's goals. Specifically, I argue that the modern risk management paradigm as applied in financial markets – and all of the regulatory and institutional responses which flow from such an approach – cannot meaningfully mitigate the possibility of widespread catastrophic economic losses from climate change.

This article goes beyond the current literature on climate risks in the financial sector. Current analyses tend to focus either on the potential losses which the financial sector may be exposed to in the event of sudden shifts in regulatory policy[8] (for example the 'stranded assets' debate[9]), or behavioural obstacles, such as short-termism, which render attempts to meet the EU's own climate abatement goals difficult to achieve. My critique adds further nuances to an already strong case for further intervention. In short, even if financial markets were able to adapt their behaviour to climate externalities, there are deep structural uncertainties within climate science, combined with the inability to arrive at meaningful estimates of economic damage from climate developments (in essence, the presence of Knightian uncertainty)[10] which destroy the viability of probability estimates of future damages.[11] These impacts might ruin individual institutions or contribute to extreme damage at the systemic level. As I shall outline, reforms such as those called for by the HLEG – which essentially mimic or extend existing financial regulations regarding transparency levels and standardisation for green financial products – are likely to prove insufficient; in the absence of any reliable risk calculations upon which to base capital allocation decisions, financial institutions have few incentives to reduce their exposures to GHG-risky assets, even as prospective damages both to the financial system and wider economies remain unquantifiable.

I do not address in this article the metrics or characteristics appropriate for assets to be categorised as 'GHG-risky'. Instead, the article raises questions as to what regulatory principles might be useful in the absence of reliable damage assessments from climate shifts. The critique yielded provides important insights for high-level public policy and the use of regulation to combat climate change. I argue, based on the evidence adduced in this article, that what is required in relation to such efforts is the extension of a precautionary approach to any future financing of GHG-intensive

[8] See for example AS Miller and SA Swann, 'Climate Change and the Financial Sector: A Time of Risk and Opportunity' (2016) 29 Georgetown Environmental Law Review 69.

[9] According to research, globally, a third of oil reserves, half of gas reserves and over 80 per cent of current coal reserves should remain unused from 2010 to 2050 in order to meet a target of 2 °C warming. Such restrictions would expose the financial sector to significant risks as writedowns impose losses on counterparties. See C McGlade and P Ekins 'The geographical distribution of fossil fuels unused when limiting global warming to 2 °C' (2015) 517 Nature 187.

[10] This denotes outcomes (be they known, unknown or disputed), for which probability statements cannot be made, because the data are too ambiguous. FH Knight Risk, Uncertainty, and Profit (Hart, Schaffner and Marx, 1921).

[11] M Weitzman, 'On Modeling and Interpreting the Economics of Catastrophic Climate Change' (2009) 91 Review of Economics and Statistics 1, 1.

industries.[12] The precautionary principle imposes a burden of proof on those who create potential risks, and it requires regulation of activities even if it cannot be shown that those activities are likely to produce significant harms. In the legal sphere, it is employed most appropriately as a way to tackle uncertain risks.[13] Importantly, in the case of risks of ruin, where there is no diversifying strategy, the principle becomes stronger in form. Such an approach is already adopted in a number of areas of European jurisprudence and provides well-established principles in the creation and interpretation of European legislation, particularly in the environmental and international law fields. It is also recommended for use to guide regulatory policies on climate change.[14]

As I will explain, such a principle is particularly appropriate to follow in the case of the EU, where banks remain the dominant credit providers. Whilst other jurisdictions such as the United States, China and Japan have developed deep capital markets, investment beyond the banking system within the EU – with the exception of France and the UK – remains retarded.[15] In turn, any reforms to EU capital markets and the launch of market-based finance initiatives to promote green finance (for example via the CMU) are likely to be limited in impact. Indicatively, domestic bank credit in the euro area in 2012 amounted to 255 percent of GDP, compared to around 90 percent in the US.[16] Because banks are by far the largest source of financial capital in the EU, the effects of their lending policies are magnified. This also means that EU banks are relatively more exposed than those in other jurisdictions to negative spillovers from climate shifts: one study estimates these exposures exceed €1 trillion, with potential losses from these sectors of between €350 billion and €400 billion, even under an orderly unwind.[17] Special lessons therefore apply to the EU because of its financial structure.

The application of a precautionary approach in relation to bank-financing of certain ESG-risky activities would include measures to modulate the credit supply through increasing capital requirements on brown assets. Interestingly, the reverse of such a policy is contemplated by the HLEG ie. a reduction in the levels of capital to be held against green loans. This approach is wrong-headed; it would likely reduce the resilience of the financial system and provide few incentives to rein

[12] For discussion of the precautionary principle and financial regulation, see ST Omarova, 'License to Deal: Mandatory Approval of Complex Financial Products' (2012) 90 Washington University Law Review 64 (arguing at 85 that "adopting and operationalizing the general concept of precaution in the context of post-crisis financial systemic risk regulation may be a worthwhile, and even necessary, exercise." See also I Webb, D Baumslag and R Read, 'How should regulators deal with uncertainty? Insights from the Precautionary Principle' Bank of England Underground 27 January 2017 https://bankunderground.co.uk/2017/01/27/how-should-regulators-deal-with-uncertainty-insights-from-the-precautionary-principle/ accessed 15 March 2018.

[13] M Faure and E Vos (eds), Jurisdische afbakening van het voorzorgsbeginsel: mogelijkheden en grenzen, Gezondheidsraad publicatie Nr. A03/03, (The Hague: Dutch Health Council, 2003).

[14] CR Sunstein, 'Beyond the Precautionary Principle' (2003) 151 University of Pennsylvania Law Review 1003. Taleb has argued that: "Skepticism about climate models should lead to more precautionary policies in the presence of ruin." See NN Taleb, Silent Risk, Technical Incerto: Lectures Notes On Probability, Vol 1 (Descartes Publishing, 2015) p23

[15] M Ferreira, D Mendes and JC Pereira 'Non-Bank Financing of European Non-Financial Firms' European Federation of Financial Analysts Societies (July 2016).

[16] See ECB, Report on financial structures (October 2013).

[17] F Weyzig, B Kuepper, JW van Gelder, and R van Tilburg, 'The Price of Doing Too Little Too Late; the Impact of the Carbon Bubble on the European Financial System' (2014) 11 Green New Deal Series.

in lending for ESG-risky activities. Rather, the intervention I advocate would have similar effects to a tax, with capital regulation employed as a supply-side brake on the flow of finance, making such activities more costly to fund. Importantly, similar interventions to support (or disincentivise) particular forms of bank lending have already been enacted at the EU level. I argue that such policy responses are required in the face of the irreducible complexities of the earth's climate, the lack of scientific consensus on the shape of damages from climate change at institutional and systemic levels, and the non-negligible potential for widespread catastrophe.

II. MARKET-BASED MEASURES TO CURB GHG EMISSIONS IN THE EU

Climate pollution is regarded as a classic economic negative externality; according to the influential Stern Review it is 'the greatest example of market failure we have ever seen.'[18] Externalities are those suffered by a third party as a result of an economic transaction between two or more parties to which it is contractually unrelated. In the absence of regulation to correct any cost burden, those costs will be borne by the third party, who is external to the market. From a social perspective, the distribution of these losses is a market failure, and unjustifiable. Emissions from climate change are widely regarded as a clear example of such externalities at the global scale.

Rather than adopting a top-down, command and control approach to meeting its aforementioned climate commitments, the EU has instead engaged in some innovative strategies to reduce the bloc's GHG footprint, through both mandatory and voluntary mechanisms. Support for such initiatives has been leveraged through the EU's institutional framework, including via the EIB and the European Bank for Reconstruction and Development (EBRD), whilst supra-national bodies have been created to deal with financial institutions' exposure to climate change, including the aforementioned HLEG, and a 'Task Force on Climate Related Disclosures' convened by the Financial Stability Board (TCFD).[19]

A. The European Emissions Trading Scheme (ETS)[20]

The ETS was launched in 2005, and works on the 'cap and trade' principle. The ETS encompasses only certain sectors across the Union, most notably the energy and heavy industries and (from 2008)

[18] N Stern, The Economics of Climate Change (2007) 1.
[19] Financial Stability Board, Recommendations of the Task Force on Climate-related Financial Disclosures, Final Report, June 2017.
[20] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC.

the aviation sector.[21] In brief, a cap is placed on the total amount of GHG emissions which can be emitted by installations covered by the system. Over time, the cap is reduced, so that aggregate emissions will fall.[22] Companies face heavy penalties for exceeding their emissions allowances; on the other hand, they are permitted to buy limited volumes of international credits from emission-savings projects outside the EU, and may trade or bank for future use surplus allowances.[23] As Campbell et al note, in the absence of a satisfactory tax solution, the EU has attempted to create a 'quasi-market' to mimic the market mechanism, and regulate carbon outputs. The ETS is therefore constructed along Coasean perspectives of regulation: in the presence of a negative externality the market will provide an economically superior bargain than regulation or litigation.[24]

Despite the prima facie simplicity of the ETS, it was challenged in the courts over forty times in the first four years of its operation.[25] In these cases, the Court of Justice rarely addressed the environmental merits of schemes such as the ETS; instead it settled questions as to whether or not the EU and the Commission have competence under the EU Constitution to impose such schemes.[26] Evaluations of the ETS performance have been generally positive, with supporters pointing to the abatement in EU emissions it has produced, its role in promoting investment in clean technology and its lack of negative impacts on economic growth.[27] On the other hand, there have been setbacks including the over-allocation of allowances which precipitated a price crash in the value of credits, and fraud.[28] More fundamentally, carbon trading frameworks might be flawed as currently constructed because they permit some of the largest polluters to pay to continue emitting GHGs and aggregate emissions will therefore not drop.[29] This latter important criticism is indicative of flaws in market-led approaches to regulation, particularly in the presence of threats of the order and complexity of climate change.

B. EU markets for green financial products

[21] Directive 2009/29/EC Of The European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community.
[22] D Campbell, M Klaes and C Bignell, 'After Cancun: The Impossibility of Carbon Trading' (2010) 29 University of Queensland Law Journal 163.
[23] The EU Emissions Trading System (EU ETS), https://ec.europa.eu/clima/policies/ets_en accessed 26 January 2018.
[24] R Coase, 'The Problem of Social Cost' (1960) 3 Journal of Law and Economics 1.
[25] S Bogojevic, 'EU Climate Change Litigation, the Role of the European Courts, and the Importance of Legal Culture' (2013) 35 Law & Policy 184.
[26] See for example, Case C-366/10 The Air Transport Association of America, American Airlines, Inc., Continental Airlines, Inc., United Airlines, Inc. v The Secretary of State for Energy and Climate Change [2011] OJ C 260/9, which challenged the validity of Directive 2008/101 in light of international law and international customary principles.
[27] M Muûls, J Colmer, R Martin, and UJ Wagner, 'Evaluating the EU Emissions Trading System: Take it or leave it? An assessment of the data after ten years' Grantham Institute Briefing Paper No 21 (October 2016).
[28] T Laing, M Sato, M Grubb and C Comberti, 'Assessing the effectiveness of the EU Emissions Trading System' Centre for Climate Change Economics and Policy Working Paper No. 126 (January 2013).
[29] Campbell et al above note 22.

The EU has also focused on innovative financial instruments which are designed to leverage established financial structures for use in green investments, which in some cases have struggled to gain traction amongst investors.[30] Asset forms to have emerged since 2007 which explicitly cater for investors wishing to place capital in sustainable investments include green bonds, green asset-backed securities (ABS) and green mortgages.

1. Green bonds

Like regular bonds, a green bond is a fixed-income debt instrument to allow issuers to raise finance from investors via the capital markets. They differ from plain vanilla or regular bonds in that the 'green' label signifies a commitment that the proceeds used from the bond sale will be used to finance only green projects, assets or businesses. The EU was the first institution to introduce green bonds (via the EIB) in 2007.[31] Since 2014, market-led green bond programmes have started to pick up; global issuance nearly doubled between 2015 and 2016 to reach $92 billion.[32] Given the long-term, generally stable, features of energy efficiency investing, bond markets provide a highly attractive source for capital for investments in long-term infrastructure, green buildings and energy efficient industries.

2. Green ABS

In spite of the growth of green bond markets, it is recognised that bond markets are not always appropriate for capital raising, because of problems of scalability and investor exposure. As noted by the Climate Bond Initiative:

> a number of low-carbon infrastructure investments – such as rooftop solar photovoltaic (PV), small-scale wind, energy efficiency upgrades, electric vehicles and energy storage projects – are smaller scale and prevented from accessing the bond markets directly, as such assets require aggregation to create the deal size typically sought by bond market investors (typically at least €50 million and usually above).[33]

Accordingly, the EU has also sought to exploit the centrepiece of the EU Capital Markets Union[34]

[30] For example, in 2017, a new European Green Securities Steering Committee was launched with the goal of promoting green securities market development in the EU. See S Kidney, 'New EU Green Securities Steering Committee to Promote Climate Finance Opportunities' Climate Bonds Initiative, 4 July 2017 at https://www.climatebonds.net/2017/07/new-eu-green-securities-steering-committee-promote-climate-finance-opportunities

[31] The EIB issued the world's first Green Bond, labelled a Climate Awareness Bond (CAB). As of 31 December 2016, EIB remained the largest issuer of Green Bonds with over €15bn raised across 11 currencies.

[32] See Climate Bonds Initiative, 'Bonds and Climate Change: The State of the Market' (2017).

[33] S Kidney, D Giuliani & B Sonerud, 'Stimulating private market development in green securitisation in Europe: the public sector agenda' Climate Bonds Initiative (April 2017) 4.

[34] Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions Action Plan on Building a Capital Markets Union Brussels, 30.9.2015 COM(2015) 468.

project, the new EU Regulation on Securitisation (SR).[35] This instrument provides the potential for an expansion of green finance where bond sales are infeasible. The capacity to securitise individual loans, pool them and sell securities on to investors provided by the SR circumvents the scalability of bond issuance, by ensuring that any ABS issued exceed these thresholds. The OECD estimates that annual global issuance of green asset-backed securities in the EU could reach up to $77 billion per annum by 2035, for renewable energy, energy efficiency and low emission automobiles.[36] Many large corporations are already issuing such instruments.[37]

3. Green Mortgages

Importantly, these initiatives have spread to the mortgage market, in particular through work done by DG Climate Action.[38] The policy proposals arise in the context of several regulatory amendments to have been undertaken in the EU since the turn of the twenty-first century. In 2002, the EU introduced the Energy Performance of Building's Directive[39] (restated in 2010) which requires Member States to produce legislation requiring the use of Energy Performance Certificates (EPCs) to rate the energy efficiency (consumption and demand) of buildings. The Energy Efficiency Directive introduced binding measures to produce increases in energy efficiency of at least 20% by 2020, and 30% by 2030.[40] In 2016, the world's first green retail mortgage backed security (RMBS) was issued.[41] Given the size of the global mortgage market, green RMBS represent an ideal asset class to be used to push on green financial innovations.

4. Green market-based finance: Brief conclusions

Markets in the EU for so-called green financial products have significant growth potential in the EU, although scaling them will likely be difficult thanks to standardisation issues (which the HLEG, as discussed below, attempts to address). Yet, placing trust in the market mechanism to deliver efficient and climate-friendly capital allocation is unlikely to fully reflect the risks posed by underlying structural impediments to greening the EU financial system; in particular, the twin threats of investor short-termism and flawed risk management processes. As I shall explain in later sections, such

[35] European Commission, Proposal for a Regulation of The European Parliament and of The Council laying down common rules on securitisation and creating a European framework for simple, transparent and standardised securitisation, Brussels, 30.9.2015 COM(2015) 472 final 2015/0226 (COD) [hereinafter SR Proposal].
[36] OECD, Green bonds: Mobilising the debt capital markets for a low-carbon transition, December 2015.
[37] Ibid.
[38] European Commission and DG Climate Action, Shifting Private Finance Toward Climate-Friendly Investments (March 2015).
[39] Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings.
[40] Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC.
[41] Dutch-based Obvion issued the world's first green Residential Mortgage-Backed Security (RMBS) in June 2016, a €500m deal certified under the Climate Bonds Standard.

market-based initiatives are unlikely to address these factors. This is particularly relevant in EU credit markets, which remain dominated by incumbent banks.

C. Tackling short-termism: HLEG and the Capital Markets Union Action Plan

"Financial markets are prone to short-termism" is a finding well-established in the literature (and certainly not confined to climate-related finance). There is substantial evidence that both incentives and investment horizons within the financial industry are so skewed towards the short-term – what Mark Carney has characterised as "the tragedy of the horizon"[42] – as to be insurmountable. As Carney notes, breaking this tragedy is key to the sustainability agenda. Such obstacles include: mismatched investment horizons, based upon a 'double compression of time and risk;[43] very high equity turnover rates by large investors which weaken incentives for long-term engagement;[44] frequent financial reporting, which induces managerial short-termism (myopia);[45] compensation systems which prioritise short-term targets[46]; and the career concerns of fund managers, whose performances are evaluated over limited timescales and benchmarked against those of their peers. [47]

In view of such obstacles, the HLEG was established to identify ways in which investment in green financial assets could be boosted. Despites the aforementioned EU initiatives, investment in clean energy technologies has fallen from $35 billion in the second quarter of 2011 to an average of $10-$15 billion per quarter over the last few years.[48] Indeed, the HLEG announced that the EU remains likely to miss its own 2030 energy policy target of €11.2 trillion investment; the current annual deficit is €177 billion, or €1.77 trillion between 2021 and 2030.[49] EU regulators regard arresting this deficit as crucial in adapting to the threat of climate change.

On this basis, the recommendations of the HLEG form the basis of the latest iteration of the EU's Capital Markets Union Action Plan, published in March 2018 which, inter alia, argued for the following:

(i) Establishing a common language for sustainable finance, i.e. a unified EU classification system – or taxonomy – to define what is sustainable;

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[42] Mark Carney, 'Breaking the Tragedy of the Horizon – climate change and financial stability', speech given at Lloyd's of London, 29 September 2015.
[43] See note 7 above p19.
[44] AG Haldane, 'Patience and Finance' Speech at Oxford China Business Forum, Beijing, 2 September 2010.
[45] F Gigler, C Kanodia, H Sapra and R Venugopalan, 'How Frequent Financial Reporting Can Cause Managerial Short-Termism: An Analysis of the Costs and Benefits of Increasing Reporting Frequency' (2014) 52 Journal of Accounting Research 357.
[46] J Cullen, Executive Compensation in Imperfect Financial Markets (Elgar, 2014).
[47] J Chevalier and G Ellison, 'Career Concerns Of Mutual Fund Managers' (1999) 114 Q. J. of Economics 389.
[48] A Louw, 'Clean Energy Investment Trends, 3Q 2017' Bloomberg New Energy Finance, 5 October 2017, p16.
[49] EU High-Level Expert Group on Sustainable Finance, Financing a Sustainable European Economy: Interim Report, July 2017, p13.

(ii) The creation of EU labels for green financial products;
(iii) Clarification of the duties of asset managers and trustees to consider sustainability in their investments;
(iv) Requiring insurance and investment firms to disclose to clients their sustainability preferences;
(v) Enhancing transparency in corporate reporting; and
(vi) Exploring ways of incorporating sustainability criteria in prudential requirements which apply to banks and insurance companies.[50]

III. RISK AND UNCERTAINTY: INFORMATION DISCLOSURE AND THE LIMITS OF PRIVATELY-DRIVEN CHANGE

The preceding section discussed some of the legislative and regulatory programmes at EU level designed to address climate change via the financial system. Such reforms may seem to be unambiguously positive steps towards climate change abatement within the EU. I argue in this section, however, that such an approach is likely to fail to address sufficiently the challenge of climate change, because the narrative concerning the role of the financial markets in combating this challenge remains grounded in classic theories of financial market behaviour, upon which prevailing risk management exercises are based. Various factors dictate that basing policy prescriptions upon such theories is highly unlikely to provide sufficient incentives for long-term behavioural change on the part of banks and other credit providers. Indeed, as I shall explain, they may contribute further to the problem if the solutions to climate change are regarded as reducible to the closing of information asymmetries through transparency and disclosure initiatives.

A. Rationality and Investment Risk

Traditional approaches to financial risk management and regulation are founded upon the view that the market – as an epistemic device – is uniquely endowed with the capacity to evaluate and price risk. These frameworks in the EU are underpinned by the rational investor model.[51] In short, this model holds that investors inter alia: correctly calculate expected values as the probability-weighted sum of potential outcomes, and make decisions fully consistent with these estimates; are equally and fully informed; and all share the same beliefs and risk preferences.[52] Whilst these assumptions may be relaxed in specific circumstances, agents in macroeconomic models largely conform to this view of investors in the aggregate. In such models, a single, representative agent is used to represent the actions of all agents within the model; this agent maximizes well-ordered preferences subject to

[50] European Commission, Sustainable finance: Commission's Action Plan for a greener and cleaner economy, Brussels, 8 March 2018.
[51] Eilis Ferran, Building an EU Securities Market (Cambridge University Press, 2004).
[52] B Jones, 'Asset Bubbles: Re-thinking Policy for the Age of Asset Management' Working Paper No. 15/27, 2015.

specific constraints (which are normally budgetary and/or temporal) and acts upon full and complete information.[53]

In consequence, at its most rudimentary level, the rational investor model posits that the predictions of agents will be correct on average over time. In other words, although the future is not fully predictable, agents' expectations are assumed neither to be systematically biased nor lead to collective errors, with any deviations from this (perfect foresight) regarded as random.[54] As a result, rational expectations do not differ systematically or predictably from equilibrium results. Absorbing this information of course results in price which provides not only an objective "value" but also important foundations for risk management and strategy. Because the market – given full information – can price any eventuality, there exists a market of complete contingent contracts with an assigned probability for each anticipated state. As Fama – a Nobel-prize winning proponent of such theories – notes, a critical requirement for this price formation is that all "important current information is almost freely available to all participants." [55] But what does this mean for financial market regulation?

B. Legal and Regulatory Implications of Informational Theories

In the case of financial markets, regulators provide legal and regulatory frameworks so that publicly-listed corporations and financial institutions reduce asymmetries by making disclosures about various aspects of, and risks to, their businesses. In the case of the EU, the vast majority of such climate-related factors disclosures are at present voluntary. An exception is the Non-Financial Reporting Directive which requires disclosure relating to as a "minimum, environmental, social and employee matters, respect for human rights, anti-corruption and bribery matters."[56] However, the view that given more information, markets will be able to better manage the transition to lower carbon states remains pervasive; it is championed by those most closely associated with green finance developments in the EU, as can be seen from the recommendations by the HLEG and under the CMU. A recent example is instructive: the CMU project follows the TCFD recommendation to encourage certain financial institutions to "develop voluntary, consistent climate-related financial disclosures that would be useful to investors, lenders, and insurance underwriters in understanding material risks."[57] Such voluntary disclosures "would enable stakeholders to understand better the concentrations of carbon-related assets in the financial sector and the financial system's exposures to

[53] As noted by Hands: "This is the 'rational economic agent' of mainstream microeconomics—the agent who maximizes a well-behaved utility function subject to a budget constraint in demand theory and makes decisions based on maximization of expected utility in risky environments—as well as the rational individual agents in 'decision theory' and 'rational choice theory'…this familiar utility-maximizing individual is used to model the demand, supply or equilibrium of an entire market or characterize the equilibrium of an entire economy." See DW Hands, Conundrums of the representative agent (2017) 41 Cambridge Journal of Economics 1685.

[54] E Avgouleas, 'The Global Financial Crisis and the Disclosure Paradigm in European Financial Regulation: The Case for Reform' (2009) 6 European Company and Financial Law Review 440.

[55] EF Fama, 'Random Walks in Stock Market Prices' (1965) 21 Financial Analysts Journal 55, 56

[56] EU Directive 2014/95/EU regarding disclosure of nonfinancial and diversity information by certain large companies and groups OJ L 330.

[57] See note 19 above at piii.

climate-related risks."[58] The FSB noted that financial sector disclosures would assist investors and regulators in at least two key ways: (i) "foster an early assessment of [climate-related] risks" and "facilitate market discipline"; and (ii) "provide a source of data that can be analy[s]ed at a systemic level, to facilitate authorities' assessments of the materiality of any risks posed by climate change to the financial sector, and the channels through which this is most likely to be transmitted."[59]

In this vein, Mark Carney, Chairman of the FSB and Governor of the Bank of England, has argued that "[f]inancial markets have the potential to improve our prospects for tackling climate change, but only if we make climate risks and opportunities more transparent."[60] Carney elaborates as follows on this point:

> Along with analysis of wider market conditions, investors need accurate data. The more incomplete or opaque the data and analysis, the more inefficient are markets. Yet the climate-related risks and opportunities businesses face are currently shrouded in secrecy. Having information on such risks would allow investors to back their convictions with their capital, whether they are climate optimists or pessimists, evangelicals or sceptics. It would also permit corporates not only to meet investor demand for information, but also to position their businesses to win, rather than be left behind in, the transition to a low-carbon economy… by acting in their own interests, leading companies, banks and investors from across the G20 are helping society address one of the gravest challenges we face. The more transparent and effective we make markets, the more we will all benefit.[61]

Statements such as this bear all the hallmarks of similar pronouncements on the efficiency and effectiveness of market-determined pricing, according the market – even in the face of a challenge as great as climate change – with the role as primary arbiter of the level and character of adjustments to industrial strategies and investor portfolio preferences. In Carney's language, the relevant mix of investors between "optimists and pessimists, evangelicals or sceptics" will determine the allocation(s) of investment capital to particular projects and their convictions will be tested by future events.

Yet, as I shall explain in remaining sections, characterising the information gaps in market understanding of the financial risks of climate change by using such terms as "secrecy" or "win[ning]" is highly dubious. For example, it is trite to observe that the risks from climate change to economic and financial systems are not hidden; this implies that someone, somewhere has the requisite information to address the problem and, by implication that the problem contemplated is soluble. In reality, there is no agreement even on the likely shape of the damage function in relation to climate change, still less any consensus on what this will mean for financial markets. Moreover, there

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[58] Financial Stability Board, Proposal for a Disclosure Task Force on Climate-Related Risks, 9 November 2015.
[59] Ibid.
[60] Mark Carney, 'Better market information can help combat climate change' Financial Times, 28 June 2017, https://www.ft.com/content/51e60772-5bf5-11e7-b553-e2df1b0c3220?mhq5j=e6.
[61] Ibid. Indicatively, the European Banking Federation (EBF) argues that: "Clear terminology must be defined and financial regulation needs to be assessed at every level to achieve optimal disclosure and transparency and to ensure success… A common taxonomy, set of minimum standards and disclosure framework on Green Finance are essential for efficient allocation of financial resources to green projects…" See EBF, Towards a Green Finance Framework (2017) 2, 7; the TCFD argues that: "Without the right information, investors and others may incorrectly price or value assets, leading to a misallocation of capital…Increasing transparency makes markets more efficient and economies more stable and resilient." See note 19 above p3.

are few objective bases upon which to be "optimistic" or "pessimistic" regarding the potential consequences of climate change, particularly in extreme outcomes. These factors have important consequences for the regulation of financial markets, particularly in relation to banks which finance activities that contribute to climate change.

IV. RISK MANAGEMENT, FINANCE AND CLIMATE CHANGE

As I explained earlier, my critique of current EU initiatives is based upon the limitations of the market's capacity to produce sustainable climate-friendly investment policies. I shall now outline some objections to the view that increasing information disclosure will drive financial institutions to produce more efficient capital allocation, particularly in relation to risks for which we have no reliable risk management capacities, including substantial climate alteration.

A. The Uncertainties of Climate Change

Risk management techniques normally employed to evaluate the relative economic costs and benefits of particular policies and/or regulatory interventions include forms of cost-benefit analysis (CBA). CBA, however, is regarded by most analysts as an inappropriate tool for setting GHG emission targets in the context of climate change.[62] Such costs and benefits are normally expressed in monetary values, providing a marginal financial assessment of the desirability of various interventions. In ascribing such monetary values, variances in the net present marginal costs and benefits of regulatory action/inaction must be finite. Climate change risk, however, does not conform to such parameters; in fact, the costs may be infinite.[63] Such risks are heavy- or fat-tailed, meaning that the extreme downsides of large temperature changes are non-negligible.[64] As warming increases, the damage function may rise more rapidly and eventually tend towards 100% at very high warming. In the face of such a calculus the pressures placed on the market to correctly interpret the potential damages inflicted on the economy from climate change are enormous. Briefly, such risk management techniques must grapple with the following:

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[62] C Azar and K Lindgren, 'Catastrophic Events and Stochastic Cost-benefit Analysis of Climate Change' (2003) 56 Climatic Change 245.

[63] GN Mandel and JT Gathii, 'Cost-Benefit Analysis versus the Precautionary Principle: Beyond Cass Sunstein's Laws of Fear' (2006) 5 University of Illinois Law Review 1037.

[64] NN Taleb, Y Bar-Yam, R Douady, J Norman and R Read, 'The Precautionary Principle: Fragility and Black Swans from Policy Actions' 24 July 2014.

1. Structural Uncertainties

Structural uncertainties attached to the complexity of the global ecosystem and the inherent difficulties in establishing links between GHG emissions and a variety of distinct climate and ecosystem phenomena[65] as well as the effects, valuation and temporality of climate change, make meaningful evaluations of scales of damages speculative at best. Weitzman, a renowned Harvard climate economist, argues that:

> The unprecedented scale and speed of GHG increases brings us into uncharted territory and makes predictions of future climate change very uncertain. Looking ahead a century or two, the levels of atmospheric GHGs that may ultimately be attained (unless decisive measures are undertaken) have likely not existed for tens of millions of years, and the speed of this change may be unique on a time scale of hundreds of millions of years.[66]

The complexity inherent in tampering with real world systems – in this case, climate alteration – means that a certain class of systemic risks will remain unknown.[67] This unknowability reduces drastically the utility of traditional risk-management exercises, to the point that they overwhelm any risk management tools employed by financial institutions and other market actors. In tandem with the rapid development of climate science in recent years, concerns about the uncertainty of possible consequences have metastasised, in particular in relation to the gross underestimation in many financial models of the impacts of potentially catastrophic outcomes.[68]

2. Data Interpretation

Even if one could agglomerate all relevant data, there is no consensus on the probabilities of warming upon which to base any serious policy solutions contemplated. Whilst the TCFD for example encourages financial institutions to engage in scenario analysis for risk management purposes, its most extreme scenario contemplates 2°C warming by the end of this century. Yet, the World Bank estimates that even under a "medium business-as-usual pathway" there is a 40% chance of at least 4°C warming by 2100.[69] Importantly, the World Bank Report is by no means isolated in its outlook.[70]

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[65] As an example of this uncertainty, the IPCC in 2001 argued that global temperatures might rise anywhere between 1.4°C and 5.8°C by 2100; however, no assessment was made of the relative likelihood of intermediate warming values, because the scientists involved held significantly divergent views on the scale of warming, and consequently believed that a single probability distribution could not capture this divergence.

[66] M Weitzman, 'Fat-Tailed Uncertainty in the Economics of Catastrophic Climate Change' (2011) 5 Review of Environmental Economics and Policy 275.

[67] M Weitzman, 'GHG targets as insurance against catastrophic climate damages' (2012) 14 Journal of Public Economic Theory 221.

[68] N Stern, 'The Structure of Economic Modeling of the Potential Impacts of Climate Change: Grafting Gross Underestimation of Risk onto Already Narrow Science Models' (2013) 51 Journal of Economic Literature 838.

[69] World Bank Group, Turn Down the Heat: Confronting the New Climate Normal, 2014. According to Covington and Thamotheram of Cambridge and Oxford Universities respectively, these World Bank Reports "describe a world for which projections are highly uncertain, climatic tipping points may be exceeded and impacts may cascade at regional scales. They estimate that about 60% of the global land surface will be

At such levels, economic damage becomes severe: Dietz and Stern estimate that under such a 4°C warming scenario, annual GDP will be 50% lower compared to a scenario where no warming occurs.[71] Moreover, there is no mechanism with which investors and institutions may protect themselves from losses via countervailing policies, insurance or investment diversification to offset the risks involved to the value of their assets and future profitability. Some estimates place the levels of such "unhedgeable" risk at around half of the total of potential impacts on financial asset values.[72]

3. Non-linearities in the climate system

The compounded effects of events in a non-linear system such as the global climate, in which small changes in one part of the system may lead to large, unpredictable effects in another, mean that environmental damages may be severely underestimated.[73] In such systems, the stability of each constituent is a function of its linkages with other constituents. Real-world coupling and/or connectivity between complex systems may cause them to exhibit patterns and behaviours which are unpredictable, produce "surprises"[74] and are therefore intractable for modelling purposes.[75] Moreover, these systems are also often prone to "tipping points", a reference to a critical threshold at

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subjected to unprecedented heat extremes, implying a completely new climatic regime posing immense pressure globally on natural and human systems. There will be severe droughts, major floods, inundations of coastal cities, unprecedented heat waves and more high-intensity cyclones. Monthly temperatures will increase by six standard deviations in the tropics and two to five standard deviations in the mid-latitudes. The warmest July could be 9 [degrees celsius] warmer in the central US and Mediterranean than the warmest July at present. There will be substantially increased water scarcity, increased risks to global and regional food production, an increase in ocean acidity of one and a half times and an irreversible loss in biodiversity." See H Covington and R Thamotheram. 'The Case for Forceful Stewardship (Part 1): The Financial Risk from Global Warming' (2015) p7-8 available at SSRN: http://ssrn.com/abstract=2551478.

[70] According to two of the authors of the 2014 IPCC Report, "the [2°C] goal is effectively unachievable. Owing to continued failures to mitigate emissions globally, rising emissions are on track to blow through this limit eventually. To be sure, models show that it is just possible to make deep planet-wide cuts in emissions to meet the goal. But those simulations make heroic assumptions — such as almost immediate global cooperation and widespread availability of technologies such as bioenergy carbon capture and storage methods that do not exist even in scale demonstration." See DG Victor and CF Kennel, 'Climate policy: Ditch the 2 °C warming goal' (2014) 514 Nature, 30, 30-31. See also Raftery et al, who argue that: "The likely range of global temperature increase is 2.0–4.9 °C, with median 3.2 °C and a 5% (1%) chance that it will be less than 2 °C (1.5 °C)." See AE Raftery, A Zimmer, DMW Frierson, R Startz & P Liu, 'Less than 2 °C warming by 2100 unlikely' (2017) 7 Nature Climate Change 637.

[71] S Dietz and N Stern, 'Endogenous Growth, Convexity of Damage and Climate Risk: How Nordhaus' Framework Supports Deep Cuts in Carbon Emissions' (2015) 125 The Economic Journal 574.

[72] Cambridge Institute of Sustainability Leadership, Unhedgeable Risk: Stress Testing Sentiment in a Changing Climate, 2015.

[73] SH Schneider, 'Abrupt non-linear climate change, irreversibility and surprise' (2004) 14 Global Environmental Change 245.

[74] Intergovernmental Panel on Climate Change, 'Climate change 1995—the science of climate change' in JT Houghton, LG Meira Filho, BA Callander, N Harris, A Kattenberg, and K Maskell (eds) The Second Assessment Report of the IPCC: Contribution of Working Group I (Cambridge University Press, 1996).

[75] As noted by Schneider: Such surprises are "defined as rapid, non-linear responses of the climatic system to anthropogenic forcing, such as a collapse of the ''conveyor belt'' circulation in the North Atlantic Ocean or rapid deglaciation of polar ice sheets. Potential climate change, and more broadly, global environmental change, is replete with such surprises because of the enormous complexities of the processes and interrelationships involved (such as coupled ocean, atmosphere, and terrestrial systems) and our insufficient understanding of them." See note 74 above at 245.

which very small disturbances can qualitatively alter the state or future development of a system.[76] Because damages tend toward 100% at the extremes, "at some point along the warming scale there will be an economic tipping point at which the climate damage function rises very rapidly from the level proposed by… standard model[s]."[77]

B. The banking system and uncertainty

The EU banking system remains a heavy financier of fossil-fuel companies. Analysis of the international syndicated loan market demonstrates that between 2004 and 2014, the world's 25 largest commercial banks channelled at least $1.85 trillion to the top fossil fuel industries, compared with just $171 billion to renewable energy.[78] A large proportion of climate damages will be caused by continued funding of GHG-intensive industries by banks, who as a group are expected to invest more than $6 trillion in fossil fuels over the next decade.[79] Research shows that of the top fifteen funders of "extreme"[80] fossil fuel activities, four were headquartered in the EU, contributing over $45 billion between them to such activities in the period 2012-2016.[81] Another recent report shows that the fifteen largest European banks inter alia still: carry significant exposures to climate-related liabilities and risk; all (bar one) have no explicit objectives for decreasing such exposures; and none could accurately report on the ratio of high-carbon assets amongst their risk-weighted assets (RWAs).[82] EU regulators already acknowledge the vulnerability of banks to asset writedowns thanks to climate-related events or changes in financial regulation.[83] Other research shows that over fifty percent of bank assets in the Euro area are exposed to climate change-related risks.[84] Such institutions remain under-prepared for the effects that climate-related losses may have on their capital positions.

The banking sector accordingly acts a significant accelerator of climactic risks.[85] Even if one assumes that such risks can be modelled to some degree of accuracy (which of course is not the

[76] TM Lenton, H Held, E Kriegler, JW Hall, W Lucht, S Rahmstorf, and HJ Schellnhuber, 'Tipping elements in the Earth's climate system' (2008) 105 Proceedings of the National Academy of Science USA 1786.
[77] See note 69 above p7.
[78] Fair Finance Guide, Undermining our future: A study of banks' investments in selected companies attributable to fossil fuels and renewable energy, 2 November 2015, p.iv.
[79] C Emanuele, 'Beyond carbon pricing: the role of banking and monetary policy in financing the transition to a low-carbon economy' (2015) Ecological Economics 121.
[80] "Extreme" in this context refers to extreme oil (such as tar sands oil or Arctic drilling); coal mining; coal power (mainly the funding of power stations); and liquefied natural gas export. Many EU banks have pledged to end their funding support for coal mining; however, there are no such pledges in relation to other extreme activities.
[81] BankTrack et al, Banking on Climate Change: Fossil Fuel Finance Report Card, June 2017.
[82] ShareAction, Banking on a Low-Carbon Future, December 2017.
[83] European Systemic Risk Board, Too late, too sudden: Transition to a low-carbon economy and systemic risk, Reports of the Advisory Scientific Committee, No 6, February 2016, p2.
[84] S Battiston, A Mandel, I Monasterolo, F Schutze, and G Visentin, 'A climate stress-test of the financial system' (2017) 7 Nature Climate Change 283.
[85] M Aglietta and É Espagne, Climate and Finance Systemic Risks, more than an Analogy? The Climate Fragility Hypothesis, CEPII Working Paper No. 10, 2016.

contention of this article) the foreseeable systemic risks from climate shifts are significant. Catastrophe risk insurance for example is becoming increasingly expensive, with some insurers simply withdrawing from the market. This exposes the banking system to higher order losses, because if companies cannot insure themselves against catastrophe risk – or are charged high prices for doing so – their ability to withstand losses occurring due to climate-related events will be lowered significantly and, if they are counterparties to banks, any distress they face may be transmitted to the banking system.[86] Ex ante, any resulting reduction in collateral values from seriously damaging weather events would lead to reduced lending, imposing further feedbacks to the wider economy.[87] These dynamics also operate ex post; losses from natural disasters increase the probability of bank failure over the medium term following the relevant event.[88] Exogenous shocks such as natural disasters may also lead financial institutions (especially insurance companies) exposed to losses to sell bonds at fire sale discounts, adding to any fall in collateral values.[89]

Yet, these estimates do not account for the potential extreme losses that realisable under the heavy-tailed distributions discussed in this section, and do not address the supply of financial instruments which fund GHG-intensive activities. If eventuated, such losses have the potential to collapse the entire financial system, as spillovers from losses on assets are amplified. Moreover, any failure to correct the flows of finance to GHG-intensive assets may result in irreversible economic damages far beyond the financial sector. On this basis, I shall argue in the final section that the EU ought to use the opportunity it has been presented with by the findings of the HLEG to fundamentally shift its approach to the bank financing of assets which contribute to climate shifts.

V. PRECAUTIONARY APPROACHES TO BANK FINANCING OF GHG INDUSTRIES

The preceding analysis revealed the limitations in applying traditional risk management techniques to the problem of climate change. This section explores how a precautionary framework to climate finance may be usefully employed in the EU, specifically in the case of reducing the flow of finance from the EU banking system to GHG-intensive projects.

A. The Precautionary Principle in EU Law

Although agreement on its definition is not universally agreed, the central claim of the precautionary

[86] S Batten, R Sowerbutts and M Tanaka, Let's talk about the weather: The impact of climate change on central banks, Bank of England Staff Working Paper No. 603, May 2016.
[87] M Garmaise and TJ Moskowitz, 'Catastrophic risk and credit markets' (2009) 64 Journal of Finance 657.
[88] C Lambert, F Noth and U Schuewer, 'How Do Banks React to Increased Asset Risks? Evidence from Hurricane Katrina' 29th International Conference of the French Finance Association (AFFI) 2012.
[89] L Zhang and M Massa, 'The Spillover Effects of Hurricane Katrina on Corporate Bonds and the Choice between Bank and Bond Financing' (2012) AFA 2012 Chicago Meetings Paper.

principle is that the absence of definitive evidence of harm should not be used as the basis for a decision not to take action. In doing so, it also aims to avoid the potential costs of inaction, which may outweigh the short-term costs of adopting a precautionary approach. For example, the most widely referenced articulation of the precautionary principle, Principle 15 of the 1992 Rio Declaration, states that "in order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."[90] Similar terms are used in the 1992 Framework Convention on Climate Change.[91]

Although there have been some doubts expressed in the US and elsewhere concerning the status of the precautionary principle in law[92], the EU has adopted a precautionary approach in circumstances it considers appropriate. Indeed, the Commission went as far as formally endorsing its use in legal analysis.[93] Beyond using the precautionary principle in its approach to climate change, the EU has applied it to health protection[94], biodiversity management,[95] chemical management[96] and emerging technologies.[97] This approach finds support in the EU's policy towards the environment; the EU Treaty Article 174(2)[98] states:

> Community policy on the environment shall aim at a high level of protection taking into account the diversity of situations in the various regions of the Community. It shall be based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should as a priority be rectified at source…

[90] UN Rio Declaration on Environment and Development. A/CONF.151/26 Vol. I.
[91] Framework Convention on Climate Change (May 9, 1992). 31 ILM (1992). Preamble 9.
[92] For example, see the arguments presented to the World Trade Organisation (WTO) between the EU on the one hand, and the US, Canada and Argentina on the other, concerning the status of the precautionary principle in international law in European Communities – Measures Affecting the Approval and Marketing of Biotech Products, Report of the Panel, WT/DS291/R, WT/DS292/R and WT/DS293/R, final report issued 29 September 2006.
[93] European Commission, Communication from the Commission on the precautionary principle, Brussels, 2.2.2000 COM(2000) final.
[94] For example, the Water Framework Directive (notably where the identification of priority hazardous substances is concerned), decisions regarding phthalates take the principle into account.
[95] See Regulation (EU) No 528/2012 Of The European Parliament And Of The Council Of 22 May 2012 concerning the making available on the market and use of biocidal products OJ L 167.
[96] See Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC OJ C 317E.
[97] See Directive 2009/41/EC of the European Parliament and of the Council of 6 May 2009 on the contained use of genetically modified micro-organisms OJ L 125.
[98] Consolidated version of the TFEU Part Three: Union Policies And Internal Actions - Title XX: Environment - Article 191 (ex Article 174 TEC), Official Journal 115 , 09/05/2008 P. 0132 – 0133.

In common with virtually all official articulations of the principle, the EU affirms the view that prevention of a potential harm is preferable to ex post correction of its effects. The precautionary principle is also most appropriately invoked in relation to circumstances in which large or irreversible side effects are possible.[99] In the case of climate change, the IPCC has argued that some impacts from climate change will "continue for centuries" even if all emissions from fossil-fuel burning were to stop, and that continued emission of GHGs at current levels would likely lead to "severe, permanent, and irreversible damage."[100] On this basis, overreacting to small probabilities is not irrational when the potential effects are large.[101]

In deciding whether to apply the principle, the Commission states the relevant authority should: start with a scientific evaluation, as complete as possible, and where possible, identifying at each stage the degree of scientific uncertainty; perform an evaluation of various risk-management options, to include the option of taking no precautionary action; and ensure process transparency and involve as early as possible all interested parties.[102] Where regulatory intervention is deemed necessary, the Commission states that any measures should be:

(i) proportionate to the chosen level of protection;
(ii) non-discriminatory and consistent (meaning that comparable situations should not be treated differently);
(iii) based on cost-benefit analysis, including the costs or benefits of lack of action; and
(iv) subject to review in light of new scientific information.[103]

In his otherwise critical appraisal of the use of the precautionary principle in law and regulation, Sunstein considers that the Commission's communication constitutes a "quite sensible"[104] direction, in that it urges consideration "within a structured approach to the analysis of risk" that includes "risk assessment, risk management, [and] risk communication."[105] As Sunstein notes, this means that any measures based on the principle must not be "blindly precautionary, but should be non-discriminatory in application and consistent with similar measures previously taken."[106] More significantly, we can see from the above observations that the principle in EU law must satisfy a proportionality condition,

[99] NA Ashford, 'The Legacy of the Precautionary Principle in US Law: The Rise of Cost-Benefit Analysis and Risk Assessment as Undermining Factors in Health, Safety and Environmental Protection' in N De Sadeleer (ed) Implementing the Precautionary Principle: Approaches from the Nordic Countries, the EU and the United States (Routledge 2007).
[100] IPCC, Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2014) p8.
[101] See note 64 above p10.
[102] European Commission, Communication from the Commission on the precautionary principle, Brussels, 2.2.2000 COM(2000) final, p4-5.
[103] Ibid. p6.
[104] See above note 14 p1017.
[105] See above note 102 p3
[106] See note 14 above p1017.

in recognition of the fact that risk "can rarely be reduced to zero."[107] As I shall now explain, amendments to bank capital requirements to reflect the environmental risks of certain assets satisfy such a requirement.

B. Precautionary Approaches to EU Bank Regulation

As I have noted, EU banks remain the most substantial financers of climate-warming industrial and corporate activities in the Union and beyond. From the perspective of climate abatement, one possible precautionary measure would be the outright prohibition of such credit allocation. However, such a prohibition would inevitably cause huge distress, both at financial institutions and in debt and equity markets. Introducing regulation too quickly in order to tackle these problems may inadvertently cripple the financial system, particularly if large corporations invested in fossil fuels are forced to engage in massive writedowns of assets deemed unsustainable. Second-round effects on financial institutions with exposures to such firms might also be significant if they are forced to absorb losses. Moreover, such a prohibition would also be limited in impact in the absence of any pan-global commitment to follow suit.

On the other hand, in light of preceding discussions, concerted action from financial institutions in making significant positive contributions to climate change abatement is unlikely to materialise. In the absence of a shift away from a 'business-as-usual' approach, there are policy levers available to European regulators which could be used to influence the flow of credit to such ventures. A proportionate precautionary response to such lending, in line with the parameters set out by the Commission, would be to reprice the funding of such activities to reflect externalities created. In particular these levers coalesce around the capital requirements relevant to specific asset classes, which may be used to modulate the costs of credit provision, dependent on the requirement applied. Such capital requirements are already set for all EU credit institutions at the European level under the Capital Requirements Directive (CRD).[108]

1. The Function of Bank Capital

In relation to individual institutions, the primary purpose of capital regulation is to mitigate prudential risks by ensuring there is a large enough capital buffer to absorb losses in the event of an impairment of an institution's assets. Capital requirements are tailored according to the credit risk of the financial products in question, whilst the entire capital adequacy ratio is underpinned by a system of risk-weighting of assets; the riskier the asset on the bank's books, the more capital the bank needs to fund

[107] Ibid. p4

[108] Directive 2013/36/EU of the European Parliament and of the Council of 26 June 2013 on access to the activity of credit institutions and the prudential supervision of credit institutions and investment firms, amending Directive 2002/87/EC and repealing Directives 2006/48/EC and 2006/49/EC OJ L 176/338.

it with (known as a 'capital charge').[109] The fundamental function of such requirements is to guard against losses in asset values which might translate into institutional or systemic distress. Accordingly, there have been reservations expressed by regulators that they should not be used as policy levers:[110] the role of capital is not envisaged to mitigate wider risks, even those as grave as from climate change. Rather, only idiosyncratic risks from legal or transaction-level factors are deemed relevant. As noted by Alexander in the context of the Basel Capital Accords (which form the basis of the CRD)[111]:

> Pillar 1 of Basel does require banks to assess the impact of specific environmental risks on the bank's credit and operational risk exposures, but these are mainly transaction-specific risks that affected the borrower's ability to repay a loan or address the 'deep pockets' doctrine of lender liability for damages and costs of property clean-up.

Reflecting this view, regulators have also failed to yet include climate change as a material risk under the Basel Accord's second pillar of market supervision. According to Alexander, "most bank supervisors have not utilised Pillar 2's supervisory approaches to incorporate forward-looking models that estimate the potential stability impact of supplying credit to environmentally unsustainable or sustainable activities over time into their stress tests."[112]

2. Greening the EU Banking System

Despite these views, the EU has recently signalled that approaches to mitigating climate risk under the CRD may be considered. Preparatory work in this field is being undertaken into the feasibility of lowering capital requirements against certain 'green assets'[113] which, it is claimed, are excessively high under the current asset risk-weighting regime.[114] According to the CMU, the Commission intends to:

> explore how banks and insurance companies can contribute to funding projects that will ensure the transition to a more sustainable economy, where justified from a prudential point of view … identifying a legally-enforceable classification system will need to go hand in hand with a thorough capital calibration in order to not undermine the effectiveness of the EU prudential rules. On this basis, the Commission will explore the feasibility of recalibrating the capital requirements for banks (so called "green supporting factor") when it is justified from a risk perspective, while ensuring that financial stability is safeguarded.[115]

[109] Basel Committee on Banking Supervision, Basel III: A global regulatory framework for more resilient banks and banking systems, December 2010 (rev June 2011).
[110] See note 84 above.
[111] Kern Alexander, 'Stability and Sustainability in Banking Reform: Are Environmental Risks Missing in Basel III?' (CISL & UNEP FI, 2014) p15.
[112] Ibid. p19.
[113] J Brunsden, 'Brussels looks at easing bank capital rules to spur green investment' Financial Times, 10 January 2018.
[114] For example, the HLEG comment that: "There is… a perception that calibrations on project financing and specialised lending are high. Feedback from banks with a long history of project financing suggests that regulatory capital requirements far exceed economic capital calculations." See above note 50 p32.
[115] European Commission Fact Sheet, Frequently asked questions: Action Plan on financing sustainable growth, Brussels, 8 March 2018, p3.

There is a precedent for such reforms: lending to EU SMEs is currently accorded preferential capital treatment under SME Supporting Factor (SME SF) introduced in 2014 under the Capital Requirements Regulation (CRR).[116] Similar preferential treatment for infrastructure projects is found in EU insurance company regulation.[117] Indeed, the Commission has explicitly stated that capital requirements may be subject to "targeted adjustments in order to reflect EU specificities and broader policy considerations."[118] The levels of any reductions under such a supporting scheme for green assets would be modelled on the discounts for small SME investments under Article 501 of the CRR, currently comprising a capital reduction of 23.81 percent for banks' exposures to small firms for investments below €1.5 million.

These reforms have a mooted introductory date of mid-2019. As I have argued, they reflect a much-needed change in thinking on the activities of credit institutions in the EU. However, there are at least three important objections to this approach to amending credit risk calculations. The first is that 'green' investments, whilst perhaps more desirable from a public policy standpoint than so-called non-green investments, are no more creditworthy than non-green assets.[119] Boot and Scheonmaker argue succinctly that reducing capital requirements for green assets is "asking banks to turn a blind eye on proper risk management, as we don't know which green technologies will win. It is unacceptable."[120]

The second is that research indicates that incentivising loan origination in this way would produce marginal results; banks will simply price loans less aggressively in the event that capital requirements are lowered. According to researchers at Cambridge: "regulatory capital … requirements as currently set forth in Basel III's Pillar 1 approach play at most a marginal role in influencing a bank's decision to provide specialised lending on project finance for environmentally sustainable economic activities such as renewable energy infrastructure projects"[121] with other factors including political and economic riskiness playing much more prominent roles.[122] In line with this, there is little evidence that the SME SF has been effective in either lowering borrowing costs or

[116] Regulation (EU) No 575/2013 of the European Parliament and of the Council of 26 June 2013 on prudential requirements for credit institutions and investment firms and amending Regulation (EU) No 648/2012, OJ L 176.
[117] Commission Delegated Regulation (EU) 2017/1542 of 8 June 2017 amending Delegated Regulation (EU) 2015/35 concerning the calculation of regulatory capital requirements for certain categories of assets held by insurance and reinsurance undertakings (infrastructure corporates) OJ L 236/14.
[118] Proposal for a Regulation of the European Parliament and of the Council amending Regulation (EU) No 575/2013 as regards the leverage ratio, the net stable funding ratio, requirements for own funds and eligible liabilities, counterparty credit risk, market risk, exposures to central counterparties, exposures to collective investment undertakings, large exposures, reporting and disclosure requirements and amending Regulation (EU) No 648/2012, COM(2016) 850 p3.
[119] S Matikainen, 'Green doesn't mean risk-free: why we should be cautious about a green supporting factor in the EU' 18 December 2017 http://www.lse.ac.uk/GranthamInstitute/news/eu-green-supporting-factor-bank-risk/
[120] A Boot and D Schoenmaker, 'Climate change adds to risk for banks, but EU lending proposals will do more harm than good' Bruegel, 16 January 2018, http://bruegel.org/2018/01/climate-change-adds-to-risk-for-banks-but-eu-lending-proposals-will-do-more-harm-than-good/
[121] See note 111 above.
[122] Ibid p16.

increasing access to finance for SMEs.[123] In contrast, what the introduction of the SME SF did lead to was a reduction in aggregate EU bank capital of over €12 billion, arguably denting financial stability.[124] Equally undesirable consequences in relation to a green supporting factor cannot be discounted.

Finally, the largest banks in the EU use the internal-based approach to risk weight modelling (IRBA), which is permitted under the CRR.[125] Nothing prevents larger banks from already lowering their capital requirements against particular forms of asset – including green assets – provided that regulatory approval for their assessments and methodolgoies have been approved by bank supervisors. Because large banks in the EU are those most responsible for continued large-scale funding of brown assets, and such banks are already given latitude to reduce their capital requirements by regulation, it is unlikely that any green asset SF will have any impact on their lending appetite.

3. Penalising Brown Assets

Thanks to the aforementioned limitations, rather than focusing only on the incentive-generation effects of green supporting factors, capital requirements therefore instead ought to be used to penalise so-called "brown" projects, or those which carry high-climate risk. This concept was mooted by the HLEG in its Interim Report:

> A 'brown-penalising' factor, raising capital requirements towards sectors with strong sustainability risks, would yield a constellation in which risk and policy considerations go in the same direction [as rewarding green projects]. Moreover, it would be more focused and easier to rationalise as capturing the risk of sudden value losses due to 'stranded assets'.[126]

It is unclear why the original HLEG initiative was abandoned. As noted, evidence collated by researchers at Cambridge suggests that altering capital requirements downward (for example, under a green supporting factor) would likely have a negligible effect on banks' decisions on whether to make specific loans.

In contrast, higher risk-weighted capital requirements are known to disincentivise lending, including when targeted at particular asset classes.[127] Powers to amend lending in this way are already afforded to bank regulators under the CRD and CRR; such an option provides regulators with a flexible, targeted tool with which to funnel credit away from particular sectors, and thus decrease financial flows to such projects. In the UK for example, the Bank of England is afforded a tool known as the Sectoral Capital Requirement (SCR), whereby the Bank's Financial Policy Committee can

[123] European Banking Authority, Report on SMEs and SME Supporting Factor, EBA/Op/2016/04 23 March 2016.
[124] Ibid.
[125] Articles 144(2), 173(3) and 180(3)(b) of Regulation (EU) No 575/2013.
[126] See above note 49 p31.
[127] H Fraisse, M Lé, D Thesmar, The real effects of bank capital requirements, ESRB Working Paper Series No 47, June 2017.

order increase banks' capital requirements on exposures to specific sectors where lending poses risks to financial stability, providing "targeted incentives for banks to limit the expansion of riskier…exposures".[128]

Increasing the capital required for such assets would also act as an indirect tax on such activities. In almost all jurisdictions debt service costs (interest) are deductible against payable taxes, whereas any dividends on capital are not.[129] By raising the capital requirements on certain brown assets, banks would have to fund such assets with a greater proportion of capital (shareholder funds), thereby raising banks' cost of funding. Such a regulatory change is likely to mean banks will charge higher rates for particular asset forms. It also would avoid the potential avenue for banks to use the proposed green supporting factor to subsidise funding for brown assets. In the absence of any portfolio restrictions operating in tandem with such a green supporting factor, there is substantial moral hazard embedded in any preferential prudential treatment for green assets, as such assets may be used to cross-subsidise the origination of credit for GHG-intensive purposes.

If tightening regulations on financial exposures to carbon-intensive firms had the intended effect of increasing the cost of finance for those borrowers, this would reduce their ability to diversify away from their current activities or to invest in GHG-reduction technologies, unless exclusions can be applied to financing specifically earmarked for such investments.[130] This is something that must be considered alongside any proposal to modify capital requirements with respect to brown assets. Nevertheless, a much stronger case can be made for penalising certain brown assets rather than introducing a green supporting factor. Not only would this be more stability-inducing than cutting capital for green assets, it would discourage banks from funding investments which contribute to climate change. This will produce two socially desirable outcomes: increased (rather than lower) loss absorbing capacity at financial institutions; and the internalisation of at least some of the costs of climate shifts. It would also incentivise a more rapid transition by GHG-intensive firms to a lower carbon future by providing cheaper funding for green investment relative to continued capital allocation to brown assets. Naturally, a globally-binding measure would be preferable to one which is merely EU-wide. On the other hand, EU banks are significant contributories to the funding of brown assets outside the Union, and so their activities cannot be evaluated simply on the basis of their role in funding emissions internal to the EU. Furthermore, the EU has imposed upon itself targets for the reduction of GHG emissions; introducing such measures would assist in this endeavour. The bloc remains committed to remaining in the vanguard of climate abatement policies; it must ensure that financial regulators are provided with sufficient prudential tools to facilitate such a transition.

[128] Bank of England, The Financial Policy Committee's powers to supplement capital requirements: A Policy Statement (January 2014) p10.
[129] SM Chaudhry, A Mullineux, N Agarwal, 'Balancing the regulation and taxation of banking' (2015) 42 International Review of Financial Analysis 38.
[130] See note 84 above p6.

A further potential externality of any penalisation of brown assets under bank capital rules would be that the financing of such investments would simply migrate to the capital markets, and be financed directly either through equity or bond finance.[131] However, fears concerning such externalities are likely misplaced. Such migration is improbable, largely because capital markets are already attuned to the risks of climate shifts and punish perceived transgressors of contemporary investment norms, which regard investment in GHG-intensive industries (such as fossil fuels) negatively from both financial and ethical perspectives.[132] Indeed, significant momentum away from investment in such assets has been built: high-profile divestment campaigns restricting the funding channels through which high-ESG risk activities may be financed have been widely established.[133] Importantly, such trends expose the banking system as the locus of continued investments in brown assets or brown technologies. Despite this centrality, the impetus to force divestment from brown assets is not as strong within the banking system as elsewhere in capital markets: bank investors are in general much less concerned with long-term performance than other investor types.[134] This is even more pertinent to the EU because of its aforementioned financial structure, which is heavily biased towards banks. Increasing capital requirements on brown assets is highly unlikely to jolt capital market participants into funding ventures which many now regard as objectionable from both economic and ethical perspectives. In short, the current path evidences contraction, rather than expansion, of these funding markets.

VI. CONCLUSION

I have argued in this article that a fundamental change in the approach to the funding of brown assets ought to be adopted by EU authorities. Existing measures – and even those proposed by the HLEG – do not sufficiently address the deep uncertainties attached to climate change, which make any estimations of damage, both to the financial system and the economy as a whole, speculative in many respects. In recommending that particular asset classes be targeted by EU regulators to address the

[131] This valuable point was made by a reviewer of the article.
[132] For example, according to the Financial Times, "[p]ension funds cite both ethical and financial reasons for reducing exposure to fossil fuels." See A Mooney, 'Growing number of pension funds divest from fossil fuels' Financial Times, 28 April 2017.
[133] For example, according to Arabella Advisors: "On the one-year anniversary of the Paris climate agreement, the value of assets represented by institutions and individuals committing to some sort of divestment from fossil fuel companies has reached $5 trillion. To date, 688 institutions and 58,399 individuals across 76 countries have committed to divest from fossil fuel companies, doubling the value of assets represented in the last 15 months." See The Global Fossil Fuel Divestment and Clean Energy Investment Movement, December 2016, https://www.arabellaadvisors.com/wp-content/uploads/2016/12/Global_Divestment_Report_2016.pdf. Such momentum continued in 2017, with institutions including the World Bank, Axa, ING, Norway's Government Pension Fund Global, and the New York City Common Fund declaring they would scale back or end investment in some fossil fuel industries.
[134] A.G. Haldane, 'Control rights (and wrongs)' Wincott Annual Memorial Lecture, Westminster, London, 24 October 2011.

climate change challenge, I recognise that certain political choices must be made. Technocrats are not politicians and are not accountable to voters; such restrictions may therefore be regarded by some as democratically questionable. However, the challenge of climate change poses a magnitude of risk not currently countenanced by financial regulation; measures such as increasing capital against investments which contribute to possible outcomes with huge negative externalities are designed to mitigate the potential for systemic ruin. Moreover, even if the more optimistic predictors in relation to the likely shape of climate damages are correct, we have no way of knowing this today. In such cases, a proportionate precautionary measure to shift financial flows away from climate-damaging activities should be considered.