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Central Banks and Climate Justice: The Case for Green Quantitative Easing and its Justification

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Declaration: I confirm that this is my own work and the use of all material from other sources has been properly and fully acknowledged.

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Abstract

This thesis makes two distinct contributions to the debates on climate justice. First, it offers a range of policy proposals that central banks can implement to make a faster transition to a sustainable or 'green' energy system. Second, it addresses the normative issues raised by some of these green monetary policy proposals, which involve shifting part of the costs of climate change mitigation and adaptation onto future generations. The project draws together debates from climate justice, intergenerational justice, and the politics of central banking. By taking an interdisciplinary perspective on the problems created by climate change it aims at proposing policy options for the central bank to combat the effects of global warming, and it defends them from the perspective of moral and political philosophy.

The argument starts from a distinction between two kinds of principles of intergenerational climate justice. There are principles that tell us to mitigate climate change in order to protect future generations, and principles that tell us how to share mitigation costs fairly across generations. I will present the case for Green Quantitative Easing or green central banking as a range of policies to serve both kinds of principles of intergenerational climate justice. First, I show that central banks can, and should, serve intergenerational climate justice by implementing policies that cut emissions and thereby reduce the climate burden on future generations. Second, I argue that some of these policies justly shift part of the financial costs of mitigation onto future people, promoting a fairer distribution of mitigation costs between the present and future generations.

The thesis presents a range of policy options that a green central bank can implement to meet the two principles of climate justice. I start with milder proposals and end with more radical but still realistic ones that are intergenerational in scope. These more radical proposals can be seen as instances of 'borrowing from the future': This is the idea that we need to take climate action now, but we can shift some of the costs onto future generations. Given the power of central banks to create money and buy bonds that can be kept on their balance sheet, Green Quantitative Easing is superior to alternative strategies, such as a global carbon tax or the World Climate Bank envisaged by Broome and Foley. Moreover, unlike Broome and Foley, I suggest that policies that 'make the grandchildren pay' for mitigation are not justified only due to the present generation's unwillingness to bear the costs of urgent climate action. I also defend cost-shifting in enthusiastic terms: as a means to promote intergenerational distributive justice.

The justice-based defense of Borrowing from the Future is grounded in the Intergenerational Ability to Pay Principle (IGAPP) as a guiding principle to share the burden of climate change mitigation and adaptation across generations. I draw from Caney's well-known pluralistic account for the intragenerational case and offer a pluralistic account of burden-sharing principles for the intergenerational case. However, I depart from Caney by arguing that the IGAPP should apply to a broader set of costs. Finally, I respond to one important objection raised by Gardiner: that making our grandchildren pay is a case of intergenerational extortion. I conclude that Green Quantitative Easing is a superior strategy to the alternatives proposed: a strategy that promotes urgent climate action now, whilst fairly sharing the costs with future generations.

Acronyms

APP: The Ability to Pay Principle

BFF: The Principle of Borrowing from the Future

BPP: The Beneficiary Pays Principle

C: The present generation's consumption

E: Climatological capital stock that the present generation needs to invest to eradicate the emission of greenhouse gases and stop climate change

ECB: European Central Bank

GCTs: Greening Compensatory Transfers

GDP: Gross Domestic Product

GHG: Greenhouse Gases

Green QE: Green Quantitative Easing

IGAPP: The Intergenerational Ability to Pay Principle

IGPP: The Intergenerational Polluter Pays Principle

K: Conventional capital stock that is invested in institutions for future generations, such as infrastructure, health, education or social security

PPP: The Polluter Pays Principle

QE: Quantitative Easing

WCB: The World Climate Bank

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Alex Mihailov has been my second supervisor. When he presented our joint discussion paper at the University of Birkbeck, he explicitly mentioned (I was attending online) that before meeting me, he was a mainstream economist, trained as a central banker in the National Bank of Bulgaria. So when I came with my crazy ideas about creating money to fund a transition to a green economy, he found them awkward. On the other hand, Alex is very open-minded, probably because he has lived in several countries (something unusual in Spain) and speaks several languages (something uncommon in the UK). I have benefited a lot from his expertise. After several meetings, he introduced the right economic assumptions to shape the ideas we shared during these meetings, which are reflected in chapter 3. His contribution also appears as a mathematic model supporting the Green Compensatory Transfers proposal that comes as an appendix to this dissertation.

I would also like to thank my mentors, Paula Casal and Andrew Williams, in this competitive academic world – although less competitive

than the legal world where I used to practice before coming back to the University in 2010. I had the opportunity to share some of my arguments with them during these past years. I remember a day we went on a bike hike where we discussed some key aspects of the dissertation (I guess you can figure out how difficult it is to discuss political philosophy while trying to keep pace with them on my bike). I also remember a more relaxed walking promenade in which we went to discuss each chapter of the thesis during a weekend we spent together in Costa Brava. I would also like to thank other colleagues and friends that have been lovely and extremely helpful in shaping my views about the normative aspects of central banking during this last decade or so devoted to political philosophy. Paul Bou-habib, Peter Dietsch, Clément Fontan, Iñigo González, Axel Gosseries, Rob Jubb, Catriona McKinnon, Marco Meyer, Serena Olsaretti, Jahel Queralt, Jens van't Klooster, and many others that I cannot mention here because the list would be too long.

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1 Introduction

1.1 Climate Change and Intergenerational Justice

Current climate change is anthropogenic. It is caused by our emissions of greenhouse gases (GHG) that have the effect of warming the surface of the planet. Its potential effects on life on Earth make it one of the most challenging problems facing humanity today (Volk 2008). The Intergovernmental Panel on Climate Change (IPCC) report claims that Global GHG emissions in 2030 associated with the implementation of nationally determined contributions (NDCs) announced before COP26 would make it likely that warming will exceed 1.5°C during the 21st century. Limiting warming to below 2°C would then rely on a rapid acceleration of mitigation efforts after 2030.[1]

Climate change is, therefore, one of the most critical problems for the generations that will come after us. The dangerous climate change we face threatens to harm the young today and future generations. The increase in diseases, extreme weather events, droughts and famines, sea-level rise, or agricultural disruption is likely to produce major harm for the planet and those who live on it in the future (McKinnon 2012; see also Solomon et al., 2009; Schaeffer et al., 1993; and C. M. Rosenzweig et al.,1993). In the worst-case scenarios, if not tackled, climate change might cause human beings, as well as many other species, to go extinct.

To get a sense of the potential impact costs of climate change, we can make a rough division in this category of costs between a) those stemming from the increase in global average temperature, b) those stemming from extreme weather events, and c) those stemming from climate catastrophes, such as those that could occur if we were to pass so-called climate 'tipping points' and set in chain massive and irreversible

[1] The IPCC has finalized the third part of the Sixth Assessment Report, Climate Change 2022: Mitigation of Climate Change, the Working Group III contribution. It was finalized on 4 April during the 14th Session of Working Group III and 56th Session of the IPCC.

effects (McKinnon 2012). There is an imperative to stop some of these costs from coming about, and further sets of costs are associated with securing this moral imperative. These prevention costs can be divided between mitigation and adaptation costs. The former costs are required to limit the amount of climatic change that will occur and the latter to guard against the effects that come about even if we take climate action or precisely because we are delaying climate action.

Suppose we want to protect future generations of humans and species from the risk of harm caused by climate change. In that case, we need to advance as much as we can the date of technological transition, that is, the date by which we will not depend on burning fossil fuels to obtain the energy necessary for our economies and for reaching a decent standard of living (Shue 2014). The longer it takes to reach this technological transition date, the more dangerous the world will be for future generations of humans and other species because the total sum of carbon emitted since the Industrial Revolution will be higher.

Shue (2014) argues that there are four salient moral characteristics of climate change: (a) if we do not take climate action, it is not just that we are not helping future generations. We are violating the general moral duty to refrain from causing harm to others; (b) If we fail to stop the acceleration of climate change, we will be harming some generations further in the future than those that will already suffer from climate change if we take climate action now; (c) if we do not stop global warming, we risk crossing thresholds beyond which climate change would feed-back on itself through positive feedbacks that would not have occurred had we acted sooner and would severely worsen the situation of future people (See Hoffert, 1992). That is, delay in reducing emissions may cause the climate system to pass a threshold into abrupt changes that might cause even worse climate change, making adaptation even harder. Moreover, if we do not take climate action now, we are creating the risk of irretrievable climate changes. Finally, (d) we are creating the risk of crossing some threshold beyond which climate change will be

catastrophic, and that might cause the extinction of humankind (and many other species).

The budget of GHG is cumulative, which means that it is not enough to reduce carbon emissions to the level of 1990, as some politicians proposed in the past. This is not enough because what matters is the total accumulated in the atmosphere since 1850 (See Niel, Bowerman, Frame, Huntingford, et al., 2011; see also Pierrehumbert, 2013). If we want to limit global warming to 1.5 ºC, emissions of GHG should reach a zero-sum total. A zero-sum total means that nobody can use any of the emissions beyond their individual limit without anyone making a corresponding reduction, unless all of us exceed the limit. We need to reach annual GHG emissions that can be absorbed by natural or artificial sinks every year. Thus, according to Shue (2014), there are only three possible alternatives:

1. We can continue with business as usual and cause climate change, avoiding any decision to reach a zero-sum total of emissions.
2. Reduce our economic activity and living standard by having a lifestyle using only our fair share of emissions that allows us to reach a zero-sum total of emissions; or
3. Develop non-carbon-based energy sources, which would make carbon emissions non-essential and achieve any zero-sum total set to make global warming irrelevant to most people's lives, thus defusing this issue of intergenerational justice.

This thesis defends Green Quantitative Easing and Borrowing from the Future as tools to bring forward the date of technological transition and avoid further harm to future generations. The thesis presents a range of policy options that a green central bank can implement to meet the requirements of climate justice. I start with milder proposals and end with more radical but still realistic ones that are intergenerational in scope. These more radical proposals can be seen as instances of

'borrowing from the future': This is the idea that we need to take climate action now, but we can shift some of the costs onto future generations.

I will argue that finance and green central banking is crucial in realizing the third strategy amongst the menu listed above. The argument starts from a distinction between two kinds of principles of intergenerational climate justice. There are principles that tell us to mitigate climate change in order to protect future generations (type 1), and principles that tell us how to share mitigation costs fairly across generations (type 2). For intergenerational climate justice, climate change raises two major challenges. First, we need to identify the harms to future people and compare them to other damages to decide how much we should reduce our GHG to mitigate the effects of climate change on future people. On the other hand, it is also within the scope of intergenerational climate justice to provide sound reasons to justify the distribution of the costs of mitigating and adapting to climate change across generations (Caney 2014, 2018; Moss 2015).[2] I will present the case for Green Quantitative Easing or green central banking as a range of policies to serve both kinds of principles of intergenerational climate justice. First, I show that central banks can, and should, serve intergenerational climate justice by implementing policies that cut emissions and thereby reduce the climate burden on future generations. Second, I argue that some of these policies justly shift part of the financial costs of mitigation onto future people, promoting a fairer distribution of mitigation costs between the present and future generations.

1.2 Finance and Climate Change

What role, if any, should central banks take in combating climate change? My answer to this question briefly stated, is that due to their

[2] In the rest of the thesis, I will refer to these two questions as type 1 and type 2 questions of climate justice.

strategic position in financial markets and the global economy, they should play a vital role in climate change mitigation. Furthermore, there is a second related question that I will address, namely, how can Green Quantitative Easing be used to promote intergenerational climate justice? This dissertation argues that central banks can and should be decisive not only in promoting a transition to a sustainable economy but also in fairly distributing the costs of mitigation and adaptation across generations.

This normative research on climate justice is original in the sense that I will not only appeal to political philosophy but also economic analysis and finance. Mark Carney (2019), former governor of the Bank of England and United Nations Special Envoy for Climate Action and Finance, stressed recently that the global financial system is currently funding a 4°C rise in the planet's temperature. This rise is more than double the pledge to limit increases to well below 1.5°C contained in the Paris Agreement (Carney, 2019). The financial system's role in the economy and society is to facilitate the necessary financing and liquidity for human and economic activity to thrive. Therefore, as things stand out right now, financial markets enable investment in fossil fuel resources. Since we want to reduce GHG emissions that derive from human and economic activity, we need to diminish the investment in fossil fuel resources. One option is to regulate the financial system and promote sustainable or green finance (see Alexander and Fisher 2019).

Regulators and central banks need to take this financial reform to influence investment and consumption and switch to a form of energy that is sustainable and does not threaten future generations. An optimal policy for a transition to a low-carbon economy requires the coordination of monetary authorities greening the financial system with fiscal rules to implement a carbon tax (see Schoenmaker 2019). In this dissertation, I will focus on monetary policy and the recent literature on green monetary policy. Some think that given the absence of regulation (e.g., a carbon tax), Green Quantitative Easing (Green QE) or green central banking is

the second-best policy for greening the economy (Volz 2017). However, even if there should be a coordination of fiscal and monetary policies for tackling climate change, I will argue that Green QE is a superior strategy to carbon taxes or other traditional forms of borrowing from the future. The thesis aims at providing an interdisciplinary piece of work that analyses and justifies Green Quantitative Easing (Green QE) as an instance of borrowing from the future. Besides the mainly financial chapter 3, the thesis focuses on the justification of Green QE. It addresses the normative issues raised by the move to make future generations pay for mitigation costs, by examining the principle of borrowing from the future (BFF). It builds an *enthusiastic argument*[3] in favor of making our grandchildren pay for mitigation costs and discusses potential objections to the BFF principle and Green QE. The thesis has two distinct parts. First, the empirical part argues that central banks are a powerful institution to transition to sustainable finance. In chapter 3, I will present the case for Green Quantitative Easing to serve the two kinds of intergenerational climate justice principles highlighted above. The rest of the thesis will defend Green QE as an instance of borrowing from the future (BFF) and discuss the normative issues around this idea of making our grandchildren pay.

In the following sections, I provide some important background to this argument. First, I draw out the wider normative significance of central banks and put my project in the context of recent literature in the philosophy of finance. I will also show why they are essential in the case of climate and briefly explain the current debates about what they could do. Second, I will discuss the role of central banks in relation to climate change in particular, highlighting recent high profile calls for a 'Green New Deal'.

[3] See Gardiner (2017) for the distinction between concessive and enthusiastic defenses of borrowing from the future.

1.3 The Normative Significance of Central Banks

In this section, I discuss why central banks are important in general and explain their normative significance. Independent central banks have general goals, such as controlling the money supply and fixing the interest rate, securing price and financial stability, and, in some cases, other goals like high employment and sustainable growth. According to Goodhart (2010), the primary role of central banks is threefold: to be in charge of the money supply through open market operations to adjust their balance sheet; to fix the interest rate; and to monitor the risks of strategic financial institutions.

A helpful starting point for thinking about the normative standing of central banks is through the Rawlsian notion of the basic structure. For Rawls, the primary subject of justice is the basic structure of society, or the way major social institutions distribute fundamental rights and duties and determine the division of advantages from social cooperation (Rawls 1971, 1977, 2001). The financial system is part of the basic structure of society. It is important to note that the system contains private elements, such as commercial banks and investors, and public ones, such as the central bank and regulators (de Bruin et al., 2018). Central banks and regulators, being the public elements of the financial system, are part of the basic structure and connect finance with questions of political legitimacy and justice (Fontan et al., 2016, Tucker, 2018, Dietsch et al., 2018, Van't Klooster 2019, 2020, Fontan and Van't Klooster 2020, Dietsch 2020).

To understand how a central bank works, we need to look at the most crucial feature of central banks: the fact that they have a monopoly on the issuance of currency. This unique power makes the central bank the best institution of our democracies to achieve price and financial stability. The main channel for monetary policy implementation consists of *open market operations* that are used to fix the interest rate. If the bank wants to expand the economy's money, it buys bonds and pays for them

by creating money. In contrast, if it wants to contract the money supply, it sells bonds and removes from circulation the money it receives from the exchange of bonds. As the central bank buys bonds, the demand for bonds increases, increasing their price while the interest rate on bonds goes down. In contrast, when the central bank makes a contractionary open market operation, it decreases the bonds' price and increases interest rates on them.

For decades, during what has been called "The Great Moderation Era" (Stock and Watson 2002), central banks were seen as apolitical bodies. The independence of central banks was instrumentally justified when their only goal was to fix inflation with a single instrument, the short-term interest rate. Time-inconsistency problems caused by electoral pressures make governments less able to promote long-term stable inflation (Kydland and Prescott 1977, Rogoff, 1985). Thus, delegating monetary policy to unelected experts was seen as a self-binding device to overcome such electoral pressures and promote long-term price stability. Jon Elster famously defended the government should tie its hands if it wants to achieve the price stability target (see Elster, 1979; 1994; 2000). The independence of the central bank ensures this goal by the appointment of financial experts not subject to re-election and who cannot easily be removed by the legislature. Insofar as independence involves the delegation of powers by the government, it is similar to the establishment of constitutional constraints.

The government acts as illustrated by the case of *Ulysses and the Sirens*. It exercises its ability to bind itself to achieve a target in the long term (Elster, 1979: 61). Delegation in favor of an independent central bank has similar features. The government defers its right to rule over monetary policy to the board of directors of the independent central bank. They act on behalf of the government for determinate purposes, adding financial expertise and avoiding the dilemmas and conflicts of interest that the government faces when handling monetary policy.

It is important to note that setting an inflation target is a decision with distributional consequences, at least in the short term. If the central bank raises the interest rate to fight inflation, this will lead to lower economic output and more unemployment. This decision is clearly a political choice with distributional effects. We might argue that unemployed people are amongst the worst-off members of society. Thus, this contractionary monetary policy seems to contradict prominent accounts of distributive justice, e.g., that inequalities should maximize the prospects of the least advantaged.

However, for several decades before the Global Financial Crisis 2007-9, it was normally thought that the fiscal authority had the tools needed to achieve distributive justice. They could compensate for the distributive effects of the central bank's decisions. After the 2008 global financial meltdown, central banks recovered, with tremendous energy, their interest in broader financial stability and started using various instruments besides managing the short-term interest rate. Many of these instruments represent forms of quantitative easing (QE): the outright purchase of financial instruments such as bonds, stocks or financial derivatives by the central bank. Several authors have highlighted that the government's political actions cannot compensate the overall distributive effects of QE (Fontan et al. 2016, Dietsch et al. 2018).

Quantitative Easing (QE) has to be understood as an instrument to achieve financial stability in the financial system and the government's debt markets after the 2007-2009 Global Financial Crisis. These new policies like QE and their distributional impact have gained interest amongst central bankers themselves, economists, and political theorists. Some think it is less acceptable that independent experts can choose any unconventional means to achieve price and financial stability when these policies have deep distributional consequences (e.g. Fontan et al. 2016, Tucker 2018, van't Klooster 2019, 2020). It is helpful for these purposes to distinguish between ends and means of the central bank (Dietsch

2016). The central bank's mandate establishes the ends or goals that the institution needs to achieve, namely price and financial stability, but the central bank has freedom of means to achieve these ends. Before the crisis, the central bank used just one instrument, the short-term interest rate, to achieve the ends established by the legislature's mandate. After the global financial crisis, central banks have started to use multiple instruments and means to provide price and financial stability. This new role of the central bank implies a much broader set of political choices since each of these means has different distributive effects.

In 2000, even before the Global Financial Crisis, Japan launched QE programs to fight deflation when nominal interest rates were close to their zero lower bound. This strategy was seen as a particular case derived from distinct features of Japan's economy. In 2008, in the aftermath of the Global Financial Crisis, the Federal Reserve Bank in the United States and the Bank of England responded to the global financial meltdown with an unconventional monetary policy such as QE. The European Central Bank (ECB) joined them a few years later, amid the Euro crisis. These programs involved the outright purchase of large amounts of financial assets on secondary markets. Under these programs, central banks have purchased a wide range of financial assets with varying maturities, including government bonds, asset-backed securities, and corporate bonds and stocks. Quantitative Easing implied a massive increase in the money supply - almost 3,000 billion Euros for the ECB only before the pandemic - to purchase bonds and stocks, increasing the size of these central banks' balance sheets five or six times (Fontan et al., 2016).

A growing number of political theorists have been examining the social responsibility of finance and the distributional consequences of QE programs. The central worry within the recent literature on the political philosophy of finance is that monetary policy implies decisions made by independent non-elected officials that have enormous distributional consequences, which in turn compromise the government's political

legitimacy. For instance, QE programs favor bonds and stockholders, who see their assets increase in value (Montecino and Epstein 2015). This consequence is potentially problematic for two reasons. First, it raises concerns about distributive justice. For example, bond and stockholders who benefit from QE are typically among society's most advantaged members. Second, there are issues of democratic or procedural legitimacy: some question whether unelected officials should have such freedom of means to achieve price stability. These new policies like QE do not fit well with the traditional justification of central bank independence as self-binding devices to achieve stable long-term inflation. Some authors claim that it is especially problematic that its current narrow mandate focused on price stability can include such profound political decisions, given central banks' independence and weak democratic accountability. I will try to briefly respond to the concerns about the legitimacy of green central banking in chapter 3. However, I am primarily concerned with another kind of normative issue arising from QE, namely the two intergenerational climate justice issues highlighted at the start of this introduction.

1.4 An Interdisciplinary Approach: What Can Central Banks Do to Promote Climate Justice?

This thesis connects (i) recent debates about the social responsibility of central banks with (ii) more established theoretical work on intergenerational justice. This connection is essential because debates about intergenerational justice have been neglected, with some welcome exceptions like Broome & Foley's proposal of a World Climate Bank (2016), issues about finance crucial to climate justice. On the other hand, the recent literature in finance philosophy has focused on central banks' legitimacy and distributive justice (Fontan et al. 2016; Diestch et al. 2018; Turner 2018; Van't Klooster 2019, 2020; Fontan and Van't Klooster

2020). But these authors have not yet considered the influence of finance on intergenerational climate justice.

I will also engage (iii) with relevant literature on climate justice, particularly around the principle of borrowing from the future. I will show that monetary policy is a powerful tool to transition to a sustainable economy, mitigate the effects of climate change, and promote a fairer distribution of mitigation and adaptation costs to climate change across generations. Furthermore, (iv) I will also engage with the recent literature on green monetary policy or Green QE in economics. Finally, an essential contribution of the thesis is to show that Green Quantitative Easing offers us a range of economic policy options to distribute the costs of mitigation and adaptation to climate change across generations.

To begin with, Baer et al. (2021) distinguish between *prudential* and *promotional* interventions of central banks to favor the transition to a low-carbon economy. Prudential interventions refer to the mitigation of risks caused by climate change that can have an impact in financial or price stability. Promotional interventions, in contrast, refer to the enormous potential of using the social technology of money creation to promote a transition to a sustainable form of energy. In addition, this dissertation's contribution is to show Green QE's intergenerational role in distributing mitigation and adaptation costs to climate change across generations, and why it is a strategy superior to the alternatives proposed as forms of borrowing from the future in the past.

I will call intergenerational Green QE, central bank's interventions to purchase climate bonds with very long maturities. We have an opportunity to design these bonds with very long maturity dates, say 100 years, and divide the burden of mitigation and adaptation to climate change across several generations. In this case, central banks would not only promote a transition to a low-carbon economy but also help to distribute the burden of taking climate action now across generations. In particular, I will focus on the Generation-Shared Green QE Bonds

proposal developed together with Alexander Mihailov.[4] Finally, I will propose another original policy, Green Compensatory Transfers, developed by Mihailov and myself. GCTs are meant to compensate the present generation for the extra cost of sustainable goods and energy.[5]

1.5 What Are Central Banks Doing to Combat Climate Change?

Central banks are at the core of our financial system. This explains why the American Green New Deal promoted by Alexandra Ocasio-Cortez in the Congress of the United States and the UK New Green Deal announced by a group of economists in the aftermath of the 2008 Global Financial Crisis (see Pettifor 2020) rely heavily on central banks and monetary policy.[6] The idea of a Green New Deal is inspired by the Keynesian policies adopted in the 30s by the president of the United States, Franklin Roosevelt, and that also inspired the response to World War II, moving huge amounts of public money to create jobs and finance public projects. The special powers of central banks make them strategically adequate for a systemic change that transforms our economy into new forms of a sustainable energy system that does not rely on the emissions of GHG. The proposals defended here can be seen as a range of policies that should be part of the systemic change demanded by the defenders of the Green New Deal on both sides of the Atlantic.

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[4] Mihailov, A. and Ferret, J. (2021): "Green Quantitative Easing as Intergenerational Climate Justice: On Political Theory and Pareto Efficiency in Reversing Now Human-Caused Environmental Damage." Discussion Paper, University of Reading.

[5] See also the Appendix.

[6] See also the United Nations, Department of Economic and Social Affairs, Division for Sustainable Development, *A Global Green New Deal for Climate, Energy, and Development*, Technical Note 8 (2009). The current market price of fossil fuels is extremely low because fossil fuels are so abundant and cheap that they do not cover the current costs of renewable energy. In a Global Green New Deal, the mechanism that would be used for government subsidies is the "feed-in tariff". The government simply guarantees to add to the grid all electricity that is produced by any renewable means. Private investors choose which technology to bet on. A guaranteed higher price for renewable electricity fed into the grid is currently used with considerable success by Germany and other countries, including Denmark, and until the euro crisis, by Spain. It has the great virtue of not requiring the government to pick which technology is likely to be successful, but rather to "pick the winners" (see Shue 2014).

Even the most conservative central bankers agree that central banks should consider climate change for *prudential* motives. In this conventional view, central banks should only play a subordinated role to their governments regarding climate change. Central bankers in the western economies often talk about the division of labor between delegated and political agencies and claim that central banks should not be the primary actors in mitigating and adapting to climate change (Dietsch et al., 2022). Thus, should central banks play any role in mitigating and adapting to climate change? Should central banks go green? Many central bankers say they should not, because they have to remain market neutral, and the transition to a green economy is a task that elected politicians can only undertake. I will respond to this view in chapter 3, arguing that the strategic position of central banks and their unique power to create money makes them the perfect institution to lead the race to advance the date of technological transition.

However, this traditional position of central bankers has changed in South-East Asia in the aftermath of the global financial crisis (Dietsch et al. 2022). Central banks in most countries in that region, have long been playing a developmental role, in which they implement their monetary policies to target economic sectors prioritized by their governments. They have also been working in close collaboration with governmental agencies, adding new green objectives to the central bank (Volz 2017). For example, the Bank of Indonesia was at the vanguard of adopting *promotional* policy objectives. Other central banks, such as the Bank of Bangladesh and the People's Bank of China, implemented similar measures. They went even further as they were the first to implement credit refinancing lines at favorable terms for green activities and quotas for lending to carbon-intensive sectors (Dikau and Ryan Collins 2017).

This dissertation proposes a range of policy options in line with these developments. In some cases, they should not only be understood as promotional but also as intergenerational. That is because they allow us to take climate action now, given the problem's urgency, but shift some

of these costs onto future generations. However, another, maybe even more important question I will have to answer is whether we should use central banks to shift some of these costs to future generations. Should not the polluting present generation assume all the costs of mitigation and adaptation to climate change? I will argue that this is not the case. Furthermore, it is also important to note that Green QE is a superior strategy to a global carbon tax and the traditional form of understanding borrowing from the future, for reasons we will explore. This conventional view considers that BFF implies a government issuing debt that will be paid by future taxpayers (Sachs 2015). Once we introduce a central bank into the picture of BFF, new possibilities emerge, including, most importantly, the opportunity to adapt to changes in the ability to pay of future generations and protect their generational sovereignty.

To understand the role of central banks in greening the economy, the dissertation will distinguish three kinds of Green QE policies. Policies (a) that help transition to sustainable finance and mitigate climate change, (b) Green QE policies that promote long and stable demand for green bonds. These two kinds of Green QE are prudential and promotional in Baer's sense. In contrast, what I call (c) intergenerational interventions serve the purpose to promote a fairer distribution of the financial burdens associated with our mitigation efforts across generations. Thus, coming back to the two distinct principles of intergenerational climate justice announced at the beginning. Standard and Progressive Green QE serve intergenerational climate justice by implementing policies that cut emissions and reduce the climate burden on future generations (type 1 question). On the other hand, Intergenerational Green QE justly shifts some of the mitigation's financial costs onto future generations (type 2 question).

1.6 Is Borrowing from the Future Morally Permissible?

The idea that we should issue climate or green bonds to finance mitigation is not entirely new in debates about intergenerational climate justice. This idea is instantiated in Broome & Foley's (hereinafter B&F) proposal of a World Climate Bank (WCB) that would issue climate bonds with a long maturity paid by future generations (2016). The idea is simple: we must mitigate climate change and take climate action now, but we might shift some of the costs of doing so to future generations

Broome and Foley think that BFF is unjust, but nevertheless morally permissible all things considered. On the other hand, Gardiner (2017) thinks that BFF is impermissible. I will challenge both of these arguments. Broome & Foley claim that BFF is unjust, even if it was the case that it provides a more egalitarian distribution across generations. However, they still favor such a principle because they claim it is more feasible to take climate action now with BFF than if the present generation has to bear all the costs of mitigation and adaptation to climate change. B&F clearly make a defense of BFF exclusively in terms of feasibility, but is it possible to make a justice-based defense of BFF? I will show the shortcomings of B&F's arguments in favor of BFF in chapter 2 while also providing my justice-based defense of it in chapter 4.

Broome & Foley are concessive.[7] Their argument claims that BFF is unjust because the current polluting generation should pay for mitigation. They also rely on an empirical claim: that BFF is useful for getting current generations into taking climate action. Climate action is not politically feasible if current generations are required to bear all the costs. I will critically evaluate the assumptions about political feasibility that underpin Broome and Foley's concessive argument. My enthusiastic argument, by contrast, rejects that BFF is unjust but might still endorse,

[7] See Gardiner (2017) for the distinction between concessive and enthusiastic defenses of borrowing from the future. I will draw on this distinction to make my justice-based case in favor of making our grand-children pay.

partially, the empirical claim that BFF is a way to get things done. The aim of chapter 4 will be to argue that the present generation does not exclusively bear the duty to bear the costs of mitigation and adaptation, and it is shared amongst several generations.

As I will argue, we might say that BFF constitutes a fair distribution of the costs of mitigation and adaptation to climate change across generations. To make an argument like this, we need to justify a principle of distribution of these costs across generations that grounds the proposal of BFF and Green QE. In addressing this question, it is helpful to start with the intra-generational case and examine the different principles proposed by prominent political philosophers: The Polluter Pays Principle (PPP), the Beneficiary Pays Principle (BPP), and the Ability to Pay Principle (APP), something I will do before presenting my defense in chapter 4 of the Intergenerational Ability to Pay Principle (IGAPP) to ground, normatively, proposals of making our grandchildren pay.

I will draw on Simon Caney's widely discussed account of the relationship between these principles across the members of the present generation but also depart from him in some key issues. Caney justifies this lexical priority of PPP over APP in terms of the causal responsibility of the polluter and its intentionality in emitting GHG. In addition, Caney appeals to the APP to justify paying the costs of what he calls the Remainder. That is, the APP complements the PPP for these emissions for which no one can reasonably be held responsible or are necessary to meet the basic needs of the poor.

Like Caney, I will advocate for a pluralistic account of the principles that should guide the intra-generational distribution of burdens and benefits of climate change mitigation and adaptation. In my view, however, we should expand the Remainder. Instead of a basic needs limit, as the author proposes, I will argue that we should adopt a fair share limit. No one should pay any costs if she has less of what she would be entitled to according to an ideal distribution of resources, primary goods, or any other currency of justice that we deem appropriate to make

interpersonal comparisons. Then, I will move to the intergenerational case to offer my pluralistic view on how we should distribute costs across generations. Thus, one crucial question is whether it is fair to switch some of the costs of mitigation and adaptation onto future people. My reply is to defend the IGAPP on a pluralistic account of the interplay of different principles for distributing these costs across generations.

However, there is one major caveat to applying the IGAPP for deferring the costs of taking action against climate change. The argument in favor of the IGAPP depends on there being economic growth in the future. For such reason, a critical advantage of introducing Green QE is that we allow the option of partial or full non-repayment of the climate debt. Thus, it permits adapting to changes in the ability to pay across time and protects generational sovereignty. For instance, future generations might use the option of non-repayment if they experience deplorable living conditions due to climate change or are not better off at the end of the day than the present generation. Thus, I will conclude that Green QE is a superior strategy for borrowing from the future, compared to a government issuing debt that will be paid by future taxpayers.

One might also wonder whether Borrowing from the Future is morally permissible. In chapter 5, I will examine a critical objection to the argument presented in the rest of the thesis. The objection claims that the principle of borrowing from the future constitutes a case of intergenerational extortion (Gardiner 2017). For Gardiner, against enthusiastic arguments, there is a natural presumption that the polluting present generation should pay and ought not to expose future generations to the threats of catastrophic climate change. Chapter 5 will argue that Gardiner's case against intergenerational extortion fails due to the problem of the non-existence of future people and the lack of communication between distant generations. I will analyze Gardiner's extortion claim and show that he slides between a number of different claims. I will distinguish three different objections to the principle of BFF

we can find in Gardiner's views, and I will respond to them also in chapter 5.

1.7 Scope of the Thesis

Before I outline the agenda for the thesis, it is worth highlighting four key points about the scope of my argument. First, in this dissertation, there is the background assumption that we have reasons to take significant climate action now (type 1 question), and I will focus on the second of the questions of intergenerational justice raised by climate change. However, when necessary, I will also address the consequences of these debates over burden-sharing for the first question about the just target for mitigation. Second, it is important to notice that we need to reach a zero-sum total of emissions. This means that we have to reach an annual and global level of emissions that natural or artificial sinks can absorb; it also means that we should reduce the current level of global emissions drastically. To reach a zero-sum total some claim that we need to invest in research to obtain new technologies that can substitute the current energy system based on burning fossil fuels to maintain the current standard of living without emitting GHG and causing climate warming. On the other hand, there are more pessimist views which claim that it is impossible to maintain the current level of economic growth. Thus, we need to reduce consumption drastically to reduce emissions of GHG and stop global warming. I am not going to enter into the debates about growth/degrowth approaches to climate justice. However, it is important to note here that the latter view is right in arguing that we should reduce, at least, consumption of luxury goods which increase our emissions of GHG. In contrast, the de-growth view is problematic for the following reason. For instance, on the order of eighteen million people die each year of easily remediable chronic poverty for lack of relatively small sums of money and the related institutional changes (Pogge 2007), and 1,500

million live without electricity.[8] They do not have a decent living standard. At least for now, there is no other way to promote economic development in the poor countries where these people live but by burning fossil fuels and emitting GHG. Thus, when reducing global emissions, we should leave enough rights to emit for the poor of the world so they can survive and achieve a decent living standard (Shue 2014). This concern for poor countries means that the global rich (us) should reduce even more our emissions if we want to reach the zero-sum total. Thus, it is unfair that we continue using luxury emissions that will cause sever harm to future generations and demanding the poor to contribute to achieve a zero-sum total when this requires reducing their subsistence emissions. Subsistence emissions are necessary for reaching a decent living standard or avoiding deprivation (Shue 2014). De-growth then seems to clash with our duties of intra-generational and global justice. My view is that mitigating climate change will irremediably reduce economic growth, but we should limit the decrease in growth to do not risk failing to the global poor. One way of doing so it is to make our grandchildren pay some of the costs of mitigation. However, having said that, it is important to clarify that, third, I am not going to address issues of intragenerational or global justice in this dissertation unless necessary. Still, one can imagine using Green QE or BFF to finance the transition to a sustainable form of energy to favor the economic development of poor countries without relying on burning fossil fuels and the emission of GHG. Therefore, BFF could also serve to alleviate intra-generational problems of justice created by global warming.

The investment required to reduce emissions of GHG and comply with the IPCC report is usually estimated at 1.5–2% of global gross domestic product (GDP). According to a 2008 study by the International Monetary Fund, the policies needed to reduce emissions by 60% from 2002 would leave the global economy about 2.6% smaller than it

[8] United Nations, Department of Economic and Social Affairs, Division for Sustainable Development, *A Global Green New Deal for Climate, Energy, and Development, Technical,* Note 8 (2009).

otherwise would be in 2040.[9] Some distinguish between mitigation and adaptation costs and argue that we should apply different principles to these costs (see Vanderheiden, 2008; see also against Caney 2018). However, fourth, in this thesis, I am not going to focus on the distinction between mitigation and adaptation costs because I am interested mainly in financial costs, which can be stated as this cost on economic growth derived from climate action and how we should distribute it across generations.

I have briefly explained why climate change raises problems of intergenerational justice: questions about how much we should cut our emissions to reduce harm to future generations, and about how we should distribute the costs of mitigation and adaptation to climate change. The aim of this thesis is to investigate what role central banks can, and should, play in addressing these problems. Specifically, it offers a range of policies that could help serving both questions of intergenerational climate justice. This research is interdisciplinary and in the next chapters I will move to a more positive argument about what central banks can do to promote climate justice and how these policies are justified from the point of view of political philosophy.

The proposed policies aim to be feasible, although some are radical. This is so because I aim to engage with mainstream economic debates and policy-makers who have a say in designing monetary policy and the transition to a sustainable economy. For these purposes, the contributions made in this thesis assume mainstream views about monetary policy, which are disputable, at least in two domains. First, the policy proposals implicitly assume that increasing the money supply might lead to a rise in inflation. This idea is at the core of the justification of central bank independence and its instrumental legitimacy (see section 1.3 above and section 3.6 below). However, this assumption is questionable. Notably, Modern Monetary Theory (MMT) defenders claim this is not necessarily so. MMT makes a case for functional finance —the

[9] Visit http://www.imf.org/external/pubs/ft/fandd/2008/03/tamirisa.htm

view that governments should set their fiscal position at whatever level is consistent with price stability and full employment, regardless of current debt or deficits (Mosler, 1997; Tcherneva, 2017). On the other hand, the orthodox mainstream economics view argues that debt or fiscal sustainability is a target of the government. The government is responsible for the debt-GDP ratio converging to a finite value rather than rising indefinitely (Jayadev & Mason, 2018).

The debate between MMT and mainstream macroeconomics is over which instrument should be assigned to which target. The orthodox assignment is that the interest rate, under the control of an independent central bank, should be assigned to reduce the output gap and comply with the inflation target. In contrast, the fiscal position, under the control of the elected budget authorities, should be assigned to the debt sustainability target. MMT assignment is the reverse —the fiscal balance under the budget authorities is assigned to the output target. At the same time, any concerns about debt sustainability are the responsibility of the monetary authority that fixes the interest rate (Lerner, 1943).

This view supports the case for Progressive Green QE. In contrast, mainstream economics claim that the reversal of tasks proposed by MMT is not easy or even infeasible and traditionally assigns the fiscal position to the government regardless of the interest rate set by the central bank. There are reasons to believe that, according to this view, Green QE could compromise fiscal or debt sustainability and price stability. Thus, as suggested by professor Lisa Herzog and Professor Alan Cromartie in their reports, despite the argument presented here implicitly assuming some of MMT's main claims -that is, that the central bank can far increase the money supply to deal with societal challenges like climate change (Tooze, 2020)- I do prefer to engage with mainstream economics. Thus, some of the proposals fit well with some central assumptions in MMT, but actually, I frame or develop them, so they are also plausible from within mainstream economics. This relates to the point about using green QE only at certain points in the economic cycle as a counter-cyclical

measure, which is how mainstream views think that expansionary monetary policies should be in place only. This is clearly a concession to mainstream economics. I aim to make proposals that can be enacted and implemented by central banks, as currently designed, and justify them from a normative point of view.

Historically, governments have monetized debt to finance big wars, using the central bank to buy new debt created by the government. However, climate change is one of the most pressing issues we face today, if not the most. According to the IPCC report 2022, we need to reduce our emissions of greenhouse gases drastically if we want to avoid a temperature increase beyond 1.5°C. Thus, the project aims to show that climate change is an emergency and asks whether, in this case, it is justified to implement Green QE using the central bank to print far more money and buy green bonds that fund a transition to a new economic system that does not require burning fossil fuels.

Secondly, as another concession to mainstream economics, I assume that there will be economic growth in the future that will benefit the generations to come. Some authors dispute this assumption of future economic growth. Shue (2014), for example, claims that if we do not combat global warming, our inaction will make future generations the worst-off generations of all time. I will respond to these worries at the end of chapter 4 (see section 4.8).

1.8 Concluding Remarks and Thesis Outline

In this introduction, I have shown that financial markets enable investment in fossil fuel resources, and the moral duty to mitigate climate change might be accomplished, at least to some significant extent, by greening the financial system. Regulators and central banks need to take this reform to influence investment and consumption and switch to a form of energy that is sustainable and does not threaten future

generations. The thesis will show that monetary policy and central banks can serve intergenerational climate justice by implementing policies that cut emissions and reduce the climate burden on future generations. I will also argue that some of these policies involve shifting part of the financial cost of mitigation onto future generations. I will present the case for Green Quantitative Easing as a policy to serve both kinds of intergenerational climate justice principles and argue that it is a superior strategy to the alternatives. Finally, I will address the normative issues raised by that move to 'make our grandchildren pay'. I will argue that we have reasons to favor the principle of borrowing from the future because it is an effective tool for getting current generations to engage in mitigation. These mitigation efforts are not politically feasible if current generations are required to bear all the costs. However, the case for borrowing from the future should not be made exclusively on this concessive terrain. Cost-shifting also serves intergenerational justice because it promotes a more just distribution of the costs of mitigation and adaptation to climate change between the present and future generations.

The thesis proceeds as follows. In chapter 2, I will critically examine Broome & Foley's proposal of a World Climate Bank to borrow money from the future and the underlying principle of efficiency without sacrifice. I will clarify their institutional proposal's shortcomings and concessive argument in favor of BFF. Chapter 3 then moves to Green QE as an alternative to the WCB that also involves BFF. I will present a range of policy options that enable central banks to respond to type 1 and type 2 questions of climate justice. The options are offered from the mildest ones, which barely imply any shift of costs into the future, to more radical but realistic ones that should be seen as instances of BFF. Chapter 4 comes back to the normative underpinnings of Green QE and BFF. It makes a vigorous defense of the latter, grounded on a defense of the Intergenerational Ability to Pay Principle and the moral justification of deferring some of the costs of climate change mitigation and adaptation to the future. Finally, as said earlier, chapter 5 addresses a critical

objection to Green QE and BFF: that it constitutes a case of intergenerational extortion.

2 The World Climate Bank and Efficiency without Sacrifice

2.1 Introduction

One of the purposes of this dissertation is to examine the idea that we should issue climate or green bonds to finance mitigation and adaptation to climate change. Green bonds are not an entirely new idea in debates about intergenerational climate justice. For example, this idea appears in Broome & Foley's (after this B&F) proposal of a World Climate Bank (WCB) that could issue climate bonds with a long maturity paid by future generations (2016). The idea is simple: we must mitigate climate change and take climate action now, but we might shift some of the costs of doing so onto future generations. We can call this idea the principle of borrowing from the future or making our grandchildren pay, and it has already been discussed by notable political philosophers working on intergenerational climate justice (Foley 2009, Rendall (2011, 2019), Broome 2012, Maltais 2015, Broome & Foley, 2016, Lawlor 2017, Gardiner 2017).

In this chapter, I will focus on B&F's proposal of a WCB and their defense of the principle of efficiency without sacrifice. The latter principle grounds their concessive argument in favor of BFF. As a general remark, B&F financial approach to climate justice serves to respond to type 1 issues of climate justice. This thesis adds that BFF and all the financial approach I share with B&F is very appropriate to respond also to the type 2 question of climate justice. B&F show that we can, and should, advance climate justice (type 1) by using financial tools to 'borrow from the future.' But they make at least four mistakes:

1. They are too quick to claim that WCB solves feasibility problems and ignore how it raises some of the same issues that they suggest have been barriers to climate action.

2. They claim efficiency without sacrifice when there is no 'no sacrifice' solution for the present generation. Still, as I will argue, efficiency without sacrifice is separable from the broader principle of BFF.

3. They dismiss enthusiastic arguments to make a case for BFF on concessive grounds only, denying that BFF also serves type 2 issues of climate justice, as I will argue in chapter 4.

4. They also suggest that eliminating the externality amounts to achieving type 1 climate justice, and I will not endorse this idea in my defense of Green QE and BFF.

B&F claim that BFF is unjust but still favor such a principle because they claim that it is more feasible to take climate action now with BFF than if the present generation has to take all the costs of mitigation and adaptation to climate change. Furthermore, they make a concessive argument that claims that although borrowing from the future is unjust because the present generation should bear the costs of mitigation and adaptation to climate change, it is defensible in light of the alternatives (Broome 2012, Maltais 2015). In contrast, I will defend an enthusiastic argument like Rendall's (2011) and Caney's (2014), because making the grandchildren pay can help create morally preferable distributions of resources across generations.

The chapter has the following structure. Section 2 presents the concessive argument, which implies both an empirical and a normative claim. Section 3 distinguishes between the efficiency with sacrifice and efficiency without sacrifice, being the latter the principle that supports B&F's concessive argument in favor of borrowing from the future and the institutional proposal of a World Climate Bank, the details of which are explained in section 4. Sections 5 and 6 explore the shortcomings of their empirical claim, that is, the idea that the WCB is more feasible than proposals that imply efficiency with sacrifice. I highlight the problems of the feasibility of the WCB, and I also endorse Lawlor's critique that there is no 'no sacrifice option' to tackle climate change for the present

generation. Section 7 draws on Kelleher's arguments against Broome's approach to climate justice and defends that efficiency (with *or* without) sacrifice cannot amount to achieving climate justice. Section 8 then turns to the normative claim, that is, that BFF is unjust, and critically examines B&F's justification of this claim. Finally, section 9 makes a brief excursion in what seems to me an internal contradiction in B&F's normative claim *vis à vis* Broome's endorsement of the non-identity problem.

2.2 The Concessive Argument

The concessive argument in favor of BFF involves both a normative claim (i) BFF is less just than mitigation paid for by current generations; plus an empirical claim (ii) BFF is an effective tool for getting current generations to engage in mitigation; mitigation efforts that are not politically feasible if current generations are required to bear all the costs. Enthusiastic arguments reject the normative claim but might still endorse the empirical claim that BFF is a way to get things done and take climate action. According to enthusiastic arguments, such as the one I will present in chapter 4, the present generation does not exclusively bear the duty to bear the costs of mitigation and adaptation and shares it with future generations.

In this chapter, exploring the justification for a World Climate Bank offered by Broome & Foley, allows me to examine the nascent literature on B&F basic reasons in favor of the principle of borrowing from the future. Furthermore, B&F have a similarly interdisciplinary approach to climate change mitigation (their proposal is also centered on finance and the principle of borrowing from the future). I will identify the core disagreement with them: They are 'concessive' whereas I am also 'enthusiastic' -according to the classification mentioned above made by Gardiner (2017)-. Moreover, and that's crucial, this thesis argues that BFF, and Green QE, as an instance of this principle, is a policy that

promotes the fair distribution of the costs of mitigation and adaptation across generations.

However, I do not want to present Green QE in opposition to the WCB, but precisely as the perfect complement to it. Green QE requires the central bank to buy bonds from entities investing in a transition to a sustainable economy. These bonds can be issued by private corporations, a public investment bank, or the same WCB envisaged by B&F. As I will argue, using Green QE can solve some of the problems of feasibility - namely of liquidity and capitalization- of the WCB, problems that in my view makes the WCB less feasible than what B&F think.

Consequently, this second chapter aims to delineate the different (sometimes opposing) lines of critique in this nascent literature around the WCB and the principle of BFF. I will carefully set out the various lines of argument against Broome's reasons to favor the WCB into different kinds of objections: (i) Objections to B&F's concessive argument; (ii) arguments against the principle of efficiency without sacrifice; and (iii) arguments against borrowing from future generations. I consider this to be the most important areas of debate that B&F's proposal points to, some of which are addressed in the existing literature, and some of which I will address in this chapter. This work will allow me to evaluate the objections to Broome, tell where my proposal will fit, and answer them. There are some objections to Broome I can endorse because they do not bite against my distinct proposal; and I will also distinguish between objections we can deal with on Broome's behalf and objections to Broome that look powerful and potentially affect my proposal.

For instance, I share Lawlor's objection that there is no 'no sacrifice option.' However, I also think that Broome can reply to the criticisms to the negative aspect of their empirical claim. Finally, Kelleher's argument about the absurdity of economist's free solutions to climate change also bites against my own proposal and I will need to address it carefully. Therefore, evaluating B&F's WCB in this chapter is the starting point of

my task of examining the normative principles that justify Green QE and borrowing from the future.

As noted in the introduction, we can usefully distinguish between two big questions of climate justice (Caney, 2010, 2018, Rendall, 2011, Moss 2015): (a) What are our duties of mitigation and adaptation? (Type 1 question of climate justice); and (b) How should we distribute the costs of mitigation and adaptation to climate change? (Type 2 question of climate justice). Regarding the first question, I assume that it's clear that we must act, given the scale of risks involved. We have strong reasons to be cautious and mitigate climate change because it threatens the chances of future people to live meaningful lives and their entitlement to some basic rights. However, this leaves open the question of how we should share the costs of mitigation and adaptation across generations. That latter type 2 question is the one I will focus on in this dissertation. To begin with B&F's concessive argument in favor of BFF to respond to type 1 climate justice issues, we must first look at their distinction between the efficiency with *or* without sacrifice.

2.3 The Efficiency with Sacrifice vs. Efficiency without Sacrifice

B&F offer a sophisticated justification for the WCB that requires a lot of detailed analysis. They claim that the emission of greenhouse gases creates an externality and that externalities can always be eliminated by promoting efficiency (2016: 159). That the emissions of GHG create an externality means that the price of burning fossil fuels does not include the damage that the emissions do to other people affected by climate change. The non-inclusion of these damages means that this harm is an external cost of the emitters' activities that is not part of their price. The creation of an externality is a waste of resources, according to economists, an inefficiency. If the economy is to work well and efficiently, the benefits and costs derived from the activities of emitters should be aligned, avoiding wasteful usage of resources.

It is always possible, according to economists, to eliminate an externality by promoting efficiency. A Pareto improvement means that the externality can be eliminated, making someone better off without making anyone worse off (Cohen 2008). If we want to eliminate the externality created by burning fossil fuels and emitting GHG, a Pareto improvement is possible in two different ways: *efficiency with sacrifice* and *efficiency without sacrifice*.

According to the former, the inefficiency would be removed if emitters pay the full cost of their economic activities. They would have "to pay the price for their emissions that is equal to the harm the emissions do to other people" (Broome 2012: 40). In this case, there is a Pareto improvement because the externality is eliminated by the emitters paying the full cost of their activities. Of course, they are worse off than before, but this is because they were not assuming the full cost of their activities; they were obtaining an unjust enrichment. Eliminating this undue benefit makes them as rich as they should be, not better-off nor worse-off than what they should be if markets work correctly, and we do not want to waste resources.

One way to achieve efficiency with sacrifice is to set up a carbon tax equal to the social cost of carbon. This increased carbon price will be used to encourage the substitution of carbon-intensive consumption goods by green friendly goods. The former will become more expensive and be substituted by goods that do not contribute to climate change. The consequence will be to reduce the harm done to future generations who, accordingly, will be better off than if the externality remained unaddressed and they had to suffer severe climate change.

The other alternative to promote a Pareto improvement is efficiency without sacrifice. This requires emitters to cut their emissions whilst being compensated by the receivers of emissions for their sacrifice (Broome 2012: 44). If those harmed by the emission of greenhouse gases pay a fee to the polluters and the polluters reduce their pollution to the level that those harmed would be willing to pay to avoid that harm, then

everyone would be made better off without making anyone worse-off. It is a Pareto improvement because the reduction in climate damage compensates future generations that will be better off even if they have to pay compensation to the present generation. At the same time, the latter will not be worse off precisely because future people pay them compensation for the costs of mitigating and adapting to climate change.

Wait a moment, how can future people pay compensation to present people for the rise in energy cost required for mitigating climate change if they do not even exist? In short, the answer to this question is debt: issuing debt today that future people will pay. In Broome & Foley's (2016: 160) account of efficiency without sacrifice, the latter requires borrowing from future generations. This ideal can be promoted by a World Climate Bank that issues bonds that investors will buy (Broome & Foley 2016). The World Climate Bank will use the money received in exchange for such bonds to invest in greener energy sources and compensate current consumers and producers for the increased cost of energy.

2.4 The World Climate Bank

If we are to endorse efficiency without sacrifice, compensation has to be paid in financial terms. Where will the money come from? One source of revenue is the carbon tax, but B&F assume that not all the compensation required by the current generation can be paid from revenue raised from the current generation itself. Therefore, some compensation will have to be financed by borrowing. Governments or international organizations will have to borrow on a large scale (Broome & Foley 2016: 165). One available means is to issue government or international bonds. These bonds constitute an alternative asset that investors can choose to invest in and substitute their usual investment in conventional capital. They will withdraw funds from conventional investment to buy bonds and switch to sustainable investment. These funds will come into the hands of the issuers of the bonds, who can use them to pay for reducing

greenhouse gas emissions through green investment and compensate the present generation for the extra cost of clean energy and food (Broome & Foley 2016: 166; See also Rosenzweig and Parry 1993).

The institutional proposal that realizes the non-ideal principle of efficiency without sacrifice is the World Climate Bank. A World Climate Bank (WCB) is an international institution created by the world's governments that would issue bonds to get funds that we will use to pay for green investments and compensate current consumers and producers for the increased energy cost. Broome and Foley consider two possible sources of capital for the WCB: (i) the WCB could claim a share of national government revenues, or (ii) it could claim a share of global, national, or regional carbon taxes or a share of emissions permits generating royalties (Broome and Foley 2016: 168). However, it is not clear who will buy these world climate bonds with a very long maturity. B&F make some proposals to provide liquidity to the bonds issued by the WCB, like making them international reserve assets, which should motivate conventional investors to buy these bonds instead of conventional 'brown' bonds when they look for safe assets to complete their portfolios. These bonds are marketable, so they will switch hands during their lifetime -which encompasses several generations willing to invest in these bonds and receive periodic coupons. At the maturity date, the WCB -capitalized with the two sources of revenue mentioned earlier- will pay back the debt to the future bond holders. The institutional design of the WCB raises several questions, but fundamentally, it pumps up some concerns about the feasibility issues it is trying to overcome.

2.5 The Empirical Claim or Why the WCB also Has Feasibility Problems

According to B&F, efficiency without sacrifice "constitutes borrowing from future generations to pay for the improvements it makes for the sake of future generations" (Broome & Foley 2016: 166). They claim that social

borrowing must be part of climate policy in a capitalist economic order, in which government cannot directly allocate resources but must instead influence private investment and production decisions. A carbon tax tries to shift consumption in favor of substitute goods that do not contribute to climate change. In the same way, the WCB also tries to move conventional investment in fossil fuel energy to GHG mitigation and adaptation investments while compensating the present generation for the cost of the shift in the energy system. The positive aspect of Broome and Foley's position is that it calls for climate action. Therefore, it must be stated clearly here that, like Broome and Foley, I defend taking climate action now but deferring, at least partly, the costs of mitigation and adaptation onto future generations, as they do. Other aspects, such as the empirical claim about feasibility, require more discussion.

B&F think that efficiency without sacrifice is unjust. Why, then, do Broome and Foley believe we should favor the principle of efficiency without sacrifice and borrow money from future generations if it is not ideal? B&F make a concessive argument in favor of efficiency without sacrifice. They claim it is not the correct principle because it is unjust to make the victims of the harm pay to tackle climate change. They also claim that it is more feasible than the principle of efficiency with sacrifice. This is so because any attempts to deal with the emission of greenhouse gases have failed due to the unwillingness of the representatives of states to assume the cost of reducing such emissions. According to Broome (2012), borrowing from the future is strategically justified given the moral weakness of the present generation. In this section, I will examine the concessive argument's empirical component in favor of the principle of efficiency without sacrifice.

I will show that they go too quick to claim that the WCB is more feasible than a global carbon tax, and they ignore that it raises the same issues that they claim have postponed climate action during the last three or four decades. It is important to note that B&F's concessive argument is formulated basically in terms of the lack of international coordination

to assume the costs of reducing GHG emissions. It seems that B&F make a swift move to suggest that borrowing from the future through a WCB will be motivationally more efficacious and thus politically more feasible because it does not require us to bear economic costs in the here and now. There seems to be a big assumption in the background here: that the major block to getting things done on climate change is the unwillingness of current generations to bear the economic costs. However, they do not provide any analysis of why serious action to mitigate climate change has so far failed and, more importantly, why their institutional proposal does not face the same problems.

We can think about the empirical claim as comprising a negative and a positive claim: negatively, it holds that significant climate action is infeasible without BFF; positively, it maintains that BFF can make climate action feasible. Alternatively, we could think about it in terms of necessary and sufficient conditions for climate action: Broome and Foley suggest that BFF is both necessary and sufficient to get significant action on climate change. Broome (2012) supports the negative empirical claim by noting that a global carbon tax has not been approved in the Kyoto Agreement (nor in the Paris Agreement) because rich states are very reluctant to assume the internal costs of this tax. This unwillingness to assume costs is the reason, according to Broome, why these agreements have established a cap-and-trade market of emissions.

Against the negative empirical claim, I must say that international coordination to tackle the problem of climate change has been increasing in the global, regional, national, and internal spheres during the last two or three decades (Shue 2014, Maltais and McKinnon 2015).[10] Although a worldwide carbon tax is not in place yet, it does not mean that this kind of coordination cannot exist in the near future. The Paris Agreement, a far-reaching international treaty on climate change, was concluded in

[10] The Paris Agreement, the EU Emissions Trading Scheme or the UK Climate Change Act are respectively, international, regional, and domestic examples of these efforts. See also the IPCC Sixth Assessment Report, Climate Change 2022: Mitigation of Climate Change, the Working Group III contribution for the latest policies adopted nationally and regionally to reduce carbon emissions.

December 2015 by 196 signatories and entered into force in November 2016.[11] This achievement is unprecedented: for the first time in the history of humankind, a binding agreement unites all nations under a common threat, with the ambitious goal to combat climate change and adapt to its effects. So maybe a global carbon tax is not as unfeasible as B&F claim. As time passes and the impact of climate change is more apparent to the present generation, the signatory parts of the Paris Agreement may enforce it sooner than later.

Figure 1:

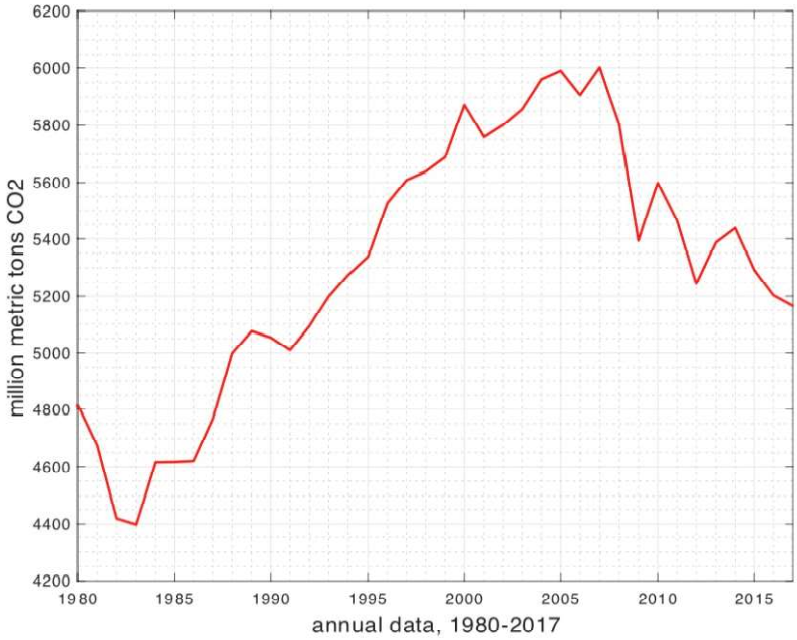

Figure 1: Total Emissions of Carbon Dioxide, US. *Source:* FRED Data.

Figure 1 presents the evolution in annual data since 1980 of carbon dioxide emissions in all economic sectors of the US economy across all fuels (coal, oil, and natural gas). Again, we can see the worrisome upward trend, broken just before the Global Financial Crisis. Then comes the Paris Agreement in 2015, so we can expect further improvements, also given the urgency of the need for action by the current generation. Again,

[11] See the webpages of the United Nations on climate change: https://www.unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement.

however, this is just the US, and major polluter nations across the globe are not visible in the graph.[12]

There are some signs of optimism, looking at the decreases in the last years, although what really matters is the total global emissions of GHG. Developing countries depend on burning fossil fuels to achieve economic development -unless rich countries transfer them a clean cheap technology that does not rely on the emission of GHG. We can expect that the total global will keep increasing if we do not want to condemn a big part of humanity into poverty. Since the carbon budget is cumulative, that is, what matter is the total global emissions accumulated in the atmosphere since the Industrial Revolution; we are still far from solving the problem, even if we reduce our emissions to the levels of 1990, for example, as the Obama administration suggested.

Shue (2014) and Maltais (2015) offer several reasons why motivating the present generation is complex. We are delaying climate action at the cost of risking some fundamental rights of future people yet to exist. According to them, there are several reasons why tackling global warming has been so difficult. First, there is the problem of coordination at a global scale of a high number of essential actors like states.[13] Second, there are the interests and influence of the fossil fuel sectors in policymaking.[14] And third, there are the complexities and uncertainties of reforming our economies and forms of energy.

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[12] See Mihailov and Ferret (2021).

[13] See for illustration Durwood Zaelke and James Cameron, 'Global Warming and Climate Change: An Overview of the International Legal Process', *American University Journal of International Law and Policy*, 5 (1990).

[14] For subsidies to Oil, see Hanlon, Seth. 'Big Oil's Misbegotten Tax Gusher: Why They Don't Need $70 Billion from Taxpayers Amid Record Profits', (Washington: Center for American Progress, 2011) and US Congress, Joint Committee on Taxation, 'Estimated Budget Effects of S. 2204, The "Repeal Big Oil Tax Subsidies Act", 23 March 2012, JCX-29-12.

For subsidies to carbon, see Goad, Jessica, and Stephen Lacey, 'Top Three Ways That American Taxpayers Subsidize Dirty Coal Development', Climate Progress (Washington: Center for American Progress, 2012).

For a global view, see International Energy Agency, 'IEA Analysis of Fossil-Fuel Subsidies, World Energy Outlook 2011' (Paris: International Energy Agency, 2011).

However, Maltais (2015: 93) argues that amongst all these impeding factors, "it is the role of time that appears to be the most toxic feature of this political problem." It is precisely the long-time lapse between emitting GHG and the increases in temperature that make it hard to motivate the present generation to engage in climate action. Not only that, but the efforts we make now to reduce emissions make little difference to the climate damages current agents will experience in the course of their lives due to the long time standing of GHG in the atmosphere and the cumulative effect of the emissions made since 1850.[15] These arguments seem to support the negative empirical claim about the infeasibility of taking climate action without BFF.

We need now to consider the positive empirical claim that BFF has the capacity to make climate action feasible. I see two main problems concerning the positive element of B&F's empirical claim. First, WCB's feasibility problems that I will show in this section. Second, there is a deeper problem with the principle of efficiency without sacrifice that I will address in the next one. Maltais (2015) suggests that BFF is a necessary condition to take climate action now. To see if it is a sufficient condition, I think it can be helpful to start looking at the feasibility problems that the World Climate Bank envisaged by B&F imply. One problem with B&F's institutionalization of the principle of borrowing from the future through a WCB is that it also requires a high level of international coordination. It requires international cooperation to put together the necessary capital to pay the coupons of the WCB's bonds and pay back the debt at maturity, three or four generations after they have been issued. The standard strategies to tackle climate change require long and stable coordination between international actors like states. This kind of coordination is part of what B&F consider that makes efficiency with sacrifice unfeasible. The problem with this institutional proposal, the

[15] See for illustration Kasting, J. F. (1998) 'The carbon cycle, climate, and the long-term effects of fossil fuel burning', *Consequences: The Nature & Implications of Environmental Change*; and James Hansen, Pushker Kharecha, Makiko Sato, et al., 'Assessing "Dangerous Climate Change": Required Reduction of Carbon Emissions to Protect Young People, Future Generations and Nature', *PLoS ONE*, 8:12 (December 2013).

WCB, is that it has some of the same features that B&F claim render efficiency with sacrifice infeasible. If this is the only way of institutionalizing BFF, it cannot be a sufficient condition to tackle climate change.

This worry applies to the proposal of capitalization of the WCB and the liquidity of climate bonds. We should have this kind of worry when designing the financial mechanism of intergenerational borrowing. For example, we need government revenues to capitalize the WCB, and several generations of investors will benefit from the yields/coupons/interest from the WCB (or green QE) bonds received. In contrast, corresponding generations of taxpayers will be financing these interest payments. These aspects of the WCB are essential when we examine the institutionalization of the principle of borrowing from the future through a World Climate Bank. Recall that B&F consider two possible sources of its capital: a share of national government revenues and a share of carbon taxes or the price of emissions permits. The nature of these two sources seems to contradict the negative part of B&F's concessive argument that efficiency without sacrifice is the best solution given the unwillingness of governments to assume costs when negotiating international conventions to mitigate climate change. If they do not want to bear costs, how can we believe they will be willing to give a share of national revenues or a carbon tax? I think that B&F do not think that their WCB can solve the problem of climate change alone. Therefore, at the institutional level, they continue to appeal for carbon taxes and shares of national revenues, which are more appropriate as an institutionalization of the principle of efficiency *with* sacrifice. However, this seems inconsistent with a robust version of their concessive argument. I will show in chapter 3 that central banks are much better equipped to provide liquidity to green bonds, which can be beneficial in facilitating the capitalization of a public investment bank or the WCB, and that this speaks in favor of Green QE. Therefore, I will argue that the proposal I defend here is more consistent with the positive aspect of the empirical claim of concessive arguments in favor of BFF. It is so because

it does not rely so much on international cooperation and provides more substantial incentives for investors to invest in climate bonds.

In the next section, I will look at the second problem related to the positive part of the empirical claim of the concessive argument. B&F call their proposal 'efficiency without sacrifice', but unfortunately for us, there is no 'no sacrifice option.' In the next section, I am going to discuss an objection to the principle of efficiency without sacrifice raised by Rob Lawlor. He claims that even under these circumstances, there is still a sacrifice to be made by the present generation.

2.6 There is No 'No Sacrifice Option' for the Present Generation

A simple way to state the principle of efficiency without sacrifice can be the following. Efficiency without sacrifice requires emitters to stop emitting by being compensated by the polluted for the extra costs of combating global warming. If those harmed by the emission of greenhouse gases pay the polluters and the polluters reduce their emissions to the level that those injured would be willing to pay to avoid climate heating, then everyone would be better off without making anyone worse (Broome & Foley 2016: 160).

To begin with, we should pay attention to the first formulation of BFF by Foley (2009). In Foley's simple formulation of efficiency without sacrifice, the current GDP is distributed amongst three components. GDP = K + C + E. Where C = The present generation's consumption, K = Conventional capital stock that is invested in institutions for future generations, such as infrastructure, health, education or social security, and E = Climatological capital stock that the present generation needs to invest to eradicate the emission of greenhouse gases and stop climate change. It is possible, according to Foley (2009), to reduce K and increase E without deteriorating consumption (C) for the present generation. The author adds that if this is not enough to finance a transition to a green

economy and sustain the level of consumption of the present generation, we might also borrow from future generations. Broome & Foley's institutional proposal, the WCB, tries to realize these ideas and principles. Issuing world climate bonds aim at crowding out conventional investment (K) and increasing investment in Climatological capital (E). It compensates the present generation for the increased energy cost that will follow when we shift to a sustainable energy system. Therefore, the current generation can maintain the same level of consumption (C).

Lawlor (2016), in particular, raises two critical problems with the principle of efficiency without sacrifice and the positive element of the empirical claim of B&F's concessive argument. First, Lawlor asks whether there are enough goods available for current consumption that are not themselves going to exacerbate climate change. Therefore, even if we are compensated for the costs of mitigating climate change, there will still be a cost if we have to make an economical substitution of some consumption goods that contribute to climate change. B&F (2016: 163) recognize that the present generation under efficiency without sacrifice "will have to consume a new range of goods" that are less carbon-intensive, but "its overall standard of living will not deteriorate." The present generation will receive financial compensation from the future generation. Still, Lawlor's question is about what they can meaningfully do with that compensation that will not itself undermine mitigation efforts, and whether it does really meaningfully compensate them for changes in lifestyle, consumption, etc., they will have to undertake to mitigate climate change. Many examples can help to understand this objection. Just imagine someone who enjoys most traveling around the world. Unless we find an alternative energy source that does not require burning fossil fuels to fly across the planet, there is no way to substitute her pleasure in flying and traveling across the Earth. Maybe she will have to sail for two months to go to the Caribbean islands (much more joy in my view), but unfortunately, she will probably not have the time to spend two months sailing the Atlantic every year.

To understand this cost Lawlor has in mind, which we can call the cost of economic substitution, we might look at the insurance market. For example, suppose there's a fire in your house, and you lose everything you have inside. Imagine, too, that you had insurance that protects your home against fire. The pay-off of the insurance certainly compensates you, and your living standard does not deteriorate (you can use the money received from the insurance company to buy a new house as good as the one you had before). Nevertheless, imagine that in the fire in your home, you lost some goods that were very valuable to you and that cannot be replaced by new ones (e.g., some family legacy like a painting). In this case, you are compensated, and your living standard does not deteriorate (you can buy another painting), and still, the loss of this valuable and irreplaceable object implies a sacrifice. In this sense, Lawlor is right; there are many sacrifices still to be made by the present generation under the principle of efficiency without sacrifice.

One might argue in defense of B&F that they have in mind a different account of how to make interpersonal comparisons of well-being than Lawlor's. When B&F claim that there is no sacrifice for the present generation, they measure well-being in terms of standard of living. In contrast, Lawlor has a different way of measuring well-being that might be according to more objective theories of well-being, capability theories, or principles like the principle of equal opportunity for welfare. However, I think that the difference is important. Borrowing from the future might reduce the financial cost of mitigating and adapting to climate change. Nevertheless, there are still costs to be paid by the present generation that are not financial, or even worse, they are not compensable in monetary terms.

What B&F have in mind is that under efficiency without sacrifice, the present generation is financially compensated for its sacrifice, while in the case of efficiency with sacrifice they have to pay the full financial cost for its emissions, and that is what the label 'efficiency without sacrifice' wants to stress. However, I agree with Lawlor that there is no

'no sacrifice' option for the present generation. Nevertheless, I do not think this objection speaks against the principle of borrowing from the future through a WCB or Green QE to institutionalize our duty to do no harm to future people and cut our emissions of GHG while distributing the costs across generations fairly. I think that these are two separable ideas. We might endorse the principle of borrowing from the future without relying on efficiency without sacrifice. We can accept that even if we make our grandchildren pay for some of the costs of mitigation and adaptation to climate change, the present, and subsequent generations will have to pay some costs. Lawlor's objection seems less important when we have to choose between institutionalizing the principle of efficiency without sacrifice or efficiency with sacrifice. We can implement the latter principle through a carbon tax. However, a carbon tax also has the effect of promoting a shift in our consumption. It aims at the economic substitution of carbon-intensive goods for goods that do not contribute to climate change. Thus, even under the principle of efficiency with sacrifice, the same "sacrifice" mentioned by Lawlor remains. We will have to change lifestyle and consumption if we apply one or the other principle. The difference is that if we use the principle of borrowing from the future, there will be some sacrifice, measured in income and wealth, that we will not have to make. I agree with Lawlor that there is no 'no sacrifice option' for the present generation. Still, his critique is made against the principle of efficiency without sacrifice, not against BFF, because the latter and efficiency without sacrifice are separable ideas. We can defend the former without relying on the latter; that is, we can defend the idea that we must BFF to take climate action without claiming that we must fully compensate the present generation.

Secondly, Lawlor (2016) raises another objection to show that there is no 'no sacrifice option'. To understand it, we need to recall Foley's first formulation of efficiency without sacrifice: GDP = K + C + E. Lawlor (2016) raises the question of whether there is much purely future-oriented investment we can cut back on; and whether assuming this, is consistent with Broome's assumption that people are generally unwilling to sacrifice

for the benefit of future generations. Is it possible to cut investment in K (Current capital for future generations) to invest in E (Climatological capital) when B&F assume that the present generation is reluctant to make sacrifices for future generations? Specifically, should we expect much K to start with, given the assumption that people will not sacrifice for the benefit of future generations?

One might think that we invest in K while we invest in our current institutions that will also benefit future people, and if that is the case, there is no reason we should not expect much K. For example, when we build a road, we do it to improve the mobility of the current generation and the transportation of everyday goods. Still, the construction of a new highway will nevertheless benefit future generations. I suggest that K represents partly this kind of investment that helps the present generation and benefits future ones. Lawlor's point precisely is that most investment that benefits future generations is undertaken partly because it benefits current generations as well. The question is whether there is much purely future-oriented investment, where the *purely* part is important.

In conclusion, it is unrealistic to think that the principle of borrowing from the future can be institutionalized without any sacrifice by the present generation, and Lawlor, as mentioned above, is absolutely right on this. However, there is an important difference between existing proposals in favor of BFF and the one defended in this dissertation, Green QE. When authors think about BFF, they normally have in mind a government (Sachs 2015) -or a group of governments capitalizing the WCB- issuing debt that future taxpayers will pay. In contrast, once we introduce the central bank into the equation of BFF, things turn out to be different. This is because central banks can create money to buy these bonds during a sequence of business cycles and keep them on their balance sheets. This opens the door for a range of policies (see chapter 3) that are more appropriate and feasible than the traditional way of understanding BFF.

2.7 Efficiency vs. Climate Justice

However, Lawlor's objection is compelling and speaks against ideal economic solutions to the problem of climate change that hide the moral charge of the problem. Still, I do not think it is an argument against borrowing from the future to pay some of the costs of climate change mitigation and adaptation. Lawlor does not speak against the idea of shifting the economic costs of mitigation into the future. It just speaks against the description of that project as involving no sacrifice on the part of current generations. According to Lawlor, and I agree, it is misleading to talk about efficiency without sacrifice if there *are* going to be actual costs borne in the present in terms of changing lifestyles. More strongly, we might think that this framing is dangerous – if it makes us think we can discharge our duties of intergenerational climate justice without bearing any real costs. That could lead us to underestimate what we owe future generations regarding climate action seriously.

Secondly, there is still a more profound question: Would efficiency (with *or* without) sacrifice amount to climate justice? One difficulty with B&F's approach is that we do not know what the future harmed people would be willing to pay. Kelleher (2015) makes two important points about this identification of efficiency and climate justice. First, he claims that eliminating the externality and promoting efficiency might leave some GHG emissions unaddressed. Second, Kelleher claims that framing climate justice in terms of efficiency leaves some crucial features of climate justice out of the picture. To illustrate the first issue, the author uses the following example, which shows that a Pareto improvement is possible even if we do not eliminate all GHG emissions. The example of Brittany and Tyler sharing a working office shows that point. In Kelleher's illustration, Tyler smokes five cigarettes daily in the office, and Brittany would be glad to pay her a fee to reduce the number of cigarettes Tyler smokes daily. Tyler likes smoking but is happy to make a deal and reduce

her number of cigarettes in exchange for money that she can use for other things she values.

On the one hand, reducing smoking is somewhat hard for Tyler, and, on the other, Brittany's willingness to pay for further reductions marginally decreases. On the one hand, we see that the marginal cost of reducing emissions by polluters increases so their willingness to accept money in exchange for their emissions is reduced 'cigarette by cigarette.' Consequently, the marginal cost for the polluted increases and their marginal willingness to pay is reduced, again 'cigarette by cigarette.' At some point, the bargain will stop even if Tyler has not eliminated all the daily cigarettes she smokes in the office.

> Now, before any deal is struck between Brittany and Tyler, the cost of the smoke from Tyler's fifth cigarette of the day is $10.00 (i.e., the amount Brittany is willing to pay to reduce that unit of smoke). But the benefit associated with that smoke is just $4.00 (i.e., Tyler's willingness to accept compensation for that unit of reduction). This is precisely the mismatch between marginal costs and benefits that Broome associated with Pareto inefficiency, and we can now see why: in the presence of such a mismatch, it is possible to make at least one person better off without making anyone worse off. In other words, Pareto improvements are available whenever there is a mismatch between marginal costs and marginal benefits.

Nevertheless, Pareto improvements will not be available beyond the equi-marginal level.[16] No further reductions of cigarettes -or GHG emissions- when the willingness to pay is smaller than the willingness to accept compensation for further reductions. As this case shows, a Pareto improvement does not guarantee that we eliminate all the emissions

[16] "[T]he point where the marginal benefit of cigarette smoke is equal to its marginal cost. In our example, that is the point at which Tyler demands $6.00 in compensation and Brittany is willing to pay $6.00. At that point, Tyler and Brittany will strike their last deal, with the result that Tyler reduces his daily total from five to two. But no further deals will be made beyond that point, since the benefits of emitting the next unit of smoke ($7.00) are greater than its costs ($5.00)."

necessary to tackle climate change. This amount to say that eliminating the externality cannot achieve climate justice because it can leave some emissions of GHG untouched, and given the cumulative budget of GHG emissions, this might not be enough to stop global warming. Once the polluters and polluted reach "the equi-marginal level," even there is a Pareto improvement, efficiency alone does not guarantee that we will reduce our emissions enough to stop global warming.[17]

Second, we do not know what the willingness to pay of future generations is. In fact, we can just figure out a justification of what they should be willing to pay to compensate the present generation to reduce their emissions of GHG. However, even if we bracket this problem, it is only when costs and benefits are measured using the willingness to accept compensation and willingness to pay that a mismatch between marginal costs and benefits entails Pareto inefficiency, and thus there are Pareto improvements available. This means that there is another serious problem: we might not calculate benefits and costs in terms of the willingness to pay and to accept money. We might think that questions about rights,[18] about the intrinsic value of nature, or distributive justice should not drop out of our thinking about our duties of mitigation and adaptation to climate change and should be part of our calculations of benefits and costs of climate change mitigation.

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[17] "Any unit of emissions beyond that equi-marginal point brings more costs than benefits, and that means waste and inefficiency. Hence Broome associates 'fixing climate change' with 'curing' the greenhouse gas externality (p. 47), which he in turn associates with eliminating 'the inefficiency caused by emissions of greenhouse gas' (…) These Pareto improvements will cease to be available at the equi-marginal level, the point where the marginal benefit of cigarette smoke is equal to its marginal cost. In our example, that is the point at which Tyler demands $6.00 in compensation and Brittany is willing to pay $6.00. At that point, Tyler and Brittany will strike their last deal, with the result that Tyler reduces his daily total from five to two. But no further deals will be made beyond that point, since the benefits of emitting the next unit of smoke ($7.00) are greater than its costs ($5.00). Hence Broome's claim: the correct level of pollution reduction from the point of view of Pareto efficiency is the level at which the benefits from emitting one more unit are exactly equal to its costs." (Kelleher 2015: 70-73).

[18] See for the effects of not tackling climate change on Human Righst, Shue (2014, chapter 16). See also S. Humphreys (ed.), *Human Rights and Climate Change* (Cambridge University Press, 2009), 69–90. See also Oxfam International, *Climate Wrongs and Human Rights: Putting People at the Heart of Climate-Change Policy*, Oxfam Briefing Paper 117 (Oxford: Oxfam International, 2008).

Therefore, even if we were able to know the willingness to pay of future non-existing people, there is still the question of how far we would have gone in solving the problem of climate change and achieving climate justice. i.e., can we set the demands of justice in terms of climate action in terms of eliminating an externality? Is that a convincing picture of climate justice? Kelleher (2015: 68-69) concludes that Broome associates "fixing climate change with 'curing' the greenhouse gas externality." If this is true, this is an unconvincing picture of the type 1 question of climate justice. Nevertheless, this is a big question that remains in Broome. The question about whether it is enough to achieve climate justice to eliminate the externality created by our emission of GHG and promote efficiency alone, either with or without sacrifice. Broome sometimes suggests that removing the externality amounts to climate justice in the type 1 sense, and I agree with Kelleher that this is not plausible. Even if I am not trying to answer the just target question (type 1), I am assuming we must take significant action and ask how we can use financial tools to do so. Still, in contrast to B&F, this thesis will defend BFF to promote distributive justice between present and future people rather than efficiency alone (type 2 question).

2.8 The Normative Claim or Why BFF is Unjust

Thus far, the chapter has advanced some internal objections to the empirical part of Broome and Foley's concessive argument. Specifically, I have argued that Broome and Foley's proposal raises some of the same feasibility concerns as 'with sacrifice' solutions to climate change, such as a carbon tax. More fundamentally, I have shown that the World Climate Bank does not avoid sacrifice on the part of present generations: there is no 'no sacrifice' solution to climate change. However, I emphasized that the principle of 'efficiency without sacrifice' should be seen as separable from the broader idea of borrowing from the future. In this section, I raise a preliminary objection to make the argument for

borrowing from the future exclusively in concessive rather than enthusiastic terms. In future chapters, I will defend that BFF can also serve by responding to the type 2 issue of climate justice.

The emission of GHG harms future people, and this constitutes an injustice. According to B&F, even if efficiency without sacrifice eliminates the externality created by greenhouse gases and promotes efficiency, it does not remedy the injustice. If emitting GHG harms other people, the emitters might reduce their emissions by the victims paying a fee to them to cut the emissions, but B&F claim that "although there is a Pareto improvement, the injustice remains" (B&F 2016: 160). We need to clarify, though, what this injustice is that remains. Is it because it is unjust to require the victims of harm to pay to stop the harm being done to them? Or is it because, as argued in the previous section, eliminating the externality alone cannot remedy climate injustices? I will try to clarify B&F's position in this section when examining the normative justification of their proposal for borrowing from the future.

Bernstein (2016) suggests that *efficiency without sacrifice*, "if implemented by means of the policies and institutions he [Broome] suggests, can (if these are properly designed) constitute morally permissible means to the end of minimizing harms to people due to anthropogenic climate change" (Bernstein 2016: 179). Bernstein, using the distinction between acting from duty and acting merely in accord with duty in the moral philosophy of Immanuel Kant, interprets Broome as advocating adoption of policies and institutions that would lead people to act in accordance with their moral duties despite not acting from duty.

As Bernstein suggests, it seems that Broome's concessive argument makes a similar point. Borrowing from the future is not just, and B&F defend that efficiency without sacrifice is not the correct principle we should follow. Still, it is nevertheless the most realistic one that can lead us to mitigate climate change, which is an urgent matter that needs a quick response. In contrast, one might object to Broome, that we should not take the principle of borrowing from the future only

as an unjust but realistic principle. Instead, we should consider it the right principle to mitigate and adapt to climate change. That is the reason why we should look at ways of institutionalizing it. This thesis argues that this is the case, and it is unnecessary to defend BFF only in concessive terms.

When we look at the distributive effects of climate change intergenerationally, according to B&F, we need to pay attention to two different questions: one about equality of well-being and the other about aggregate well-being. Regarding the former, efficiency without sacrifice and borrowing from the future are justified from the view of equality between generations. If climate change is not catastrophic, future generations will be better off than the present one, making them pay part of the costs of mitigating and adapting to climate change approaches us to equality between generations. I will describe this enthusiastic argument in more detail in chapter 4 when considering the Intergenerational Ability to Pay Principle (IGAPP).

However, B&F's argument is concessive, as defined earlier. First, though, they claim that BFF permits us to implement a more egalitarian distribution of costs across generations. Why, then, do B&F endorse the normative component of the concessive argument? In other words, why do they think that this cost-shifting is unjust? It is important to note that Broome (2012) claims that when we consider issues of intergenerational climate justice, we need to pay attention not only to equality across generations but to aggregate well-being as well. Broome is a utilitarian, and he considers that future generations will outnumber the present. Being that the time, if we consume less and invest more in productive technology, we might have a greater quantity of goods to consume in the future than the ones we would eventually consume now (B&F 2016: 160). Therefore, B&F claim it is better to sacrifice consumption on the shoulders of the present generation to increase consumption in, say, 150 years because that will increase aggregate well-being across generations. In that case, efficiency without sacrifice and borrowing from the future to

ensure that we can keep present consumption constant, diminishes aggregate well-being.

This argument about aggregate well-being seems to favor efficiency *with* sacrifice clearly, that is, the idea that the present generation should cut their emissions at their own cost. We might conjecture this would be the ideal solution to climate change according to B&F. However, Parfit's (1984) repugnant conclusion can be used against it. The repugnant conclusion certainly shows that it is not an appropriate target for any long-term population-affecting policy – that is, unless Broome and Foley think you should produce a world with ten times as many people at a ninth of the current average level of wellbeing. However, Broome's response to the repugnant conclusion derives from his particular utilitarian view, called critical level utilitarianism. In this view, we should maximize welfare across generations and thus reduce consumption today to increase consumption in the future, but there is a limit on this maximization strategy. Broome requires that everyone existing today or in the future, should be above a critical level of utility. Critical utilitarianism does not mean that we complement utilitarianism with sufficiency. This critical level of utility can be above sufficiency.

It is not in the scope of this dissertation, though, to discuss the pros and cons of utilitarianism critically. However, if we are not utilitarians, we might be interested in the government having other duties, not only promoting efficiency or maximizing aggregate well-being. Utilitarianism claims that justice requires maximizing the sum of utility and affirms a purely aggregative principle. Aggregative promotional values are insensitive to the distribution of benefits and burdens amongst individuals. In contrast, distributional values are of a different kind. They guide the distribution of benefits and burdens amongst the members of society resulting from the economic, legal and political structure understood as a cooperative venture for the mutual advantage of free and equal persons. This cooperative view in which we owe something to each other is the kind of view I have when thinking about type 2 questions of

climate justice. Therefore, we might have reasons to favor distinct distributional values rather than be interested in prioritizing aggregate well-being, as Broome does.

Thirdly, we might conjecture that B&F concessive argument relies on the defense of the Polluter Pays Principle or PPP. I am not going to address this possibility here, since I will discuss this principle and other burden-sharing candidate principles in chapter 4.

2.9 Borrowing from the Future and the Non-Identity Problem

Finally, there is an internal objection to the normative claim of Broome's concessive argument that does not bite against my proposal but is worth mentioning here. We need to look more into the detail at the different steps of Broome's concessive argument, which we can find in detail in Climate Matters (2012), and the potential objections to it. In *Climate Matters*, Broome distinguishes between duties of justice and duties of beneficence or goodness. Duties of goodness are duties to improve the world —to bring more of what is good into the world. Duties of justice, by contrast, are owed "to another particular person, or to other particular people" (Broome 2012: 52), and characteristically are understood as duties to not harm others. Broome (2012: 63) claims that the emission of GHG constitutes an injustice to present people harmed by those emissions but that it is not so clear that it is unjust to future people because of the challenge that the non-identity problem (Parfit 1984) poses to intergenerational justice.

A decision by the government to eliminate the use of fossil-fueled energy would cause significant changes in the world, changing the moment when people decide to procreate and, therefore, changing the identity of the people that would exist in the future. Thus, Broome concludes that governments are not obligated to do no harm to future

people because it cannot be unjust to people who would not have existed had the government not decided to cut GHG emissions.

However, even if governments do not have obligations of justice towards future non-existing people, Broome claims that governments must promote (impersonal) goodness in the world. This duty is not directed at particular individuals, as duties of justice are, and tells us to promote the goodness of outcomes (Bou-Habib 2016). Therefore, governments must implement policies that reduce our aggregate GHG emissions on the ground that such policies will promote much more 'goodness' than not implementing them. Even if governments cannot be just to future people because large-scale policies will affect the identities of future people, it is true, according to Broome, that governments should promote goodness by reducing emissions of GHG.

In *Climate Matters*, Broome says that questions of justice do not arise concerning large-scale government policy on climate change because these policies are identity-affecting. But B&F (2016) say that efficiency without sacrifice is unjust to future people (because it is unjust to require victims of harm to pay to stop harm being done to them). It seems that there is an inconsistency in Broome here. The exact words of B&F (2016:160) are that making "a person reduce her emissions by her victims paying a fee to her is unjust," even if there is a Pareto improvement. The exact words seem to suggest that, in this case, B&F (2016) do not consider the non-identity problem in the same way Broome (2012) does. Broome's view is, I think, that the government does not have duties of justice to future generations when it comes to large-scale identity-affecting climate policy; instead, it does have duties of goodness, and so it should act, but I think he endorses the view that it cannot be unjust to future people. Therefore, it is difficult to see how the injustice remains if we make our grand-children pay when it is no possible to commit an injustice to non-existing people.

The non-identity problem challenges my view, too -the view that BFF is just because it responds to type 2 climate justice issues. BFF in

this thesis serves to apply principles of distributive justice across generations. Therefore, there is the question of whether the non-identity problem challenges the application of distributional principles. Here, I address briefly whether we can take distributional values like sufficiency, priority, or equality as impersonal values that should be promoted across generations and can escape the non-identity problem. Typically, when we think about cooperation amongst contemporaries, we take these principles to reflect our duties of justice towards the worst-off; that is, we take justice to be a personal value that demands us to do what we owe to each other and comply with a duty to do no harm to others. However, if we take the non-identity problem seriously, we have realized that policy choices like implementing Green QE are identity-affecting. Therefore, we cannot claim that we are implementing Green QE because we do not want to harm future distant people that do not exist yet.

The challenge of the non-identity problem is why Caney (2014) talks about creating a world that promotes growth discounting and borrowing from the future (see chapter 4). Given the force of the non-identity problem, that is what we do when we decide to implement a large-scale policy like Green QE. When analyzing the force of the non-identity problem against distributional values, I take sufficiency and priority to be less problematic. This is because it seems more evident that sufficiency or priority can be seen as impersonal values. However, I think I can also defend equality across generations as an impersonal value. To think about equality as an impersonal value, we can start thinking about equality within a world of future distant generations. If we must create a future world, what will we prefer? Must we create a distant one with huge inequalities or a future distant world with less intra-generational inequality? If we are egalitarians, I think we have reasons to value this second world for non-personal reasons. Even if we cannot do justice to the people living in that world, we might still think that a more egalitarian world is more desirable because, for example, there will be fewer differences in status or self-respect.

In the same way, when we think about equality across generations as an impersonal value, we might also find reasons to create a world in which there are fewer inequalities between generations than another in which inequalities across distant generations are huge. The intuitive idea of a fictional cooperation scheme across generations grounds this idea that we have sound reasons to create a world with fewer inequalities across generations since there is no reason to think that differences in well-being between generations are justified. Nevertheless, I believe this dissertation is not the place to go deeply into the nuances of the non-identity problem. I just wanted to note what seems to be an inconsistency in Broome's normative claim that BFF is unjust with respect to his endorsement of this famous philosophical problem and the importance of Parfit's arguments for intergenerational justice.

2.10 Concluding Remarks

Thus, to conclude, in this chapter I have distinguished between a normative and an empirical claim in B&F's concessive argument in favor of BFF and a WCB. I rejected the normative claim that BFF is unjust, and in chapter 4 I will present an enthusiastic defense of BFF instead. Regarding the empirical claim, I distinguished between a negative and a positive element of such a claim. The negative element is at least dubious since the rapid acceleration of climate change might lead (I hope) to rapid political developments to implement a global carbon tax. However, it is palpable that our actions have been unreasonably delayed during the last three or four decades since scientists provided enough evidence of the existence of climate change caused by burning fossil fuels and emitting GHG. The positive aspect of the empirical claim that BFF and efficiency without sacrifice are more feasible than efficiency with sacrifice is also problematic. The main normative point has been, drawing from Lawlor, that there is no 'no sacrifice option' to tackle climate change for the present generation. Secondly, I have also argued that the WCB faces

some of the same international coordination problems as efficiency with sacrifice. Third, I contended that framing the problems of climate justice in terms of eliminating an externality and promoting efficiency can be misleading, if not dangerous. Fourth, I rejected the normative claim that BFF is unjust and briefly presented arguments to make the defense of borrowing from the future enthusiastic rather than only in concessive terms. Finally, I have briefly explored an internal inconsistency between B&F's concessive views and Broome's endorsement of the non-identity problem. In the next chapter, more empirical, I will return to the financial approach to climate justice that I share with B&F. I will show that Green QE can overcome some of the feasibility problems of the WCB and why it is a superior strategy to the latter and superior to Sachs' model of issuing public debt that future taxpayers will pay.

3 Green Quantitative Easing

3.1 Introduction

In the previous chapter, I examined how we can shift some of the costs of climate change mitigation and adaptation onto future generations by borrowing money from the future. I explored B&F's financial approach and their proposal of efficiency without sacrifice. One key aspect is that the literature around BFF and B&F's proposal envisages a model by which a World Climate Bank will issue debt that future taxpayers will pay. Also, in Sachs' (2015) economic model, the national government issues public debt to finance the transition to a green economy that future generations will pay.

This chapter provides a broader range of monetary policy tools we can use to support mitigation and adaptation now (discharging type 1 climate justice duties), options that B&F and Sachs fail to consider (but could be complementary to their proposal).

1. These tools reduce costs to present and future generations and (some) also leave some decision-making power for future generations and the option of full or partial non-repayment of the climate debt.

2. They address (although not completely) some of the lingering feasibility issues for B&F's World Climate Bank.

Despite the option of full or partial non/repayment mentioned in (1), there is still no 'no sacrifice' solution for future generations either. So, the 'borrowing from the future' frame of the previous chapter remains relevant (more for some of the policy options offered here than others – as I will differentiate during this chapter). Amongst other reasons, there is no 'no sacrifice option' because using the central bank to mitigate and adapt to climate change has an opportunity cost, i.e., we could use money

supply to finance other morally relevant aspects, such as the eradication of severe poverty or, as argued by Tcherneva (2017), to fund a public job-guaranteed program. As I will explain below, there are other reasons why the non-repayment option does not mean a 'no sacrifice option' for the present or future generations. After addressing all these questions, we will still be left with the normative question about whether it is justified to make our grandchildren pay, which I will address in chapter 4.

One main claim in this chapter is that if we introduce a central bank into the picture of BFF, there are critical differences in how we think about BFF and the distribution of mitigation and adaptation costs to climate change across generations (type 2 issue of climate justice). I will argue that there are ways of financing climate action now, using the central bank, that Broome, Foley and Sachs do not consider. These tools do not involve indebting future generations in the same way as the taxpayer-funded model they envisage. On the other hand, in chapter 4, I will make a justice-based case for borrowing from the future, using the tools I identify in this chapter.

I believe that with a central bank able to create money to buy green bonds, we are getting a superior and wider range of policy proposals for how to make the grandchildren pay. Specifically, the central bank's capacity to create money out of thin air to buy climate bonds and keep them on its balance sheet opens the door to new possibilities that the traditional model (Sachs 2015, B&F 2016) cannot provide. Green central banking, therefore, offers a new range of policy options, some of which I will identify here, that change our view of the implications of BFF. I will present them from the mildest and modest ones to the more radical, still realistic ones.

First, I will introduce some forms of Green QE already existing in the literature, what I call Standard and Progressive Green QE. Second, two new radical but realistic ideas are presented by Mihailov and Ferret (2021). First, Generation-Shared Green bonds that the central bank can buy and keep it in their balance sheet, even until its maturity, if

necessary. Nevertheless, some economic consequences would derive from this option. Second, Green Compensatory Transfers (GCTs) which allows the central bank to create money to transfer it to consumers for paying the extra cost of buying sustainable goods instead of less expensive carbon-intensive or 'brown' goods.

Furthermore, Green QE opens the possibility of two relevant options for the intergenerational framework of BFF. First, suppose for some reason future people are not richer than us. In that case, Green QE can adapt to these changes in the ability to pay of future generations by writing-off the climate debt. However, again, some consequences would also derive from exercising this option. Once more, there is no 'no sacrifice option' -neither for future generations- and exercising this non-repayment option would have implications and some costs for future generations. Finally, Green QE, by leaving the possibility of partial or full non-repayment of the climate debt, is also more respectful of future generations' generational sovereignty. These two issues will be addressed in chapters 4 and 5, respectively.

The chapter proceeds as follows. In the next section, I will compare two different economic policies to tackle climate change: carbon taxes and Green QE. Some claim that carbon taxes are the first-best solution and Green QE is just a second-best policy. I believe the ideal policy would be to implement both and coordinate fiscal and monetary authorities to mitigate and adapt to climate change. Having said that, I will also argue that Green QE is a superior strategy to carbon taxes alone. In the introduction, I have already briefly explained the normative significance of central banks and what they could do to combat climate change. In section 3, I will discuss, in greater depth, the literature on the role of central banks in tackling climate change. Sections 4 and 5 explain what Quantitative Easing (QE) is and the range of policies labeled as Green QE. These policies can help us transition to a sustainable form of energy (type 1) and distribute the costs of mitigation and adaptation to climate change across generations (type 2). As I will argue, they constitute a

superior strategy to the WCB envisaged by B&F and the traditional model by Sachs, in which the government or the WCB issue debt that future generations will repay. The chapter ends by examining the challenges that green central banking poses to the legitimacy of independent central banks.

3.2 Carbon Taxes vs. Green QE

The G20 Green Finance Study Group (2016) defines green finance as financing investments that provide environmental benefits. In a narrower sense, Ehler et al. (2020: 31) describe green bonds as debt instruments whose proceeds finance projects with various environmental benefits, including climate change mitigation. Over the past decade or so, such financial instruments have been growing in popularity and in traded volumes worldwide. For example, the global issuance of green bonds surpassed $250 billion in 2019 (Ehler et al. 2020: 31), which accounts for about 3.5% of total global bond issuance ($7.15 trillion).

As noted in the introduction, the global financial system is currently funding a significant rise in the temperature of the planet (see Carney 2019). This conclusion is alarming, bearing in mind the key role of the financial system in the economy and society, namely, to facilitate the necessary financing and liquidity for human and economic activity and because financial markets enable investment in fossil fuel resources. Therefore, some researchers (e.g., Fisher and Alexander, 2019) have suggested that the financial system should share in the responsibility to mitigate climate change by undergoing reform to reduce the emissions of GHG that derive from human and economic activity. This reform, to be undertaken by regulators and central banks, needs to influence investment and consumption choices in a way that incentivizes economic agents to switch to forms of sustainable energy quickly so that we can advance as soon as possible the date of technological transition.

Academic economics research (see, e.g., Manne and Richels, 2005; Nordhaus, 2008; Acemoglu et al., 2012; Golosov et al., 2014) has generally agreed that the first-best approach to mitigating climate change would be a carbon tax, in the sense that it internalizes the full environmental damage costs of carbon emissions (Barrage 2020). In this chapter, a major concern is that the global carbon tax first-best policy has not yet been implemented in the real world we live in, although some national and regional carbon taxes exist (and hopefully, their number will increase rapidly) due to various costs and trade-offs. This fact naturally moves researchers' attention to a second-best solution, possibly cheaper to enforce, as the one implied by the menu of options for immediate climate change mitigation proposed in the present chapter and some related literature cited from now on.

We should not abandon our efforts to adopt a global carbon tax. I focus here on monetary policy, though, where the main novel proposals are targeted, even if indeed embedded within a more profound monetary-fiscal-financial-social coordination effort. One reason is that monetary policy seems to have been less discussed, except very recently, with a view to its potential to help mitigate climate change. Another reason is the indirect control of monetary policy, via banking and financial regulation, over the financial system, in addition to its direct effect, via interest rate setting, on decisions of households and firms concerning saving, consumption, investment, borrowing, and lending.

Given the continuing absence of a global carbon tax first-best solution and because one single state cannot fix the problem of climate change, I will argue that what I broadly discuss as Green Quantitative Easing (Green QE, for short), even if remaining for some just a second-best policy for greening the economy (see also Volz, 2017, among others), needs to be considered seriously as a first policy solution. As I shall suggest, Green QE is not just a second-best option. Still, perhaps the only feasible urgent strategy, rich enough to involve a spectrum of

complementary measures, that can be flexibly applied to reverse climate change now, without further delay.

However, Green QE also requires coordination with governments and the international community of central bankers and a deeper political and social consensus on climate justice. Such a fundamental and multidimensional task imposes my interdisciplinary approach in the present thesis, attempting an informative synthesis of economics and political theory. Following Mihailov and Ferret (2021), we provide a menu of pragmatic initiatives in economic, financial, and social policy we refer to as (components of) green QE, to be implemented immediately and in a complementary way but spanning over a long run and thus sharing costs and benefits across generations.

Perhaps because of the problems facing regulators and elected governments when it comes to designing and enforcing a global carbon tax first-best policy, political scientists (e.g., Blyth and Lonegran, 2014) as well as academic economists (e.g., Volz, 2017; de Grauwe, 2019; Fisher and Alexander, 2019) and monetary policymakers (e.g., Carney, 2015, at the Bank of England; Brainard, 2019, at the Federal Reserve Bank (Fed) in the United States (US); Lagarde at the ECB, as reported in Jan and Merle, 2019) have more recently defended the idea that central banks should take the lead in greening financial markets. However, it is clear too that such a solution might at the same time overburden unelected central bankers, given their primary responsibility for maintaining price and financial stability (Volz, 2017; Schoenmaker, 2019) and creates some doubts about the suitability of unelected officials in central banks to take such political decisive actions. In the section about the legitimacy of independent central banks to implement Green QE, I will address this worry and defend that green central banking is compatible with the primary goal of central banks to keep price and financial stability. Therefore, if we set up the right institutional design, it does not threaten the political legitimacy of the central bank and the government.

3.3 Finance, Central Banks, and Climate Change

The IPCC report published on 2014 already claimed that there is a broad consensus that climate change will significantly impact our economies and the financial system. The report, and Carney's speech about the Tragedy of the Horizons (see the introduction), triggered an interest in sustainable finance amongst economists and central bankers (Campiglio 2016, Volz 2017, Monin 2018 a, b, Schoenmaker 2019), as well as amongst political theorists (Fontan and van't Klooster 2020, Dietsch et al. 2022). On the one hand, projected climate change will increase extreme weather events, create agricultural disruptions, and other climate risks that will affect the economy and the financial system. But on the other hand, climate change will negatively affect productivity and economic growth. Thus, climate change will have a clear impact on financial and price stability, and the central bank must attend to these effects if it aims at maintaining stable prices. The central bank is the institution in charge of maintaining price stability and, in some cases, other goals like high employment and sustainable growth. Therefore, they need to buffer the economy and financial system against unexpected shocks or disruptions, including those that climate change will create. The first climate issue that raised interest among central bankers and economists was the issue of climate risks and how climate change might affect financial markets and monetary policy (Carney, 2015, Matikainen et al., 2017, Monnin, 2018 a, b, Brainard, 2019, Shoenmaker, 2019). Matikainen et al. (2017) claim that central banks do not correctly assess certain businesses' climate risks.

On the other hand, our efforts to mitigate climate change will also impact the economy. The present generation has to make considerable investments to make a green transition that will affect our economies, reducing growth and imposing extra costs on governments and consumers. These are the kind of costs I am interested in here. The main idea in this chapter is that the central bank offers new possibilities to

distribute these costs across generations that B&F (2016) or Sachs (2015) do not consider.

For their essential role in the financial system, central banks are perfectly situated to take the lead in switching to a sustainable financial system. From the correct assessment of climate risks, economists and political theorists began to argue for more active policies to green the financial system, and the idea of Green QE appeared (Anderson 2015, De Grauwe 2019). Green QE can drive climate change mitigation but also, as I will argue, distribute the burden of mitigation across generations in different ways. The role of central banks in the low-carbon transition has been studied and discussed in a series of recent academic papers, policy notes, and articles, particularly by Matikainen et al. (2017), Volz et al. (2017), Battiston et al. (2017), Monasterolo et al. (2018), Monnin (2018 a, b), Solana (2018), Battiston et al. (2019), De Grauwe (2019), and Schoenmaker (2019). These authors call for central banks to do more than just take climate risks into account in their monetary interventions.

Under QE (see the next section), central banks have purchased a wide range of financial assets with varying maturities, including government bonds, asset-backed securities, and corporate bonds and stocks. Recall, to invoke some numbers again, that before the Pandemic, the ECB spent 2,600 billion Euros across four sub-programs: Corporate Sector Purchase Programme (CSPP), Public Sector Purchase Programme (PSPP), Asset-backed Securities Purchase Programme (ABSPP), and Covered Bond Purchase Programme (CBPP3). First, let's look at the CSPP, launched in June 2016. We can see that those businesses which are operating within the most carbon-emitting sectors, such as extraction and distribution of fossil energy sources, car manufacturing and equipment, and most energy-consuming sectors, issued 63% of the assets bought by the European Central Bank under this program (Jourdan and Kalinowski 2019).

One first claim is that central banks should not implement QE without regard to the effects that the companies issuing the bonds and

stocks they buy have on climate change. In buying bonds and stocks of carbon-intensive or brown companies, they prioritize the present generation by harming future generations that will suffer from climate change. It does not seem enough to appeal to market neutrality to justify these harms. Given the impact of climate change on future generations, a monetary policy that exacerbates the effects of carbon-intensive industries is not only environmentally non-neutral but unjust from the perspective of justice across generations.

We should ask whether it should be part of their remit to have an eye to climate impacts - or if we need to address it through other institutional channels. For example, should central banks be focused *only* on price stability? Some central banks have different goals than price stability, such as maintaining high employment. Promoting high employment undermines market neutrality, but the central bank, in this case, faces a trade-off between different societal goals at the cost of market neutrality. For the same reasons, I argue that climate change mitigation should also be part of central banks' mandate given the climate crisis emergency, even if it requires a departure from neutrality in financial markets. This view has implications for the legitimacy of independent central banks that I will briefly discuss below in section 3.6.

More precisely, the chapter identifies several areas in which central banks can impact mitigating and adapting to climate change. First, central banks should correctly assess the climate risks associated with the bonds they buy when launching QE programs. Second, central banks could even go further and gradually change the eligibility criteria to buy only green bonds, not brown bonds, under QE programs. Third, central banks could also buy bonds from a public investment bank, or the WCB envisaged by Broome and Foley (2016), that will, in turn, invest in projects to reduce the emissions of GHG and switch to sustainable forms of energy. These last two policy areas are generally known as initiatives or instruments of Green QE or green central banking; in the narrower sense, the term has been used since it was coined by Anderson (2015).

In Mihailov and Ferret (2021), we offer a broader interpretation of Green QE, and we complement these initial or core and more conventional areas by, fourth, several novels and less conventional initiatives that we can call intergenerational Green QE, as discussed in detail further below.

3.4 What is Quantitative Easing?

As mentioned earlier in the introduction, independent central banks have general goals, such as controlling the money supply, fixing the interest rate, and securing price and financial stability (see Goodhart 2010). Central banks undertake these roles through open market operations to adjust their balance sheet, fix the interest rate, and monitor strategic financial institutions' risks.

To understand how QE works, we need to look at the most crucial feature of central banks: they have a monopoly on the issuance of currency. As a result, there is a hierarchy of money, and the central bank's money is the ultimate form of settlement between economic agents (Pistor 2013, Tcherneva 2017). Indeed, the central bank is not the only institution that creates money; private banks create deposits as if 'out of nothing' when they grant loans to their customers and also when they operate in the interbank lending market. The latter constitutes 97% of the money created in our economies (see McLeary et al., 2014 a, b). However, the central bank's unique power to settle its debts by issuing its own reserves makes it the best institution in our democracies to achieve price and financial stability.

A simple explanation holds that the central bank controls the short-term interest rate charged to commercial banks to achieve price stability. However, since commercial banks hold accounts at the central bank, so this official short-term interest (or policy) rate affects their operational costs. Thus, they adjust the interest rate they charge to other market

participants as a 'markup' or 'spread' over the policy rate. These changing costs on economic agents influence their decisions about investment and consumption, changing the level of inflationary pressures on the economy (Dietsch et al., 2018).

However, to understand the financial system's hierarchy and the central bank's role within it, we need to be more precise. The main channel for monetary policy implementation consists of open market operations. To get access to more liquidity, commercial banks can turn to each other in the interbank lending market, the market where commercial banks lend to each other to meet their short-term liquidity needs. To influence the effective interest rate in the interbank market, the central bank changes the amount of liquidity to which commercial banks have access through open market operations. That is, central banks swap an amount of liquidity with commercial banks for specific assets that act as collateral. Although, as mentioned in the introduction, the bank can expand the money supply in order to fight a recession, it can do so by buying bonds and paying for them by creating money. In contrast, if it wants to contract the money supply to fight an inflation surge, for example, it might sell bonds and destroy the money it receives from the exchange of bonds, increasing the interest rate on bonds.

When central banks launch Quantitative Easing programs (QE) -the outright purchase of large amounts of financial assets on secondary markets- they purchase a wide range of financial assets with varying maturities, including government bonds, asset-backed securities, and corporate bonds and stocks. QE implies a massive increase in the money supply – near three thousand billion Euros for the ECB until 2016- to purchase bonds and stocks from commercial banks, increasing the size of these central banks' balance sheets five or six times (Fontan et al., 2016). The Pandemic implied even more aggressive Quantitative Easing programs, like the Pandemic Emergency Purchase Program launched by the ECB, and further increased the money supply.

The proposal I will offer in this chapter is to use the central bank's hierarchical position in financial markets to facilitate a transition to sustainable finance. Sustainable finance implies that financial markets do not facilitate investments in carbon-intensive industries but finance the transition to a sustainable energy system that does not require burning fossil fuels and emitting GHG (type 1). The second issue is one about the fair distribution, across generations, of the costs of mitigating climate change today (type 2). Some of the policies labeled under the name of Green Quantitative Easing offer us the possibility to design green bonds with long maturity dates. We have the option to borrow money from future, presumably richer, people to help pay the cost of taking climate action now and thereby avoid further harm to future generations.

3.5 What is Green QE?

In a recent interview in the Financial Times, Christine Lagarde (2019), President of the ECB, announced a 2.8 billion Euros program to buy green bonds; that is, the ECB will implement Green QE. In this interview, Lagarde claims she thinks about her grandchildren and great-grandchildren. She does not want them to believe that the present generation is responsible for damaging climate change and their severe living conditions. The president of the ECB adds that environmentalists should also understand that money matters to mitigate climate change. More recently, the ECB's Governing Council has manifested that "it is strongly committed:

- to further incorporating climate change considerations into its monetary policy framework;
- to expanding its analytical capacity in macroeconomic modelling, statistics and monetary policy with regard to climate change;

- to including climate change considerations in monetary policy operations in the areas of disclosure, risk assessment, collateral framework and corporate sector asset purchases;
- to implementing the action plan in line with progress on the EU policies and initiatives in the field of environmental sustainability disclosure and reporting."[19]

Given these lines of policy implementation mentioned by the ECB, it is important to recall that some authors have raised concerns about conventional QE and the problem of the political legitimacy of unelected officials taking decisions with profound distributional consequences (Tucker, 2018, van't Klooster 2019, 2020, Fontan and van't Klooster 2020). On the other hand, some normative theorists claim that environmental issues are also deeply political. Therefore, they should not be left in the hands of unelected and weakly accountable central bankers unless we reform the institution, their mandate, or its relationship with the government (Fontan and Van't Klooster 2020, Dietsh et al. 2022). I will come back to this issue when examining the legitimacy of independent central banks implementing Green QE. However, in what follows, I will present a taxonomy of different policies that can be labeled as Green QE or green central banking.

3.5.1 Standard Green QE

We can distinguish different kinds of Green QE policies. Even if the distinction is not so clear in practice, analytically, it is useful to differentiate between (i) standard Green QE policies that help to make a transition to sustainable finance and mitigate climate change, (ii) progressive Green QE, that will also serve to create a liquid market of green bonds, and (iii) intergenerational Green QE policies that also

[19] See the recent ECB's press release: https://www.ecb.europa.eu/press/pr/date/2021/html/ecb.pr210708_1~f104919225.en.html

distribute the financial burdens of mitigation more fairly across generations. Thus, we must consider the two distinct principles of intergenerational climate justice. Standard and Progressive Green QE serve intergenerational climate justice by implementing policies that cut emissions and thereby reduce the climate burden on future generations (type 1 issue of climate justice). On the other hand, Intergenerational Green QE justly shifts some of the financial costs of mitigation onto future generations (type 2 issue of climate justice).

First, we can call Standard Green QE requires central banks to buy bonds and stocks only from companies that are not "brown", that is, they are not carbon-intensive companies. As a result, the companies issuing bonds eligible for QE programs benefit from a tighter credit spread. That is, qualified bonds for QE programs have a lower gap in yield to government debt than the bonds that are not eligible for QE programs (Volz et al. 2017, Battiston et al. 2017, Shoenmaker 2019). This lower gap in yield compared to government bonds makes financing for companies whose bonds are eligible for QE programs much cheaper. Thus, implementing Green QE will increase the financial costs for carbon-intensive industries while making cheaper credit available for green projects.

Standard Green QE can extend to all the central bank's open market operations. Schoenmaker (2019:2) emphasizes that not only QE but all monetary policy operations - including conducting monetary policy operations, managing foreign exchange reserves, and operating the payment system – "involve allocation decision when purchasing assets and taking collateral (through the so-called 'eligibility criteria')." Extending Standard Green QE to all open market operations means that when intervening in the interbank lending market, the central bank will only accept as collateral a commercial bank's assets from non-carbon intensive industries or, in short, green bonds. This approach can be extended to the entire interbank lending market. When commercial banks are lending to each other, they will only accept as collateral green

assets. Standard Green QE in the whole financial system would provide liquidity and stable demand for green bonds. Since green assets would become safer assets than brown ones, investors would look for green assets as a form of secure investment. Finally, as a last resort, the central bank can step into the green bonds market and secure its liquidity and marketability. Standard Green QE requires changing the central bank's eligibility criteria when it buys bonds and stocks under QE programs. It also requires promoting a higher number of green bonds and certain homogeneity so that these can be securitized and purchased under Green QE programs (Matikainen et al. 2017, De Grauwe 2019). Standard Green QE should help to create a stable demand and liquidity for green bonds. Summarizing, the three most politically significant effects are (a) reducing the central bank's balance sheet exposure to brown assets, (b) making credit cheaper to green projects and more expensive for carbon-intensive businesses that use technologies based on burning fossil fuels and emitting GHG in the atmosphere, and (c) create long stable demand for green bonds.

One worry about Green QE is that it might lead central banks to print too much money and create inflation. It is crucial to notice that a central bank can potentially buy all debt, wait until its maturity, and substitute for new debt. There is no limit to the number of financial assets the central bank can buy because it can always create new money. In theory, the central bank could purchase all existing financial assets, but that would increase the money supply so that inflation would increase dramatically, and the value of money would fall sharply (De Grawe 2019).

A rise in inflation will compromise central banks' primary role: to maintain price stability. Usually, as in the ECB case, they have an inflation target of around 2%. Taking the ECB as an example, De Grauwe claims it could also purchase bonds issued to finance environmental investments. The only restriction on these purchases is that they do not endanger the 2% inflation target. De Grauwe (2019) notices that the ECB has bought 2,600 billion of corporate and government bonds without

fueling inflation under QE. “It has announced that when these government and corporate bonds come to maturity, new bonds will be bought in the market to keep the money stock (money base) unchanged.” According to De Grawe, this creates a ‘window of opportunities’ for the ECB. It could replace the old bonds with new “environmental bonds,” i.e., bonds issued to finance environmental projects. According to De Grauwe (2019) the ECB would not create new money. “It would only reorient money flows towards environmental projects. As the total amount of money would remain the same, there would be no risk of additional inflation.”

Nevertheless, nowadays, we are facing a sharp increase in inflation across the western economies. This rise in inflation derives not only from the war in Ukraine and the subsequent rise in energy prices, but also from the huge expansion of money supply undertaken under QE programs since the global financial crisis and, especially, during the Pandemic. Naturally, this limits the implementation of Green QE at this precise moment, but the idea defended here is to implement Green QE during a sequence of business cycles that can encompass three or four generations. It seems that if inflation surges, the central bank has to sell its green bonds on its balance sheet and destroy the money it receives in exchange (the usual contractionary policy explained earlier). But this is just to say that we are not in the right moment of the business cycle. Therefore, this is just a short-sighted view of the problem. The economy has boosts and bursts. Green QE Programs, like any other QE or expansionary monetary policy decision, should be implemented during bursts and periods of low inflation during a sequence of business cycles that might take several decades and generations.

Even if we solve the inflation-related problems with Green QE, the main problem for Standard Green QE is that green bond markets are not developed enough. For example, the total value of green bonds in European financial markets is less than that of bonds bought under CSPP undertaken by the ECB. Thus, we must gradually switch to a green

eligibility criterion if we do not want to risk price stability and the correct transmission channels of monetary policy (Schoenmaker 2019). An appropriate transmission channel of monetary policy requires a broad basket of bonds (green or brown) that ensures that the efforts of the central bank to keep inflation under control is adequately reflected in financial markets. That means that the transition to green monetary policy must be gradual. Giving the central bank a choice between green and brown bonds that secure the transmission mechanisms of monetary policy until the market of green bonds is wide enough to ensure this crucial function of the central bank. Nevertheless, Schoenmaker (2019) shows that a small tilt through green requirements in collateral transactions will reduce ECB's balance sheet exposure to carbon-intensive industries by more than 40% and create a spread of 4 basis points between green and brown bonds without compromising the transmission channel of monetary policy. However, central banks can do more than change the eligibility criteria; they can help create and promote a solid market of green bonds and long and stable demand for them (Volz et al. 2017). To see how, we have to look to more direct policies for making a transition to a sustainable financial system, like Progressive and Intergenerational Green QE.

3.5.2 Progressive Green QE

Standard Green QE shows how the central bank can, and should, promote mitigation. It promotes intergenerational climate justice because we have a clear duty to ensure that future generations do not face severe climate harm. Now, we turn to Progressive Green QE. Under this variant of QE, the central bank prints money to buy bonds from a public investment bank (Anderson 2015, Matikainen et al. 2017, De Grauwe 2019), or an international climate bank (Broome & Foley 2016), which in turn directs programs aimed at reducing emissions of greenhouse gases. The particularity of Green QE in this progressive form is that it allows us

to design green bonds, either public or private, specially created to finance projects to switch to sustainable forms of energy and stop global warming and climate change. Therefore, a window opens to widen the number of green bonds and provide them with liquidity. This progressive form of Green QE requires some degree of coordination between monetary and fiscal authorities. However, the bonds bought by the central bank under Standard or Progressive Green QE will generally have a relatively short maturity date, let's say between 10 or 30 years, and therefore they can be defended without appealing to BFF as presented in chapter 2. In this case, we could talk only about borrowing from the near future. Let's now turn to a more original, although controversial, policy option: creating a Climate Bad Bank.

3.5.3 A Climate Bad Bank

Green bonds will finance a transition to sustainable forms of energy that do not emit GHG and mitigate the effects of climate change. But they can serve other purposes too. A shift to a sustainable economy will create winners and losers, and among the latter will be the shareholders and workers of carbon-intensive companies (Salin & Daumas 2020). A just transition may have to invest in retraining these industries' workers since many will inevitably become unemployed. Furthermore, these companies' capital value will eventually fall drastically, creating losses for their shareholders. Who should pay for these losses? As Salin and Daumas (2020) proposed, one economic response to that problem is to create a Climate Bad Bank that will buy all these assets from carbon-intensive industries, thus compensating their shareholders and former workers. The central bank is vital because it can finance this Climate Bad Bank, either by funding debt issued by the Climate Bad Bank to buy these brown assets or by buying them directly in order to keep them on its balance sheet and depreciate their value.

There are significant normative issues raised by this proposal too. For e.g., we might support investment in retraining for workers, but we might think that shareholders who have knowingly invested in carbon-intensive industries ought not to be compensated. It is true that concessive arguments in favor of BFF, such as Broome and Foley's (2016) proposal of efficiency without sacrifice, which I have already discussed, can accommodate these issues, but I think they remain morally controversial. Moreover, this Climate Bad Bank could create a moral hazard problem and favor companies that are "too brown to fail."[20] So the Climate Bad Bank does not fit well with my view of BFF and raises issues outside the scope of my arguments in this dissertation. However, the Climate Bad Bank also implies cooperation across generations to support this kind of monetary initiative to tackle climate change. In this sense, a central bank supplying money to reduce emissions by buying brown assets (type 1 question) during long lapses of time is also a proxy of Borrowing from the Future worth mentioning here (type 2).

3.5.4 Intergenerational Green QE

Finally, intergenerational Green QE opens the window to design green bonds according to principles of intergenerational justice. Thus, a central bank can help to fairly distribute the financial costs of mitigation and adaptation to climate change across generations (type 2 issue). A proposal of Intergenerational Green QE could include climate bonds with different maturity dates, some of them very long. These bonds will be kept in the central bank's balance sheet until their maturity. Mainstream economists might object that this long-time increase in the money supply might lead to inflation rises from time to time. They might claim that Intergenerational Green QE implies that it might happen that within this very long period, inflation does not remain as low as it was during the

[20] Thanks to Karin Shields, who coined this term to point out the latter problem.

last decade of QE programs until very recently. Therefore, as a concession to mainstream views, we need to consider that the central bank might need to apply a contractionary policy and sell these green climate bonds when inflation surges. As mentioned, the idea is that Intergenerational Green QE programs will only be in place during recessions and periods of low inflation throughout a sequence of business cycles as a way to avoid these inflationary worries. If the central bank at some point has to sell the climate bonds when inflation surges, the implementation of standard and progressive Green QE should be enough to make these bonds marketable and liquid. Since the central bank will have changed its eligibility criteria and only accept green collateral in its operations with its reserves or the interbank lending market, I expect that there will still be stable demand for them in financial markets. The central bank could sell them without compromising its primary goal in securing price stability. One of Standard and Progressive Green QE's primary purposes is to help develop a market for green bonds that is big enough to be sufficiently broad and liquid to ensure that the monetary policy transmission channel operates correctly with only green bonds. The central bank will repurchase these green bonds when the next recession looms, and inflation decreases again. Moreover, and this is crucial for the argument of the thesis, Intergenerational Green QE allows the central bank to design green bonds according to principles of intergenerational distributive justice defended in the rest of the dissertation.

3.5.4.1 Greening Compensatory Transfers

In Mihailov and Ferret (2021), we suggest another financial instrument that could complement the array of previously discussed instruments, which have now gained some popularity, for inducing a quick and decisive shift toward nonpolluting technologies: what we call Greening Compensatory Transfers (GCTs). This novel financial instrument is envisaged as specializing in reimbursing cost differences through cash

transfers to consumers, workers, and shareholders. These GCTs have the sole purpose of compensating for the monetary (or market-valued) costs of switching from brown to green products, jobs, and securities, respectively. For example, imagine that a consumer can buy a *brown* product that is cheaper than a (complete or close) substitute that is produced using *green* technologies with no (or much less) pollution of the environment. Then such a consumer GCT will compensate for the monetary cost of switching to the more expensive green product. For instance, suppose we want to buy an electric car that is 10% more expensive than a conventional gasoline-fueled car of the same range or category. Then, GCT will compensate this consumer for the extra cost of buying the electric vehicle.

Blyth and Lonegren (2014) support a similar idea where the central bank directly provides cash transfers to the people, perhaps the bottom 80% of the income distribution for fairness reasons, especially when a recession looms. Then, consumers should spend this helicopter money to spur the economy and, possibly, eradicate recessions. In Mihailov and Ferret, the argument is that such GCTs to individuals should only be used for the specific purpose of buying a consumption good or service substitute that is green and more expensive rather than the cheaper brown alternative.[21]

One worry is that GCTs might look like a subsidy to the wealthy. Poorer people may not be able to afford green goods without or without the GCT. This concern might be genuine, but this depends on the details of how we design such a scheme. If we limit GCTs only to the bottom 80% of the income distribution, as Blyth and Lonergan (2014), we avoid subsidizing luxury emissions. Instead, we are mainly financing the poorer

[21] One worry arises here. It is often the case, that the greenest thing is to keep the stuff you have. So better to keep running an old car rather than buy an electric one. So, there is a danger that GCTs could spur consumption – and we might think that even if only serves consumption of greener goods, this is still worse than buying nothing. Even it might be better to do not consume anything, it seems unreasonable, at least to me, to think that the solution to climate change implies that nobody consumes anything else in the future.

substitution of brown goods for green goods and protecting their right to development.

Of course, that way, only the consumer's choice has been compensated for its greening. However, there are still losers from the switch in consumption, namely the workers in the brown industry that produced the cheap brown substitute and the shareholders in the firms in this industry. The latter is doomed to decline unless it is (gradually) transformed into one depending only on green technologies. Hence, there could be two additional GCTs related to the consumer GCT I just outlined. The first may be termed a worker GCT, which will cover the cost of retraining the labor force in a brown industry either to use green technologies or to get an update in qualifications so that it can be employed in another green sector. The second may be termed a shareholder GCT, and it may possibly respond to the problem caused by carbon-intensive industries that should be sized down and ultimately closed.[22] The funding for these three types of related GCTs can come from either fiscal or monetary policy. In the latter case, it could either be the monetization of government budget deficits or direct cash transfers like a gift of money.

The GCTs we propose (see Mihailov and Ferret 2021 and the Appendix) are indeed similar to the old idea of helicopter money (Friedman, 1969) having become popular with the advent of the COVID-19 pandemic once again (e.g., Benigno and Nisticó, 2020). However, the difference is that GCTs can only be used for the prescribed special purpose. This green purpose needs to be verifiable and ascertained, in principle *ex post* (e.g., by purchase receipts or other accounting methods which is feasible and easy with IT payment technologies everywhere) but could be perhaps *ex ante* too. Through such GCTs, central banks could play a key role in implementing mitigation policies to the effect of cleaning up the global ecosystem quickly and at no harm to the present or future

[22] This proposal implies the same worries discussed in connection with the Climate Bad Bank.

generations. Of course, inflation will have some impact while consumers and firms switch to more expensive but green products and technologies, respectively. But there will be no conventional spur in inflation caused by too much money chasing too few goods. In this sense, there cannot be a danger of persisting inflation beyond implementing such a GCT-based mitigation policy.[23]

Central banks could transfer Greening Compensatory Cash to the current generation without repayment. In a still milder version of the burden for the future generations, we can modify the presented theoretical framework in a way that does not require repayment of the bonds by the future generation(s). It could be that they may have the option not to repay anything or repay partially as much as they deem fair, looking back from their future time to our current choices and taking into account the damage to the planet we have incurred to them or not been able to prevent for them. Why are central banks needed in such a scenario? Because governments cannot maintain unbalanced budgets intertemporally and accumulate huge debt, whereas the central bank can simply print money at its own will and allocate it for the specific mitigation policy via GCTs, without requiring repayment (for analogous arguments, but in the post-COVID-19 pandemic context, see, e.g., Benigno and Nisticó, 2020). In such a particular version of Green QE, via GCTs as we propose, central banks seem the only institutions that could implement it.

GCTs then raise some of the problems that the Climate Bad Bank raised, and explained in the earlier section, and some new ones, like the full or partial non-repayment option. The latter makes it hard to include this proposal as borrowing from the future. Still, again, this policy should be implemented across several generations, and it requires the cooperation of more than one generation. In the end, if we expand the money supply to grant GCTs we are leaving fewer options to increase the

[23] See Mihailov and Ferret (2021) and its excerpt that comes as an Appendix here for the mathematical model.

money supply to future generations without generating inflation. We are borrowing from their capacity to create new money for other purposes. This option would not be possible if there were no future taxpayers essential for upholding central banks across generations. The possibility of full or partial non-repayment requires more discussion indeed. If there is a real non-repayment option, then should not future generations take it, even if it increases distributive unfairness - not only if they turn out to be poorer than expected- given that we created the problem?[24]

We can reverse the arrow of transfers from future to present generations through BFF because we can shift costs onto future people. But they cannot push costs back onto us if it turns out that we have unfairly made them bear too much of the burden. Given that, some might say, they should always take the non-repayment route. I will discuss this issue further in the following chapter. Nevertheless, a full normative justification of GCTs is out of the scope of this thesis. It will require a different dissertation, given its characteristics. In this chapter, I provide a range of policy proposals central banks can promote to tackle climate change. Some are justified by their feasibility or because they imply lower costs for the present and future generations. My arguments in favor of BFF, though, already advanced in chapter 2 and further elaborated in the following two chapters (4 and 5), fit better with the defense of the next policy option in the menu of options provided here, what we call Generation-Shared Green Bonds.

3.5.4.2 A Proposal for Issuing Generation-Shared Green QE Bond

Green QE could also be implemented through an extremely long-term bond issue. On this model, Mihailov and Ferret (2021) also aim to propose some variant of green QE employing an extremely long-term bond issued by households and firms as debtors of the present generation. The central

[24] See chapter 4.

bank could hold these bonds as a creditor (or an analogous government bond issue monetized by the central bank, which is approximately equivalent). The point of this type of very-long-term bond issuance is that it allows sharing of the repayment burden across generations, with an option of the future and even the present generations to pay part or not at all (and then the remaining debts will be written off).

If we assume that future generations will be more affluent than present, as is the historical trend, we can borrow from them to take action against climate change and protect them from further harm caused by climate change. This policy scheme is the most Intergenerational Green QE and the one that best fits with the debates about BFF undertaken in the previous chapter and the following ones. It allows us to design bonds with several maturity dates, say every 25 years - roughly corresponding to a generation span- over a long run of 100 or more years. Mihailov and I propose linking their yield to cover de facto annual inflation, protecting bondholders from inflation ex post, whether the bondholder is the same central bank or if the central bank has to sell these bonds to institutional investors like commercial or investment banks. At the same time, it reduces the borrowing costs for the present generation by not requiring a nominal interest rate different from zero, as we deem fair within the logic of such financial instruments.

Linking the bond interest to the inflation rate also prevents future generations from paying less in real terms if inflation rises considerably over time. Therefore, the cost of each generation should be calculated in real terms; that is, it might include the initial price of the bonds plus the increases in inflation unless we think future generations should pay less. However, as emphasized in Professor Alan Cromartie's report, we need to consider the opposite problem, too. For example, suppose some generation experience a decade of hyperinflation, with the *Harmonised Index of Consumer Prices* (HICP) -the index that the ECB uses to calculate variations on inflation- with figures of two digits. In this case, we know that the distribution of the cost of inflation across society is unequal;

while businesses transfer the rise of inflation in the price of their products and services, the salaries of workers do not increase at the same pace. A yield covering just the de facto annual inflation might be politically compromised for its actual distributive effects, even if equal in real terms across generations. To avoid this worry, the central bank should have the option to introduce a *cap* to the yield. That is, it must have the option to require a maximum yield of, let's say, a 3%, even if that does not cover de facto annual inflation.

As we propose, there is still a cost for the holder, the central bank. The price is equivalent to the loss of interest above the inflation rate; there is, of course, a cost for the current and future generations to repay fully or partially. But we, notably, argued in the context of GCTs, only the central bank can bear the cost, yet it can also always print money.

Each generation pays for, say, 25 years, then the next generation continues, and so forth; moreover, Mihailov and Ferret envisage that each generation of this super-long-run climate change mitigation bond scheme may pay only for 5-10-15 years, or not at all. Then the debt will ultimately be written off. That is why the central bank seems to be indeed the only institution to operate such a bond scheme without any adverse effects on society (such as accumulating government debt: see, again, Benigno and Nisticó, 2020, on this crucial difference between the government and the central bank, as the latter is the only that can perform the role of a lender of last resort to the nation).

We think that it is fair to allow an option to the future generations to repay partly or not repay a green debt if, at the end, they happen to be less rich than us or they suffer severe damage from the effects of not tackling climate change earlier. Writing off debts is an unusual and unproductive measure in normal times that would distort financial and economic incentives and will most likely lead to a loss in economic competitiveness and even, in some cases, to a social crash with tragic and long-term consequences. Nevertheless, the costs of writing off some such green QE debts (or bond repayment to the central bank) will be

justifiably minimal compared to the vital task of saving the life on our planet. In this sense, we think Green QE is a superior strategy to the traditional model used to discuss the principle of borrowing from the future, carbon taxes or a cap-and-trade emissions market.[25]

This Generation-Shared Green bond proposal best suits my argument that we should fairly share the costs of mitigation and adaptation across generations (type 2 question). Before entering this terrain in the next chapter, to start discussing the normative aspects of Green QE or green central banking, I will focus first on the problems that implementing green monetary policy might pose to the legitimacy of independent central banks and elected governments.

3.6 Legitimacy

In the next chapter, I will discuss the normative justification of green central banking and Generation-Shared Green Bonds from the point of view of intergenerational climate justice. I will provide there my own enthusiastic defense of BFF. Before that, in this section, I will spend some time examining whether the central bank's mandate is compatible with Green Quantitative Easing.

Recall that central bankers were seen for decades as apolitical bodies during "The Great Moderation Era" (Stock and Watson 2002). The independence of central banks was instrumentally justified when their only goal was to fix inflation with a single instrument, the short-term interest rate. Several decades before the Global Financial Crisis 2007-9, it was normally thought that the fiscal authority had the tools needed to

[25] See Jonathan L. Ramseur and Larry Parker, *Carbon Tax and Greenhouse Gas Control: Options and Considerations for Congress* (Congressional Research Service, 10 March 2009). See also Michael Grubb and James K. Sebenius, 'Participation, Allocation and Adaptability in International Tradeable Emission Permit Systems for Greenhouse Gas Control', in *Climate Change: Designing A Tradeable Permit System 193* (OECD Documents 1992); and UNCTAD, *Combating Global Warming: A Study on a Global System of Tradeable Carbon Emission Entitlements* (1992).

achieve distributive justice. They could compensate for the distributive effects of the central bank's decisions. After the 2008 global financial meltdown, central banks recovered, with tremendous energy, their interest in broader financial stability. They started using various instruments besides managing the short-term interest rate as QE Programs, which have profound distributional consequences and are much more difficult to compensate by the government. It seems that it is less acceptable that independent experts can choose any unconventional means to achieve price and financial stability when these policies have deep distributional consequences. These consequences are difficult to compensate for and affect the overall economic distribution (Fontan et al. 2016, Tucker 2018, Dietsch et al. 2018, van't Klooster 2019, 2020). Given this distributional impact, QE exacerbated the concern about the legitimacy of central banks.

This concern asks whether it undermines political legitimacy for democratic governments to delegate very important decisions to an independent body that is not subject to re-election and not easily removed by the legislature. Green QE raises the same distributional concerns and implications for the legitimacy of independent central banks (Fontan and Van't Klooster 2020, Dietsch et al. 2022). Thus, whilst the primary focus of this thesis is on questions of intergenerational distributive justice, I briefly discuss here the issue about the political legitimacy of delegating decisions with such deep political value to unelected experts.

To begin with, it is helpful to distinguish two broad views about political legitimacy. *Instrumentalism* claims that democracy is legitimate because it tends to produce the best consequences over time when compared to any other workable form of government. In contrast, *proceduralism* claims that the legitimacy of democratic decision-making is based on the fairness of its procedures in which everyone has an equal say.[26] Thus, I need to briefly consider the political legitimacy of delegating

[26] Examples of instrumentalism include Richard Arneson (1993) and, arguably, Joseph Raz (1986); the purest procuderalism was defended by Kenneth O. May (1952) while Jeremy Waldron (1999) provides a contemporary procedural view.

decisions with such deep political value to unelected experts. For decades, delegating monetary policy to unelected experts was seen as a self-binding device to overcome electoral pressures and promote long-term price stability. The government, like Ulysses, should tie its hands and put wax in his ears, if it wants to achieve the price stability target.[27] The key issue is whether the instrumental self-binding argument for the legitimacy of the delegation of powers into the independent central bank breaks down when the central bank's role expands beyond setting short-term interest rates to control inflation. This argument seems less appropriate to justify an unlimited use of tools to maintain price and financial stability (e.g. Fontan et al. 2016, Tucker 2018, van't Klooster 2019, 2020).

Recall that it is useful to distinguish between ends and means of the central bank (Diestch 2016). The central bank's mandate establishes the ends or goals that the institution needs to achieve, namely price and financial stability, but the central bank has freedom of means to achieve these ends. Before the crisis, the central bank used just one instrument, the short-term interest rate, to achieve the ends established by the legislature's mandate. After the global financial crisis, central banks have started to use multiple instruments and means to provide price and financial stability. This new role of the central bank implies a much broader set of political choices since each of these means has, for example, different distributive effects.

Central bankers have been traditionally reluctant to assume any climate responsibilities. For example, in a recent report, the Bundesbank claimed that central banks should operate under a principle of market neutrality and cannot substitute for climate policymakers (Weidman

[27] Jon Elster famously defended this view. See Jon Elster, *Ulysses and the Sirens. Studies in Rationality and Irrationality*, (New York: Cambridge University Press, 1979); Jon Elster, "Constitutional Courts and Central Banks: Suicide Prevention or Suicide Pact?", *Eastern European Constitutional Review* No. 66; and Jon Elster (2000): 150. The independence of central bank ensures this goal by the appointment of financial experts not subject to re-election, and who can't easily be removed by the legislature. Insofar as independence involves the delegation of powers by the government it is similar to the establishment of constitutional constraints.

2019). Neutrality can have two different meanings here. First, it might mean that the monetary policy should be neutral in its effects on the markets. However, this view is implausible given the distributive effects of inflation or Quantitative Easing, at least in the short run (Montecino and Epstein 2015). It is more reasonable to think that neutrality here refers to the neutrality of justification (Raz 1986, Kymlicka 1989). Therefore, central banks' preferences for broad and liquid assets in their transactions are justified to achieve price and financial stability regardless of the effects of monetary policy on distributive or climate justice. However, as said in the introduction, some central banks have other goals than price and financial stability, and their mandate includes goals like maximizing employment. In this case, these central banks depart from market neutrality in the second sense referred to above to incorporate these goals. As a result, they have to make trade-offs between these different goals and might achieve a sub-optimal inflation policy and depart from neutrality.

The response to the concern about the legitimacy of Green QE is to include climate goals in the central bank's mandate and accept that the institution has to make these trade-offs between different values and depart from neutrality. The delegation of powers in favor of the independent central bank can come from a law passed by the legislature, which can then impose limits on the central bank's remit. For example, in the case of climate change mitigation, the law can gradually forbid the independent central bank from engaging in some kinds of open market operations, e.g., buying brown bonds. It can also create a special committee with government and central bank members to oversee these purchase programs.

The Bundesbank claims that the central bank should not get involved in climate policies. But that is because they recognize the political status of these issues and then conclude that central banks are not political institutions able to make this kind of political choices. Whereas, in this case, changing the mandate of the central bank is also

to recognize the political status of green monetary policy, but in contrast, to conclude that the central bank should get involved – but with powers explicitly delegated and limited by the legislature and the government, reinforcing its procedural legitimacy.

One possible problem with this solution is that changing the mandate of central banks might not be politically feasible for non-ideal reasons like political partisanship, or it may take too long given the climate emergency. Therefore, we might want to constrain the means of the central bank to achieve price and financial stability (e.g. establishing quotas of green or brown assets in its open market operations) in another way. In this case, as argued by Dietsch et al. (2022), the central bank and the government should coordinate to promote Green QE. Again, this will reinforce its procedural legitimacy, but at the cost of its independence and instrumental value. Moreover, as some argue (Van't Klooster 2020, Dietsch 2020), this might come at the expense of promoting sub-optimal monetary policy.

Recall that the concern with *legitimacy* asks whether it undermines political legitimacy for democratic governments to delegate very important decisions to an independent body that is not subject to re-election and not easily removed by the legislature. We might either push for more instrumental legitimacy, and therefore more independence for central banks, or for more coordination with the government reinforcing procedural legitimacy, at the cost of less effective monetary policy. However, we should avoid construing central bank independence in binary terms so that central banks either are, or are not, independent. This way of construing the possibilities confronts us with a dilemma. Either we must endorse the instrumental case for central bank independence – namely, that it is necessary for economic *efficiency* – or we must reject that case for the sake of procedural legitimacy and *justice*. We should instead construe central bank independence in scalar terms so that independence admits degrees. This approach helps us to avoid the dilemma by allowing us to develop an account of independence in

which central banks can retain independence to the extent necessary for economic efficiency while meeting reasonable concerns regarding procedural legitimacy and economic and climate justice. Although, as mentioned earlier, we might have to face trade-offs, the role of central banks has changed over time, and their relations with the government as well (Goodhart 2010, Tucker 2018). Now, we should construct a degree of independence that allows us to promote intergenerational climate justice and political legitimacy while still meeting the primary goal of price stability.

3.7 Concluding Remarks

This chapter argued in favor of Green QE that a network of central banks worldwide could design and engage in coordination with governments. Green QE is a powerful tool to promote type 1 climate justice further. It can help us to mitigate now and prevent harm to future people. In addition, there are tools available that offer different options for distributing costs across generations - so also open up the possibility of promoting type 2 justice further. Specifically, some of these tools shift costs onto future generations.

Green QE has the potential to make a massive impact in reversing human-influenced environmental deterioration and distributing the costs of mitigation and adaptation to climate change across generations. I have outlined a policy-relevant menu of worthwhile financial initiatives that can be grouped as different forms of Green QE policies. Importantly, I also considered a novel instrument, the intergenerational Green QE with proposals such as Greening Compensatory Transfers and Generation-Shared Green QE bonds, issued by the central bank to the current generation without necessarily being repaid by future generations, rather than taxing them to repay. These proposals offer essential new options because the current generation has failed to implement what some think would be the first-best solution of a global carbon tax. Finally, I have

argued that the central bank, or rather the international community of central banks, is the best-suited institution to implement climate mitigation policy, for a number of advantages (relative to governments or other institutions).

These options are important in the debates about borrowing from the future because they help us understand how we can institutionalize BFF with fewer costs for the present and future generations. It also allows to adapt to different circumstances that might happen in the future, and that might cause future generations to decide not to assume the costs of climate bonds. This range of policy options also gives more chances to take climate action now to the present generation. They are more feasible because they imply less cost for the present generation than implementing a global carbon tax or a government or a WCB issuing debt that future taxpayers will repay. In the next chapter, I will examine a principle that can support BFF and Green QE, specifically Generation-Shared Green Bonds. This principle is the Intergenerational Ability to Pay Principle (IGAPP). It tries to answer the question about what constitutes a fair distribution of the costs of mitigation and adaptation to climate change across generations.

4 The Enthusiastic Defense of BFF and the Intergenerational Ability to Pay Principle

4.1 Introduction

In chapter 2, I examined BFF as it is instantiated in Broome and Foley's proposal for a WCB. I showed that their argument in favor of borrowing from the future is concessive, and, in contrast, I will present here an enthusiastic argument. Broome and Foley are correct that BFF can help us to overcome some barriers to urgent climate action, but they claim that 'making the grandchildren pay' is a justified injustice. Thus, while they claim that BFF is unjust, but we should adopt it because it is more feasible than the alternatives, I will defend that BFF helps us not just make a transition to a green economy (type 1 issue), but it also promotes the fair distribution of the costs of mitigation and adaptation to climate change across generations (type 2).

The previous chapter showed that some forms of Green QE are appropriately understood as a range of tools that constitute BFF, especially Generation-Shared Green Bonds. However, to some extent, other proposals also limit future generations' capacity to use the central bank's capacity to create money for other purposes without suffering economic imbalances. As a general thought, a state could not issue its own currency, and a central bank could not supply money in that currency if they were not future taxpayers able to pay taxes on that currency across generations. A well-functioning central bank depends on these future taxpayers' existence; if not, it would lack the credibility to supply money. That means that all the proposals made in the previous chapter depend indirectly on the ability to pay of future people. Moreover, all the proposals presented there require the cooperation of a sequence of generations to uphold an institution like the central bank and keep the

monetary base -that is, the quantity of money issued by the central bank- economically sustainable.

This chapter presents an original enthusiastic argument in favor of BFF that relies on the intergenerational application of the Ability to Pay Principle (IGAPP). To justify BFF, I will argue that a fair sharing of the costs of mitigation and adaptation to climate change across generations implies the application of the IGAPP. If we use the IGAPP, presumably, richer generations should pay more. Still, we must also consider how other competing principles, like the Polluter Pays Principle (PPP) or the Beneficiary Pays Principle (BPP), apply intergenerationally. Drawing on Caney's well-known view about the interplay of these principles *intra*-generationally, I will offer a pluralistic account of the principles that should guide us in distributing these costs across generations.

Like Caney, I defend a pluralistic account of just burden sharing, in which the PPP has lexical priority over the APP. However, I argue that the share of costs distributed according to the PPP is significantly smaller than Caney suggests. Most fundamentally, this is because Caney's sufficiency limit on the PPP is too weak. So, I argue instead that we should set up a fair shares limit. I also distinguish two more points from Caney's intra-generational account in the intergenerational case. First, the Intergenerational Polluter Pays Principle should also be limited by a fair share limit. That is, polluting generations should pay only if they are above their fair share according to what an ideal distribution of resources or primary goods -or whatever metric we are willing to use- across generations was in place. Second, I argue that the responsibility of each generation should be considered according to their Ability Not to Emit. Each generation has inherited a different technology from the previous one, which allows it to emit GHG more or less to reach its fair share of resources. Thus, their moral responsibility to pay the costs of mitigation and adaptation to climate change should be consistent with this different Ability Not to Emit.

In the next section, I will set out the Just Burden Question, which asks how the burdens and benefits involved in climate change mitigation and adaptation should be distributed. I present several candidate principles to address this question. I will also introduce a methodological issue that will clarify the scope of these principles understood in conjunction with broader domestic, global, and intergenerational justice theories. Finally, before entering into the intergenerational dimension of the burden-sharing question, in section 3, I will use the intra-generational case to see both the advantages and the limitations of different principles that political philosophers have proposed to distribute the costs of mitigation and adaptation within the present generation.

Section 4 moves from this intra-generational case to the inter-generational one and makes a case for relying on the intergenerational ability to pay principle or IGAPP. The argument is supported by the methodological issue discussed in section 4.3. Section 5 explains how my position shares some traits with Caney's pluralistic account of the interplay of the PPP and the APP but also departs from his argument in some key respects. Furthermore, I will show that when applying these principles across generations, the Intergenerational Polluter Pays Principle (IGPPP) should have a more limited scope given each generation's different Ability Not to Emit. Then, section 6 presents Caney's ecumenical case for integrating the IGAPP with prominent theories of intergenerational distributive justice. It shows that the IGAPP can be compatible with sufficientarian, prioritarian, and egalitarian theories of intergenerational justice without committing to any of these different theories. Finally, section 7 identifies and responds to three objections to the Intergenerational Ability to Pay Principle, which all question the assumption that future people will be richer than us.

4.2 The Just Burden Question

Caney (2108) distinguishes between two questions of distributive justice raised by climate change, which correspond to what I indicated as type 1 and type 2 questions. The Just Target Question asks how much protection is owed to the potential victims of climate change; the Just Burden Question asks how the burdens and benefits of preventing climate change should be distributed. This chapter addresses the Just Burden Question. Specifically, it shows that BFF helps us to respond to the Just Burden Question by promoting a fair distribution of costs (and benefits) of adopting policies that address climate change across generations. It assumes that future generations will presumably be more affluent than us. Thus, imposing some costs on them for taking climate action now and advancing the date of technological transition also promotes the benefits of these future generations.

We need first to distinguish between two kinds of burdens. First, the cost of mitigation is the cost of reducing the extent to which humans affect the climate system by emitting GHG –by reducing emissions or creating more sinks to absorb GHG. Second, the cost of adaptation is the cost of changes in the social, economic, and political systems that reduce the impact of climate change on people's entitlements (Caney 2018). Some authors claim that we should consider different principles for these two different kinds of costs. For instance, Vanderheiden (2008) argues that the question of who should bear the costs of mitigation is a question of distributive justice, while the question of who should bear the costs of adaptation is a matter of corrective justice. Caney (2018) rejects this view and claims that the same set of principles should guide both kinds of climate costs. I am not going to enter into these debates in this chapter since both types of burdens imply a financial cost, which is what Green Quantitative Easing can help us cope with. In this case, I do not think there is any relevant normative reason to treat these financial costs separately.

First, I will start with the case of the present generation and see the reasons that support the different principles that philosophers have proposed to distribute the costs of mitigation across individuals and states. Philosophers have distinguished three main principles that can guide us in solving the Just Burden Question. The Polluter Pays Principle (PPP) says that the costs of mitigating and adapting to climate change should fall on those who played the most significant role in contributing to those harms. In contrast, the Ability to Pay Principle (APP) claims that agents should bear the burden in proportion to their ability to pay. Therefore, those who can mitigate or alleviate harm ought to do it, even if they are not responsible for the damage. Finally, the Beneficiary Pays Principle (BPP) claims that the burden should be borne by those who have benefited from GHG emissions (Caney 2010, 2014, 2018). In this chapter, I will offer an analysis of these principles, and drawing but also departing from Caney, I will offer my own pluralistic account of their interplay, first, in the intragenerational case, and finally, in the intergenerational case. However, it is important to present first a methodological issue that embeds all the discussion about the Just Burden Question and the principle that should guide us in response to it.

4.3 A Methodological Issue

When considering burden-sharing principles for climate change mitigation and adaptation, we should consider climate change in conjunction with other essential issues such as eradicating poverty, promoting development, or meeting people's health needs. Thus, when applying a principle to distribute the burdens of climate change mitigation and adaptation, should we include all these other considerations as well? Some authors think that we should apply principles of justice to climate change mitigation and adaptation in isolation from other concerns. Others claim that when thinking about the just distribution of the costs of mitigation and adaptation, we should also

consider other justice issues and integrate them all. We can further distinguish between Moderate and Strong Integrationism. In the former case, we still apply specific principles to climate change mitigation and adaptation, but these principles may be informed or moderated by other considerations. Strong Integrationism in contrast, considers that no specific principle applies to climate change mitigation and adaptation. In this case, this is just one element of a total package that should be regulated by a general principle of justice, such as a global difference principle or a commitment to basic rights (Caney 2018). To address this issue, I will adopt a moderate integrationist view. That is, I will present principles expressly justified to share the costs and benefits across generations of taking climate action now, but I will acknowledge that these principles should be moderated by broader considerations about intra-generational, global, and inter-generational justice.

From the perspective of intergenerational justice, the Intergenerational Ability to Pay Principle (IGAPP) is the principle that best integrates with prominent theories of justice amongst the menu of principles examined in this chapter because future people will presumably be richer than us, and no reason justifies an inequality of this sort between generations (Barry, 1991). I will adopt a moderate integrationist view. As Caney holds, that means that we need a specific principle for the burden-sharing of climate change costs but that this principle must be "informed, or moderated, by other considerations." (Caney 2018: 672).

I will follow this path and offer a pluralistic account of burden-sharing principles that can be accommodated by moderate integrationism. My defense of the IGAPP, still, is complemented by the Intergenerational Polluter Pays Principle (IGPP). Therefore, my strategy to depart from Caney's account, which I will present below in more detail, considers the principles of mitigation in conjunction with individual entitlements to a fair share of resources, primary goods, welfare or whatever currency of justice we think is appropriate for our theory of

justice, either intra- and inter-generationally. This moderate view makes me reconsider the force of the PPP and presents a pluralistic view in which different burden-sharing principles interplay. There are two critical differences with Caney's account. First, I consider this plurality of principles as applied across generations – Caney, as far as I know, has not considered how different burden-sharing principles should apply across generations- and this has some implications, as I will show. Second, in my view, the Remainder should be bigger than Caney thinks in both the intra- and the inter-generational case. And this is again for two reasons. First, in the intragenerational case, I am applying a 'fair shares' limit rather than a 'basic needs' limit like Caney. Second, regarding the intergenerational problem, I argue that we need to take into account the different technology inherited by each generation. I will start this task by looking at the scope of the different principles proposed for the intra-generational case and how they respond to the Just Burden Question.

4.4 The Intra-generational Case

To move forward in my defense of the IGAPP, we should look more at the candidate burden-sharing principles and the nuances of the arguments in favor and against them. I begin with the Polluter Pays Principle (PPP), its appeal, and its problems.

4.4.1 The PPP and its Problems of Application

It is a widespread belief that if someone causes damage such as anthropogenic climate change, then this person is morally responsible for assuming the costs of climate change mitigation and adaptation. As

Henry Shue (2010: 187) claims, "[a]ll over the world parents teach their children to clean up their own mess." This idea behind the looking-backwards Polluter Pays Principle (PPP) has intuitive appeal. According to this view, the burdens of mitigating and adapting to climate change should be borne by those who contributed to creating a problem that will harm others. However, Caney (2010) shows that its intuitive appeal cannot overcome several fundamental objections. Therefore, we should not make this quick move from causal responsibility to moral responsibility and assume that those emitting GHG must hold the burdens of mitigation and adaptation to climate change.

The first problem is that the PPP cannot cope with the costs of earlier generations' emissions. Some polluters are no longer alive, so any burden resulting from their emissions must be attributed to someone else. One response to this problem is attributing agency and responsibility to groups (such as nations, states, or firms).[28] These entities have longer lives than individuals. Therefore, we might claim that one state, led by a sequence of governments, could be held responsible for the emissions made by those individuals who are no longer alive. Shue (2014) argues, for instance, that the states which have contributed more to global warming, have also benefited more from the emissions of GHG, and have more capacity to assume the costs of mitigation and adaptation, are indeed, those with more emissions per capita. No industrial state has yet managed to leave behind the fossil fuel-based economy that made it rich, so the biggest emitters in the past are mostly the biggest emitters now (Shue, 2014, chapter 4).[29]

It seems clear that if we take states as the duty bearers of climate change mitigation and adaptation, the answer to the Just Burden

[28] See for the responsibility of corporations, Duane Chapman, *Energy Resources and Energy Corporations* (Ithaca, NY: Cornell University Press, 1983).
[29] See also Yasumasa Fujii, 'An Assessment of the Responsibility for the Increase in the CO2 Concentration and Inter-generational Carbon Accounts', Working Paper WP-90-55 (Laxenburg, Austria: IIASA, 1990). Fujii has calculated cumulative carbon emissions per capita by region since 1800. Fujii's calculations suggest that North America and Western Europe are responsible for, respectively, 35% and 26% of the total cumulative man-made increase in atmospheric CO2 since 1800.

Question in the real world appears to be quite clear. All three principles of burden sharing point towards the same usual suspects. Things turn out to be different when we think about individuals. Although I will not delve into this question here, it seems clear that also in rich states, there are individuals that emit less and are in a situation of material deprivation. Finally, with regards to the question I will examine here, when we aim at distributing these costs across generations, things also turn out to be less straightforward than when we look at rich and poor states. The intergenerational case is different for two main reasons. First, if the current growth trends continue in the future, later generations will presumably be richer than us precisely because they would have benefited from our investments. Second, we need to take climate action now. If so, they will be able to emit less to achieve their fair share of resources (or whatever currency we deem appropriate to make inter-generational comparisons of well-being). I will consider these two arguments below.

The second problem with the PPP is *excusable ignorance* about the harm caused. It refers to those emissions made before there was common knowledge of the effects of GHG on climate change. The problem of excusable ignorance leaves a good number of emissions unattributable - those made before the 1990s when prominent scientists achieved enough scientific consensus about the anthropogenic nature of global warming and the risks involved in its rapid acceleration for future people and other species. It is challenging to hold morally responsible people who were unaware, and could not reasonably be expected to have known, the harms caused by their actions.

Finally, there is the problem of fair entitlements. The Polluter Pays Principle is a principle of individual responsibility. The underlying idea is that people should be responsible for their choices. However, individuals should be accountable for their choices within a background justice scheme (see Rawls (1999 (1971), Dworkin, 1986). Therefore, one might argue that no one should be held accountable for emissions necessary to

meet their basic needs or when to do so would deprive them of their ability to meet their basic needs. Since we do not have an alternative clean and cheap technology available, the global poor might need to emit GHG to develop their economies and reach a decent level of welfare. This issue of global justice is problematic because if the poor countries aim to reach the same level of welfare as wealthier states have achieved after emitting GHG for more than 150 years, they might become those that pollute more in the future unless the rich countries that are the only ones that have the capacity to invest in research to develop alternative technologies not based on burning fossil fuels transfer them these technologies at a lower price and permit them to develop their economies without worsening the problem of climate change (Shue 2014).

It would be unreasonable to apply the PPP in isolation ignoring the claims of the least advantaged in the world to meet their basic needs. It would also be absurd to make them pay for their emissions if that deprives them of meeting these basic needs. I agree with Caney on this, but I go a bit further. I will defend here that before making anyone pay for her emissions, we should know in advance whether she is above or below what she is entitled to according to an ideal fair distribution of resources or lifetime expectations of primary goods or whatever view we take on the metric question. Departing from Caney, I claim that only polluters who are above what they should have according to a fair distribution of resources -for short-, should be held responsible for paying the costs of mitigation and adaptation. I believe, like Caney's, that the PPP should have lexical priority over the APP, but what I have just argued implies a further limitation of the scope of the PPP and the number of emissions it applies to.

This fair share clause can be seen as a strong and unreasonable claim because it implies that anybody with less than their entitlements should not be required to bear the costs of any harm they cause. For e.g., someone who is unfairly disadvantaged ought not to pay any clean-up costs if they commit some act of vandalism. I think there is a relevant

difference between the vandal and the emitter of GHG: We might say that if someone below its fair share commits vandalism, it may be that she should be prosecuted under criminal law, have to apologize etc., but she should not bear any economic penalty if she is unjustly deprived. More generally, we can distinguish different duties, some of which we retain even under unjust conditions and some of which we do not. This issue arises not only with regards to GHG but also in other domains, e.g., in relation to the duty to work - maybe we have such a duty within a fair scheme of social cooperation, but outside of such a scheme, we may not have such a duty to work - so it may be wrong to enforce conditional welfare schemes under unjust background conditions. Criminal law is a very particular case, far enough from the problem of causing climate change (unless it is a case of emissions foreseen as a criminal offense by the law). I am not claiming that before we hold anyone responsible for an outcome in a particular domain, we need to assess the justice of their overall holdings. In the case of vandalism, or in criminal law in general, this does not make any sense. Still, I argue that this is a limit in order to distribute responsibilities to pay the costs of mitigation and adaptation.

4.4.2 The Beneficiary Pays Principle

The BPP is often invoked to deal with past emissions (see Page 2012). Even if, according to the problem of excusable ignorance, we cannot attribute responsibility for emissions made before 1990, Shue (2014) claims that it also seems relevant who benefits from these emissions. In that case, Shue argues that even if the beneficiaries should not be punished, they should bear the costs of the past emissions' harmful effects (Shue 2014). This view of historical responsibility seems plausible at first sight. As I said in the previous section, drawing from Shue himself, it appears that the PPP and the BPP should play a role when we are thinking about states in the real world as the duty bearers of the responsibility to tackle the rapid acceleration of global climate heating. It

might also be possible to attribute this kind of responsibility to carbon-intensive companies led by a sequence of persons across time but with a continued legal personality. The case is less convincing, at least for me, if we think about individuals. The fact that someone has received an inheritance that her grandfather accumulated by committing injustices might make her responsible for apologizing and expressing an honest condemnation for her grandpa's actions. However, it does not seem to me that she needs to pay the cost caused by those injustices. Butt (2007) claims that we cannot (simultaneously) condemn injustice and hold onto the proceeds of that injustice. Butt might be correct, but my intuitions are a bit different in the case of climate change. It seems that individual responsibility requires some sort of direct or indirect action and moral agency, which is absent in this case.

Even in the case of states, it might be challenging to claim that some states should bear the costs of climate change mitigation and adaptation efforts because they have benefited from past emissions. Page (2012: 306) argues that:

> "[S]tates should shoulder the burdens associated with responding to climate change according to the extent that they have derived economic benefits from activities (…) that have released greenhouse gases into the atmosphere since the beginning of the industrial revolution."

Page's argument seems to apply a principle of fair play to historical emissions. If A benefits from past emissions, A should also bear the costs of eliminating them. It is well-known that Nozick (1974) claimed that the fair play argument to justify political obligation should not apply unless individuals have accepted these benefits, rather than merely received. Those who defend the BPP can then adapt their views to respond to Nozick and claim that what is wrong here is that these people have benefited from injustice and that, in this case, it triggers a duty to repair it. Again, however, the problem of attributing moral responsibility for historical emissions clashes with the issue of excusable ignorance. It is

difficult to claim that historical emissions are unjust if we cannot attribute any fault to those who emitted GHG without knowing they were causing climate change. Consequently, it is also problematic to claim that those who benefit from those who emit in the past without knowing that they were causing climate change should bear the costs of taking climate action now.

Miller (2008) adds another argument against historical burden-sharing principles. Miller points out that since 1985 we have known about the harmful effects of GHG emissions on our climate. If we had taken quick and decisive action to limit our emissions at that time, the impact of historical emissions would have been milder, given that emissions are cumulative and a zero-sum total. Instead, we decided to continue to emit GHG, worsening global warming. Thus, suppose that when we had known about global warming, the generation present in 1985 had decided to act. The problem of climate change would have been much more manageable and less costly to mitigate. Since we decided to look away and not tackle the situation then, it does not seem that historical emissions are the key factor in accelerating climate change and causing severe harm to the young today and future people yet to exist.

Miller argues that a fair distribution of responsibilities for combating climate change should be guided mainly by the principle of equal sacrifice rather than by historic responsibility or an equal per capita right to emit greenhouse gases. He considers that from the perspective of global justice, the principle of equal sacrifice requires a fair distribution of responsibilities between states, but it does not prescribe which principle of social justice might choose a society to redistribute its fair share amongst its members. The author summarizes the principle of equal sacrifice with the old Marxist slogan "from each according to his abilities, to each according to his needs." The second part of the slogan, when applied to the fair distribution of emission rights means that poor countries should be entitled to emit more in order to develop economically and be able to provide a decent live to its impoverished members. The

first part of the slogan -from each according to his abilities- prescribes that the better-off countries reduce their emissions more, but preserving their self-determination and allowing each rich society to decide how to redistribute the associated costs to reducing emissions -reductions in GDP, living-standards and personal lifestyles- according to their own conception of social justice, e.g., implementing a carbon tax that imposes the costs on the better-off members of this particular society. The point is that Miller discards backward-looking principles and instead argues in favor of distributing the costs of emissions reductions according to the capacity of each nation. Nevertheless, he still considers that we should accommodate historical responsibility for GHG emissions for the recent past -since the problem of global warming was acknowledged- and favors linking historical responsibility to adaptation rather than mitigation costs.

In my view, however, the BPP's main problem is the same one we encountered with the PPP. Even if we disagree with Nozick's requirement of acceptance, the problem of fair entitlements still applies here, as mentioned before. Suppose someone has received benefits from past emissions. In that case, it is essential to know before making her pay whether she is above or below what she is entitled to according to a fair distribution of expectations of primary goods or whatever currency of justice we deem appropriate to apply in an ideal just distribution. It seems clear that even if she benefited from historical emissions, she should not assume the costs of adaptation and mitigation to climate change if she is below that standard. Of course, I do not claim that historical responsibility should not play any role in the real world dominated by powerful states and carbon-intensive multinationals. Still, I consider that to make people responsible for these costs based on the benefits they received should not entail producing distributive injustices.

On the other hand, suppose an individual is more affluent than they would be under an ideal distribution and has benefited from past emissions. In that case, there is still the problem of attributing

responsibility to her just because she has received some benefits without a clear act of acceptance. As mentioned earlier, this obstacle is less problematic if we take states as duty-bearers. It seems there is a straighter case to demand historical collective responsibility to states for paying the costs of past injustices they have benefited from, or at least this is what we usually think when considering cases like colonialism, war, or external debt. Still, we have to solve the problem of excusable ignorance. Besides this strong intuition about collective responsibility, it is more problematic to assume that present governments should be responsible for climate change which past governments were unaware. Second, and more importantly for my purposes, if we think about generations but not states, the problem also looks different, as I will show below.

4.4.3 The Ability to Pay Principle

The Ability to Pay Principle (APP) claims that agents should bear the burden in proportion to their ability to pay. It opens the door to progressively distribute the costs of mitigation and adaptation, so those with more holdings pay more than those who have less or nothing. Suppose someone benefits from GHG emissions, but she is below the standard of living she is entitled to as a matter of justice. Would it be fair to make her pay? The most robust defense of the APP we encounter is in Moellendorf (2014), who makes a case for the APP to be the sole burden-sharing principle. It seems to me he is adopting a strong integrationist view and treats the question of burden-sharing as just one element of the total package of benefits and burdens of a theory of justice. Now, however, imagine two unjustly advantaged individuals: one a polluter, one not. Should they pay the same? Or should the polluter pay more? It seems clear that even if the limit of fair entitlements applies to the PPP, the unjustly advantaged polluter should pay more. So, leaving aside the BPP, which role should play these two apparently opposite principles?

Let's start with Caney's response to the claim that BFF is unjust. First, Caney highlights a problematic assumption implicit in concessive arguments favoring BFF. Such arguments start with the plausible assumption (P) that justice requires that polluters should not engage in harmful activities. Broome, according to Caney (2014: 337), appears to infer from this premise the conclusion (C) that justice requires that the would-be polluters should absorb the cost of not engaging in this harmful behavior (Broome 2012: 46). But this conclusion does not necessarily follow, according to Caney:

> "One can hold that in a just world A would not do X whilst also thinking that in a just world the sacrifice involved in A not doing X should not be borne solely (or indeed at all) by A. (P) does not entail (C)."

The idea is that those who consider that BFF is unjust rely on an unqualified version of the PPP. If we endorse strong integrationism, following the conclusion that (P) does not entail (C), the APP can be defended as the sole principle to deal with any issues of distributive justice, as Moellendorf argues. Moellendorf's turns Caney's negative claim into a positive one in favor of the APP. The author's justification of the APP starts with the Rawlsian idea that in a cooperative scheme for mutual advantage, we should look at their effects on the least well-off. Next, the author claims that mitigating climate change is beneficial to all. Then the APP follows naturally as the principle that would naturally be the least demanding on the poor and can be applied progressively. Finally, Moellendorf disregards historical responsibilities and concludes that we should allocate all mitigation and adaptation costs according to the APP. The APP, he argues, both avoids the problems of trying to track responsibility for historical emissions and coheres with the right to sustainable development. On the former point, to apply the Polluter Pays Principle, we need to specify the harm done and trace it back to the causal actors, whether the nature of the harm is uncertain or unpredictable or

the link between the harm caused by the actors and climate change is uncertain (Caney 2010: 206).

On that second point, about the right to sustainable development, Moellendorf's approach is grounded on the Antipoverty Principle, which he defends on the basis of two main ideas. One is respect for human dignity, which rules out policy-guiding principles that would be unacceptable to people seeking agreement based on respect for human dignity. The other idea is that involuntary poverty is something everyone has a good reason to avoid (Moellendorf 2014). In the real world, poor countries can only expect economic development by using energy based on burning fossil fuels and emitting GHG, unless rich countries transfer them a cheap green alternative. Therefore, we cannot demand them not to pollute to achieve the economic development necessary to avoid deprivation -as we have done in the past to become wealthy states- and continue living high and consuming luxury goods. On the other hand, suppose developing countries emit GHG to avoid poverty. In that case, it is implausible to claim they should pay the costs of mitigation and adaptation to climate change 'just' because they are the polluters.

Nevertheless, those proponents of the PPP might still claim against this account that the principle is compatible with claims to sustainable development and the Antipoverty principle. As McLaughlin (2019) argues against the Antipoverty principle, we can prioritize development until a threshold. Still, beyond this, defenders of the PPP might claim that recent wrongful emissions ought to be tackled according to causal responsibility and prioritize the PPP at least for these emissions. Again, this is the problem between the two unjustly advantaged individuals, one of them polluting more than the other. It seems plausible to claim that the former should pay for her emissions; therefore, I do not think we should rely exclusively upon the APP. Still, we need to consider a pluralistic account in which different principles interplay in attributing the costs of mitigation and adaptation. This pluralistic account is also more appropriate if we adopt a moderate instead of a strong integrationist view.

I now turn to Caney's pluralistic account and his proposal of the interplay between the PPP and the APP that can help solve the difference between the unjustly advantaged that pollutes more and the advantaged that pollutes less. My argument to defend the IGAPP will draw on Simon Caney's account of the relationship between these principles across the members of the present generation. However, I will take distance from him at some points. In Caney's account, the PPP has lexical priority over the APP. Caney justifies this lexical priority of the PPP in terms of the causal responsibility of the polluters. In addition, Caney appeals to the APP to justify the payment of the costs of what he calls the Remainder: those emissions for which no one can reasonably be held responsible.

The Remainder refers to harmful climate changes that stem from (a) the emissions of earlier generations, (b) non-human-induced climate change, and (c) the (legitimate) emissions of the disadvantaged (Caney, 2010). In connection with this third kind of emissions, Caney holds that people should not fall beneath a certain standard of living. Therefore, the Polluter Pays Principle should be qualified to prevent it from being the case that people have to pay for emissions needed for their fundamental survival (Caney 2010) or that paying for these costs will deprive them of meeting their basic needs.

However, in this last aspect of the Remainder, I differ from Caney's account, as mentioned at the beginning of the chapter. I claim that it is not just a matter of not making pay people who will then fall below sufficiency. In my view, we should not make pay people who is below what she will be entitled to according to an ideal distribution (of resources, or primary goods, or whatever currency of justice we use). Also, each individual's fair share will differ depending on whether we adopt a sufficientarian, prioritarian or egalitarian theory of justice. If we assume the first of these theories, my account will probably collapse into the same proposal of a basic needs limit made by Caney. However, I do not want to commit to any of these theories and my defense of the IGAPP is compatible with any of these theories.

Before exploring the intergenerational case, one question remains: who are the duty bearers of these costs if we apply the ability to pay principle? Individuals, Nations, or Generations? If we take nations or states as duty-bearers, there is not much difference in applying the PPP or the APP since the most polluting countries are usually more affluent, even if there is no exact correlation. This inexact correlation implies another limitation of the PPP. As a guiding principle, it can mean making poor polluting countries pay costs when they have not reached a sufficient level of wealth or the level of wealth they are entitled as a matter of global justice. I am focusing here on generations, and I will clarify in the next section the differences between a case in which we take generations as the duty bearers of climate change mitigation and adaptation and a case in which we take contemporary individuals or nations to be the duty-bearers. Importantly enough, when we look at generations, there is no happy coincidence like in the case of states. The presumably more affluent future generations are not, in theory, the most polluting ones -assuming we will take climate action sooner than later and climate change will not make them the worse-off generations of all time-. This possibility challenges my defense of the IGAPP, a question I will have to address when discussing the inter-generational case.

4.5 From the Ability to Pay Principle to the IGAPP

Caney (2010), as just shown, advocates for a pluralistic account of the principles that should guide the distribution of burdens and benefits of climate change mitigation and adaptation and claims that due to the limitations of the PPP, this principle should be complemented with the Ability to Pay Principle (APP). Specifically, Caney (2010) argues that what he calls the Remainder should be distributed according to the Ability to Pay Principle, which claims that the duty to address the burdens of climate change should be borne by the wealthy and that “that duty should increase in line with an agent's wealth” (Caney 2010: 213). It

seems that this arguments can easily lead us to an enthusiastic case for deferring some of the costs of mitigation and adaptation to future wealthier generations. However, as the case between the two unjustly advantaged individuals -the more polluting one and the less polluting one- shows, it would be unreasonable to rely exclusively in this principle. I have already argued that in the intra-generational case, the Remainder should be bigger than Caney suggests. Moreover, as I will explain below, a pluralistic account in the intergenerational case also implies that the Remainder should be even more significant than in this case.

When Caney (2010) first considers the possibility of shifting some of the costs of mitigation and adaptation onto future generations, he rejects deferring costs because he identifies deferring costs with postponing action. Although he does not share the exact words that Mark Carney, former governor of the Bank of England, used, he also argues that postponing action might amount to the Tragedy of the Horizons. If we delay action, it might arrive a day in which it would be too costly to tackle the effects of climate change. Caney (2010: 220) claims that:

> "(I)t might be thought that my position justifies a policy according to which later generations pay for climate change. The thought here is that future generations will be wealthier than current generations and hence more able to pay; as such an 'ability to pay' criterion should allocate duties to them. This, in effect, amounts to a policy of not preventing climate change for now and then trying at some point in the future both to prevent further climate change and also to adapt to the changes that have occurred. Although future people may well be better off than current people, I believe that it does not follow that an Ability to Pay Principle has the implication of postponing action into the future."

Of course, when defending BFF, I do not defend postponing action. Instead, I claim that intergenerational Green QE is a policy that should help us take climate action now, and more quickly than if we do not use

green bonds that future people will pay. Therefore, I should proceed with the defense of the IGAPP as the grounding principle for implementing Green QE without postponing action. In turn, Green QE is less costly for the present generation than any other alternative like the WCB, Sachs' public debt proposal, or the more conventional proposals of a global carbon tax or cap-and-trade emissions market.

In fact, when Caney (2014) reconsiders the issue of deferring costs again after some prominent philosophers had discussed Broome's idea of BFF, the author takes a different position. Caney (2014) still claims, and I agree, that we should not delay action against climate change. However, the author also claims that growth discounting permits the present generation not to delay action but to defer some of the costs of climate change mitigation and adaptation to future generations. In short, Caney accepts that the IGAPP can be applied if economic growth makes future generations richer than earlier ones and we do not delay climate action.

There is a second reason why we should favor the IGAPP and growth discounting. Moellendorf (2014) offers a different reason for growth discounting that has either to do with distributive justice nor prioritizing consumption for the present generation. The author claims that growth discounting preserves impartiality between generations.[30] Moellendorf (2014) argues that the present generation should apply a discount rate when calculating the costs of future goods because there will be more goods of the same kind available on the market in the future and the actual market price will be sensitive to the change in supply. To compare prices for each generation, given the actual market price for the future goods, "we must not compare present market price against the future one; rather, we need to discount the present market price. Failure

[30] It is helpful to look at his example (Moellendorf 2014: 113-4) to explain this point: "The first generation knows that the second will have to replace some of its public housing stock. The dwellings will cost $100,000 each. There will be a need for ten of them – a bill of $1,000,000 (...) Supposing that between the two generations the economy, including housing stock, is expected to grow by 5 percent, the number of dwellings needing to be replaced does not change, but because of growth, there are more of these available in the future than now. Demand does not change, but supply increases."

to do so would be to compare a cost in the present to one in the future that is cheaper." Discounting for growth, he concludes, or the technological progress is required to compare costs properly.

The point of Moellendorf is that if we want to distribute costs between generations and make inter-generational comparisons of well-being, first of all, we need to compare the costs for each generation impartially, and growth discounting is necessary to do this.[31] Moellendorf argues that if we want to be accurate when we distribute costs across generations, we have to count them accurately; and this means that 100 units of costs today should count more than 100 units of costs in, say, 100 years. On that line, Moellendorf & Schaffer (2016: 6) argue that due to technological-development and investment "a higher quantity of commodities (of the same quality) can be produced in the future. Consequently, commodities (of the same quality) would be cheaper (relative to household income) in the future." This requirement of impartiality requires accounting for the lower cost of the replacement cost of a good in the future due to economic growth. And Moellendorf & Schaffer (2016: 6) conclude that "[t]o fail to discount for growth would be to count the value of future costs as too high and therefore give undue weight to the costs of future generations:" This argument makes a different point than Caney's about future people's greater ability to pay. It refers to an accounting question, we might say, on how to compare the costs incurred by the present generation and the costs that future people will have to make. It offers another reason to justify the Intergenerational Ability to Pay Principle.

Recall the negative claim that (P) does not entail (C). It is not only that we should not assume that conclusion because the fact the present generation is causing climate change does not entail it must pay all the costs of stopping global warming. Caney also believes that this argument enables a more positive claim to favor the IGAPP. We can shift some of

[31] See also Broome, *Ethics out of Economics*, pp. 44–67.

the mitigation and adaptation costs onto the future, given the right of the present generation to discount future growth.

From the negative claim, we can move more easily to the positive one, and we might have reasons to rely exclusively on principles grounded on the ability to pay, as Moellendorf does. However, I will not follow this path. A key question is whether we should apply the IGAPP only to distribute Caney's Remainder or apply it exclusively to all mitigation and adaptation costs, as Moellendorf does. I will argue that we should not rely exclusively on the IGAPP, but I will also offer a pluralistic view, which differs from Caney's intra-generational account.

To solve this problem, we should consider harmonizing the principle with broader intergenerational and global justice theories, as mentioned when dealing with the methodological issue reported in section 4.3. As discussed earlier, some have argued that the principles to distribute the benefits and burdens of climate change mitigation and adaptation have to be considered in isolation. Some of these arguments take a pragmatic view that an international convention to distribute such burdens might be more challenging if we include global justice issues. Leaving pragmatic views aside (which can also be contested on empirical grounds), I claim that when considering climate justice issues, we need to consider them in conjunction with other justice issues, such as eradicating poverty. This inclusion of the other problems of justice is necessary because our mitigation efforts have an opportunity cost. Therefore, we need to justify our priorities in using some resources to mitigate rather than for other purposes, such as promoting people's entitlements to energy, food, or health services (Shue, 2014, Caney 2018: 671). This moderate integrationism requires that the burden-sharing principles be consistent with well-established domestic, global and intergenerational justice theories. Thus, agents should be responsible for their choices, as the PPP states. Still, this principle applies only within a theory of justice according to which agents have a fair share of resources or whatever justice currency we consider distributing benefits and

burdens. Therefore, if A acts in a way that results in pollution, Caney claims that A should not pay any cost if this leaves her in a situation of insufficiency. I go further than that. In my view, I claim that one cannot argue that A should bear the cost of preventing any harm that might ensue without taking into account whether A was exceeding its fair share in an ideal distribution or not. I then conclude that if A lacks his/her legitimate entitlements, then A should be exempted from paying. Therefore, when considering the just burden question, we must first look at polluters only because of causal responsibility and intentionality (contra Moellendorf). Amongst them, those that exceed what would be their fair share of whatever metric we use to make comparisons of well-being should pay for the costs of mitigation and adaptation (contra Caney).

In the moderate integrationist view I defended in section 4.3, we must consider the burden of climate change mitigation and adaptation across generations and the benefits of taking climate action now for future generations. As a more general point, when considering issues of intergenerational distributive justice, we need to take into account both benefits and burdens. Thus, the wealth of future generations will be inherited and derives from the work of all previous generations. If future people enjoy the benefits -if we take climate action now- they should also pay partially for the cost and sacrifice of earlier generations. Then, the IGPPP should take a different form because it needs to consider each generation's Ability Not to Emit. This latter principle helps us understand that the IGAPP applies not only to what Caney calls the Remainder but to a broader set of costs arising from mitigation and adaptation.

4.6 The IGPPP and The Ability Not to Emit

In this section, I take this second strategy. My argument to defend the IGAPP has drawn on Simon Caney's (i) application of these principles across the members of the present generation and (ii) his arguments to

defer some of the costs onto future generations. Here I go beyond Caney's account by arguing that the Remainder should be bigger in the intergenerational case, too, which the author, as far as I know, has not clarified when considering reasons to defer costs onto future generations. When we think about applying the principles of burden-sharing of climate change mitigation across generations, we need to consider each generation's Ability Not to Emit.

Now, let's ask what the interplay of the IGPPP and the IGAPP is for distributing the costs of mitigating climate change across generations. First, we start identifying the polluters (applying the IGPPP) above their fair share of resources or whatever metric we deem appropriate (applying the IGAPP). Thus, the IGAPP claims that presumably richer generations should pay more, but first, we should identify who the polluters are. If the PPP has lexical priority, using that principle across generations (that is, applying the IGPPP) means that the present generation should bear the main part of the costs for the emissions caused by them except those for which no one can reasonably be held responsible. Following the reasoning of the previous section, I argue that we can hold that in a just world the present generation would not emit GHG, whilst also thinking that in a just world the sacrifice involved in not emitting GHG should not be borne solely by the present generation. If so, we have a solid reason to rely on other principles grounded in the ability to pay, as the IGAPP, to complement the IGPPP when considering the just burden question across generations. The idea again is that polluting generations should pay only if they are above their fair share if an ideal distribution across generations was in place.

Here, however, I present a second argument for minimizing the scope of the IGPPP. The view claims that we need to consider each generation's moral responsibility for emitting GHG, given the technology inherited from previous generations. Some numbers might help. Suppose the present generation (G1) needs to emit 100 units of GHG to achieve its fair share. Since we are already trying to mitigate climate change, G2 will

only need 50 units to gain its fair share, while G3 will only need 10 and G4, hopefully, only 1. I also offer a pluralistic account here. So, we look first at polluters that are above their fair share. Thus, we do not think that the present polluting generation should pay all the costs because we need to consider this different ability not to emit of each of these four generations to reach their fair share.

One might think that the inherited technology determines the Ability Not to Emit of each generation. It shows that future people will be better off in a morally relevant sense because they can reach the same living standard with lower carbon emissions. But understood in this way, the 'ability not to emit' seems more directly relevant to the fair allocation of emission rights than to the allocation of the costs of mitigation/adaptation. Future generations are more able to limit their emissions since they require fewer emissions to reach the same standard of living.

However, there is a second possible reading of the 'ability not to emit.' The point I wish to make is different. We might think that the IGPPP just applies to, and each generation is only responsible for, the emissions produced beyond the level of emissions necessary to achieve what they are entitled to according to a fair distribution of entitlements across generations. The costs caused by the emissions made to achieve each generation's fair share (which is different depending on their Ability Not to Emit) should be distributed according to the IGAPP, as well as other emissions that cannot be allocated to any generation according to the IGPPP.

The reason is that we need to consider the inherited technology that affects the level of GHG that we need to emit to meet each generation's fair share. The argument already exists in relation to the intra-generational case – that some citizens will need more emissions than others to reach an equivalent living standard- and should not be responsible for these emissions. For instance, it is argued that the global poor need to emit more to achieve our western living standard unless we

transfer them cheap and clean technology. At the same time, we are responsible for not using luxury emissions when we already enjoy more than the fair share that would correspond to us if a just global distribution was in place. Extending this argument to inherited technology means that generations with less ability not to emit need more emissions to reach their fair share than future richer generations with more ability not to emit. Therefore, the former should not be made responsible for the costs created by these emissions.

Therefore, I offer a pluralistic account in which the IGPPP and the IGAPP interplay, but the Remainder, in this case, includes the emissions necessary to achieve a fair share under the technology inherited from earlier generations. Once more, if climate change is not catastrophic and we take climate action now, future generations will be richer than the present generation and have inherited a cleaner technology. Therefore, by applying the IGAPP, we justify shifting some of these costs onto future people, borrowing money from them by implementing Green QE.

4.7 The Ecumenical case in favor of the IGAPP

Now, we need to address again the methodological issue of integrationism. Here, I will consider how the interplay of the IGPP and IGAPP principle conforms with theories of intergenerational distributive justice. If we are integrationists, one strategy is to start by settling the general question of intergenerational justice before we can evaluate alternative burden-sharing principles about Climate Change. However, I will follow a different strategy. As a moderate integrationist, I defend that we do not need to settle the big question about which theory of intergenerational justice is the right one. My account of just burden sharing is compatible with at least three prominent candidate accounts of intergenerational distributive justice, i.e., we should be integrationists, but we can make an ecumenical case for BFF.

Caney (2014) claims that prioritarian, sufficientarian and egalitarian principles can support the IGAPP. First, we can defend the IGAPP by appealing to intergenerational prioritarianism. Suppose we are willing to promote the benefits of the least advantaged over time and think that wealth will increase in the future. In that case, we have sound reasons to apply the IGAPP and favor the least advantaged present generation. We can also defend the IGAPP on egalitarian grounds. Recall that we apply the IGAPP by borrowing from the future and deferring the cost of climate change mitigation and adaptation. If we are egalitarians, we think that generations should have equal advantages and opportunities over time. Therefore, if future generations will be more prosperous, it is permissible to BFF and make the inequality between these richer future generations and the present one less than it would otherwise be without BFF.

Caney (2014: 334) elaborates more on his argument in favor of intergenerational sufficientarism. In this case, he considers the case of those who lack access to energy and consequently cannot attain a level of sufficiency:

> "Suppose, however, that we can in fact ensure both that the people in question could attain a decent standard of living and could do so without using fossil fuels. Suppose, in particular, that this is possible because, and to the extent that, the poor in this case can restrain their emissions but pass on the cost of mitigation to future wealthier people (including future generations). Suppose, for example, that they can borrow money to purchase clean technology and then pay back the relevant sum at a much later date."

Here, Caney integrates the IGAPP with theories of global justice and intergenerational justice. He claims it is unjust to make the poor pay for the costs of mitigating climate change. Given this background, Caney claims that by deferring costs and applying the IGAPP, it is possible achieving both sufficiency for the current poor and not trigger climate

change. Thus, we also avoid that future generations do not have to face dangerous climate change that impedes them from achieving sufficiency. Nevertheless, the argument made so far and the ecumenical defense of the IGAPP relies on the assumption that future people will be richer, but will they be?

4.8 Will Future People Be Richer?

Having constructed a normative argument in favor of the IGAPP, we might consider whether the empirical claim that future people will be richer is plausible or not.

We can start looking at Figure 2:

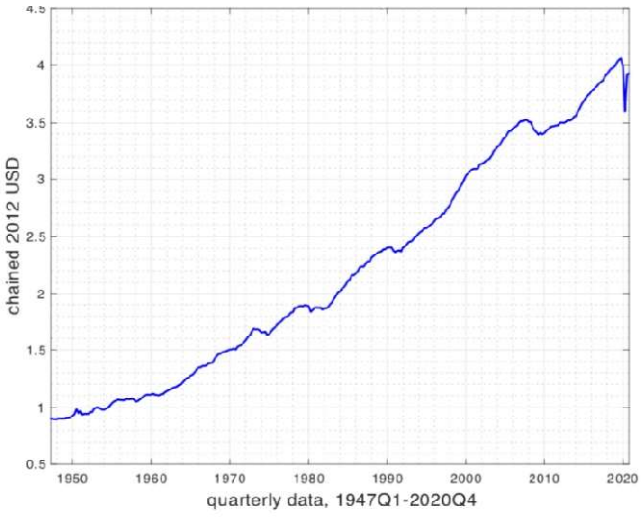

Figure 2: Real Personal Consumption Expenditures Per Capita, US. *Source:* FRED Data.

Figure 2 plots the secular increase in real personal consumption expenditures per capita in the US measured in terms of constant US dollars of 2012 (See Mihailov and Ferret 2021). It has constantly been increasing, except for the effects of the COVID-19 at the top right side of the chart. Rendall (2011, 2019), Moellendorf (2014), and Caney (2014) all claim that there is one major caveat to the claim that we should defer the costs of climate change mitigation and adaptation. The argument for BFF based on the IGAPP depends on the assumption that there will be

economic growth in the future, and people will be more affluent. There are two important and distinct objections to this assumption. First, due to climate change, future people will not be richer than us. Second, Rendall (2019) also considers the second kind of caveat for applying the IGAPP. In this case, the problem is that even if future people are richer, some will not, and they should not bear the costs of mitigation and adaptation to climate change.

To begin with, before discussing these two powerful objections, I need to clarify the overall argument and its dependence on being economic growth in the future. Implementing Green QE can be decisive in stopping global warming. If climate change is not catastrophic, there are reasons to believe that there will be economic growth and future generations will be better off than us.[32] This, in turn, will justify the case for borrowing from the future. Suppose we want to distribute the costs of mitigation and adaptation to climate change across generations, and future people will be wealthier. In that case, we are justified in shifting some of these costs onto them. As Professor Lisa Herzog pointed out in her report, this argument is circular. However, in this case, it is a virtual circle that justifies using Green QE to mitigate GHG's effects on future generations' well-being. If we use Green QE, we can halt climate change and make future people richer. Therefore, if we achieve this, we can burden them to help pay these costs. As Professor Alan Cromartie points out in his report, it might be that they will not be richer for other causes than climate change (e.g., a nuclear disaster or sustainable economic growth is not possible). In this case, as I have shown, Green QE is still a better option than other forms of borrowing from the future because there is the possibility of writing off the debt if, in the end, they are not richer than us. As just shown, BFF, through Green QE, allows us to avoid

[32] An important objection I will not address here is whether it is possible at all that future economic growth can be sustainable. Defenders of the de-growth views claim that this is not possible (see Pollin, R., 2018 "De-growth vs. a green new deal," *New Left Review*, (112), pp.5-25. However, de-growth approaches are still marginal. My primary purpose in this thesis is to engage with mainstream views that economic growth patterns will continue if climate change is not catastrophic.

making future people worse off because of climate change and, therefore, other things being equal, become richer and be able to pay their share of the costs of mitigation and adaptation to climate change.

Regarding the first of the two problems, Moellendorf (2014) claims that the uncertainty surrounding the severity of climate change should weaken our confidence that future global economic growth will resemble past growth. Shue (2016: 65) makes a similar point when he claims that it is "not reasonable simply to assume that human well-being, however it is measured, is either certain or highly likely to improve generally with each generation." Insofar as we cannot be confident in future economic growth, "the case for consumption supplied by discounting for growth is weakened" (Moellendorf 2014: 116).

Shue (2014) explains that for decades, since the publication of *A Theory of Justice*, political philosophers have been discussing the problem of intergenerational justice as a problem of choosing the correct savings rate. The goal was to ensure we did not sacrifice too much consumption to benefit future richer generations (Rawls, 1971: 251-8). Two decades later, thinking about the scarcity of some resources, Brian Barry (1991) suggested that the appropriate norm to respect future generations was an intergenerational analogy to the Lockean condition: to not leave the next generation worse off than us. Barry argued that we should replace the non-renewable resources with improved technology that allows future generations to live at least on a different and smaller resource base.

According to Shue (2014, chapter 11), the science of climate change now suggests that it may actually be naive even to think that we can leave the next generation as well off as we are. The present generation may have taken it all, he claims. So, the appropriate question, seems to Shue (2014), has become not how we can make them worse off (applying the correct saving rate) but how we can avoid making them much worse off. How can we avoid undermining the stability of the climate they and all

other living things they will value and depend on will adapt? How can we avoid imposing serious harm on them?

Thus, if future people, in the end, happen to be much worse than us, precisely because we have not taken all the necessary steps to stop global warming, is it fair to impose some of the mitigation costs on them? As explained in chapter 3, once we introduce the central bank into the picture of BFF through some of the versions of Green QE, we allow the option of partial or full non-repayment of the climate debt. For example, future generations might use this option if in fact, they experience severe living conditions or are not, at the end of the day, better-off than the present generation. Future people might use this non-repayment option in the case that future generations will not be richer than us.

There are three different problems with this non-repayment option. First, if there were no significant costs for taking the non-repayment option. Why should future people not always use this option? This is a levelling-down objection to the non-repayment option Green QE offers to future people. If there are no significant costs to use it, why should they not always use it if it does not make us worse and makes them better off? I have two points here. First, I defend that sharing the costs of mitigation across generations is fair. Then we might issue climate bonds with some strings attached, so if they happen to be richer and better-off than us because the previous generations have been able to tackle climate change, they should not have the option of non-repayment. Secondly, some inevitable costs will arise for future people if they take the chance of partial or full non-repayment, like, for instance, increased inflation and less economic competitiveness and growth. As said in the previous chapter, there is no 'no sacrifice option' for future generations either. Writing off debts is an unusual and unproductive measure in normal times that would distort financial and economic incentives and could even lead to a social crash with tragic and long-term consequences.

Third, as pointed out by Professor Lisa Herzog, the possibility of writing off the debt, if investors are aware of it, might increase the price

of the bonds. Even if the risk only arises in the future, it might translate forward because investors already anticipate that the price will be lower in the future (because of the discounting of the risk of writing off). The idea here is that we can provide a strategy to mitigate the rise in the price of the bonds. For instance, the translation of this risk in the price of the bonds depends on how we design the writing-off procedure. To write off the debt the central bank could buy all the bonds at market price before writing off the debt, absorbing all the losses and protecting investors from this risk. The central bank typically follows this strategy during a financial crisis, when it buys assets with no actual value and absorbs the losses. Its capacity to create money is a privilege that might be used if writing off the debt becomes necessary, and we want to avoid investors having to face this risk. Therefore, if following this path, there is no risk that investors anticipate this future loss, and the bonds' price will not increase.

The second counterargument to the non-repayment clause claims that if this last bit is true, the non-repayment option does not really reduce costs. Then, we have not solved the worry that future people might not turn out to be richer. Nevertheless, in Mihaliov and Ferret (2021) we believe that the costs of writing off some such green QE debts (or bond repayment to the central bank) will be justifiably minimal compared to the vital task of saving the life on our planet, and I would like to recall here, once more, that chapter 3 showed that Green QE is less costly for future generations than the traditional forms of BFF.

The second problem highlighted by Rendall (2019) can be solved by analogy to similar issues that arise in the intra-generational case. In particular, we should consider that the future poor will likely be poorer than the current rich. An analogous point has been made in the intra-generational case: if we endorse the APP, we cannot simply commit to allocating costs to the wealthiest countries and not worry about what goes on within their borders. Some in rich countries are poor, just as some in wealthier future generations will be poor. Since, in the intra-

generational case, we want to integrate our burden-sharing principle with theories of justice, the APP suggests that individuals living in wealthy countries but are poor should not pay. Consequently, if we integrate the IGAPP with broader theories of justice, we must conclude that the IGAPP also suggests that the future poor should not pay, even if future generations are more prosperous than us.

The mechanisms to achieve this that come to my mind are very simple. Future generations should have in place a just system of redistribution (e.g., through taxes) that makes the case that the future poor will not have to pay. Given the tools identified as Green QE, I do not see any tendency for costs to fall on future poor. If the central bank holds the debt, there is an opportunity cost. We could use this of a future central bank to fight future poverty instead, but Green QE is a less costly strategy for the future poor than issuing debt today that future taxpayers should pay.

On the other hand, if Green QE ended up creating inflation, it is not clear that this would be detrimental to the future poor. This is because the effects of inflation are reflected on those that hold nominal assets (not linked to inflation), which depreciate their value. In contrast, real assets (linked to inflation) increase in value. The effect of future inflation is something that Green QE tries to avoid since it is implemented through a sequence of business cycles when inflation is too low. However, the effects on the distribution of wealth in the future depend on the distribution of nominal and real assets between the poor and the rich, something that it is at least uncertain. As a general point, on the one hand, poor people usually hold more cash (a nominal asset) as a percentage of their holdings, and therefore inflation is detrimental to them. On the other hand, unexpected inflation also reduces unemployment, and thus, it benefits the least advantaged. Unfortunately, the economic effects in a future distant world of a large-scale policy like Green QE are uncertain and cannot be fully anticipated at the present moment.

4.9 Concluding Remarks

In this chapter, I have defended the Intergenerational Ability to Pay Principle as the burden-sharing principle that justifies Green QE as an instance of making our grandchildren pay or BFF. I have started examining different principles that have been proposed to distribute the costs of climate change mitigation and adaptation within the present generation and its limitations. I drew on Caney's pluralistic account of the interplay of the PPP and the APP and then expanded his theory to the problem of distribution of costs across generations. I departed from Caney in applying a limit to the PPP. While he claims that we should not make people pay for the emissions necessary to meet their basic needs, I argued that we should not make them pay for the emissions required to achieve their fair share. I also explored the possibility of relying exclusively on the IGAPP to solve any intergenerational distributive justice issue but concluded that a pluralistic account in the inter-generational case is more plausible. I argued that when applied across generations, this pluralistic account should leave more scope for the IGAPP, given the technology inherited by each generation and their different Ability Not to Emit. Finally, I also addressed a methodological issue and considered how the IGAAP applies in conjunction with global and intergenerational justice theories. Despite the integrationist character of my account, I remained a moderate integrationist. I have been non-committal on any theory of intergenerational distributive justice and offered an ecumenical case in favor of BFF. I showed that three prominent accounts of intergenerational justice, such as sufficientarism, prioritarinism and egalitarianism, can accept the pluralistic account defended here.

All the arguments to defend the IGAPP have built on the assumption that future generations will be more prosperous. So, at the end of the chapter, I addressed objections to this assumption and the

possibility that future generations will not be richer than us. Once again, I have argued that Green QE is a superior strategy to the traditional forms of BFF and that it can tackle these worries about being less economic growth in the future because it can adapt to changes in the ability to pay of future generations. In the final chapter, I will discuss one potential objection by Gardiner to the whole strategy of BFF defended so far. This objection claims that BFF, and by extension Green QE, is a form of intergenerational extortion, a form of moral corruption that invalidates the strategy presented in this dissertation.

5 Is it Borrowing from the Future Morally Permissible?

5.1 Introduction

In this chapter, I will examine one important objection to the argument in favor of BFF that claims that the principle of borrowing from the future, also known as the principle of making our grandchildren pay, constitutes a case of intergenerational extortion. For Gardiner (2017), there is a natural presumption that the polluting present generation should pay and ought not to expose future generations to the threats of catastrophic climate change. According to the principle of BFF, these threats are precisely created by those who must be paid (again, the present generation). According to Gardiner (2017: 377), this is "money for menaces", a clear case of intergenerational extortion. First, this chapter argues that Gardiner's account of intergenerational extortion turns out to be inadequate due to the problem of the non-existence of future people and the lack of communication between distant generations. Nevertheless, Gardiner's argument points to other problems of BFF that are worth mentioning and considering. In particular, I am interested in what is left of the extortion charge once we distinguish it from an unqualified commitment to the PPP.

Gardiner presents a second objection —about theft, not extortion— which I take as an objection to BFF's procedural unfairness. Third, he gives a consequentialist argument: that opening the door to BFF for taking climate action could lead to further unjustified shifts of costs into the future. Finally, Gardiner also argues that BFF involves a wrongful exercise of power by present people over future generations (the "tyranny of the contemporary" worry), which amounts to either extortion or theft. In order to examine the different arguments against BFF, the chapter starts in Section 2 by presenting Gardiner's analogy between a case of Intragenerational and Intergenerational Extortion. Section 3 discusses

the main intergenerational extortion worry and claims that it has no force due to the lack of communication between the present and distant future generations. I then explain how the extortion charge relates to the key distinction between enthusiastic and concessive arguments for borrowing from the future. Specifically, I present the theft objection in Section 4 as a distinct objection that I take to be an objection to the procedural unfairness of BFF.

Section 5 points to another distinct objection; Gardiner also argues that BFF involves a wrongful exercise of power by the present over future generations and that this is also morally impermissible. Finally, the author makes a consequentialist argument – that opening the door to BFF for climate action could lead to further unjustified shifting of costs into the future. I will examine in section 6 how persuasive this thought is. Finally, I conclude that BFF is morally permissible, although we need to take into account some of Gardiner's worries when designing institutions for future generations.

5.2 From Intra-generational to Inter-generational Extortion

Gardiner's strategy is first to introduce a paradigmatic case of extortion related to climate justice. This case is not intergenerational. Still, the author uses it to look for the similarities with the intergenerational case of borrowing from the future. He draws on Eric Posner and the so-called "Chicago lawyers" claim that climate agreements should be made on the basis of the self-interest of domestic states. Apparently, according to Gardiner, their proposal is that the most vulnerable poor states should compensate the rich to cut their GHG emissions. Gardiner (2017: 371-2) reconstructs their arguments in the Nationally Adequate Protection Argument (NAP).

(1) Each country will support robust climate action (e.g., especially major emissions reductions) if and only if, and to the extent that, it benefits that country.

(2) Some countries benefit more from robust climate action than others.

(3) Those that benefit most are typically the impoverished and low-emitting nations (e.g., Haiti, Bangladesh).

(4) Those that benefit least are the richer, high-emitting countries (e.g., the US, China).

(5) Those who benefit most from climate action do so largely because they are much more vulnerable to adverse climate impacts.

(6) If the richer, higher emitting countries engage in robust climate action only to the extent that it benefits them, they will not do enough to protect the most vulnerable countries.

(7) Therefore, to get adequate climate action to protect the most vulnerable countries, those countries (e.g., Haiti) must compensate the richer, higher emitting countries (e.g., the US and China).

We can helpfully distinguish three objections with Gardiner's critique of the NAP argument. First, the argument amounts to making the polluted pay against the most common polluter pays principle. I already discussed the problems of adopting an unqualified version of the PPP in chapter 4, so I will not devote more ink to this issue here. Second, the argument is also objectionable because it makes the most vulnerable and the poorest pay, against this time the other commonly agreed ability to pay principle. However, since future generations are presumably richer than us, this objection does not hold in the intergenerational case. Finally, Gardiner claims that the NAP argument is flawed because it involves extortion.

It is essential to distinguish the extortion charge from the other two objections to the NAP: It is the extortion worry I am going to address first in this chapter. Gardiner (2017: 374) defines extortion "as the attempt to obtain money or other valuables by means of a threat," or more generally, "through the inducement of a wrongful use of force, intimidation or the undue or illegal exercise of power." The proposal of the Chicago lawyers

to distribute the costs of climate change mitigation and adaptation involve this kind of unethical exercise of power because the polluters are telling the polluted that they will not stop their polluting activities unless the polluted pay them. Gardiner's NAP argument is the first step of his intergenerational extortion charge. The next step will be to claim that the same objectionable extortion takes place when we apply the principle of borrowing from the future. To show that, Gardiner (2017: 376) presents a second argument, which is a reconstruction of the BFF principle, that he calls the Generationally Adequate Protection Argument (GAP):

(1) Each generation will support robust climate action (e.g., especially major emissions reductions) if and only if, and to the extent that, it benefits that generation.

(2) Some generations benefit more from robust climate action than others.

(3) Those who benefit most are the most vulnerable generations, largely future generations.

(4) Those that benefit least are the least vulnerable generations, including the current generation and especially the current generation of decision-makers.

(5) Those who benefit most from climate action do so because they are much more vulnerable to negative climate impacts.

(6) If the least vulnerable current generation engages in climate action only to the extent that such action benefits that generation, it will not do enough to protect the most vulnerable future generations.

(7) Therefore, to get sufficient climate action to protect the most vulnerable future generations, those generations must compensate the current generation.

In order to evaluate Gardiner's objection to borrowing from the future, we need to examine whether the arguments against the NAP also apply to the GAP. The objection that the polluted should not pay applies to both arguments. In Gardiner, the extortion objection is bound up with his view

about what a fair distribution of the burdens of mitigation would look like – specifically his commitment to PPP. As Gardiner (2017: 377) puts it "the proposal is that the polluted pay (and polluters get paid)." Therefore, there is a moral presumption against the GAP and the principle of borrowing from the future. This presumption arises because polluters are morally responsible for paying the costs for their harmful actions and do not expose future generations to threats and then ask for compensation for the costs derived from imposing such threats. According to Gardiner (2017: 377), asking for compensation to take climate action is a clear case of intergenerational extortion.

Thus, to see what independent work the extortion objection is doing, it is helpful to consider a case in which the 'extorting' party is not a polluter. Imagine we have 4 generations. Generation 1 is the present polluting generation. Suppose now that generation 3 does not contribute any more to climate change because all previous generations (1 and 2) have made an effort to reduce their emissions of GHG. Then suppose that generation 3 still needs to invest in mitigating the effects of climate change. In this case, and given the long-lasting effects of GHG in the atmosphere, generation 3 needs to invest in carbon capture technologies to reduce the amount of GHG that continues to threaten the well-being of generation 4. To do so, it issues debt that will be paid by generation 4. In this case, the objection to BFF presented by Gardiner that claims that according to BFF, the polluted should pay the polluter does not hold because generation 3 is not polluting but just taking action to reduce GHG in the atmosphere previously emitted. Is this still an objectionable case of intergenerational extortion?

On the other hand, the second reason to oppose the NAP is that the idea that the most vulnerable and poorest countries have to pay to the wealthy only partially applies to the GAP. We might well agree that future generations are the most vulnerable to climate change, and for that reason the analogy between the NAP and the GAP holds. However, when justifying the BFF principle to future people, I argued in chapter 4 that

since future people will be presumably richer, making our grandchildren pay allows us to distribute fairly the costs of mitigation and adaptation to climate change across generations. The force of the NAP seems to rest on the fact that 'extortion' leads to a less just distribution of the burdens of tackling climate change, but is it really 'extortion' that is doing the work in the NAP? I.e., suppose the question of whether the proposal amounts to wrongful extortion rests entirely on prior principles for just distributing the burdens of climate change mitigation. In that case, it is not clear that the notion of extortion plays an independent role in Gardiner's argument. Therefore, we must examine the author's reasons for object BFF more carefully. Even if we accept the argument that BFF promotes intergenerational justice in burden sharing on the grounds of the IGAPP, are there *other* reasons to object to borrowing from the future? In particular, are there concerns about extortion that might defeat, or at least need to be balanced against the distributive justice considerations?

Even if future generations are presumably richer than the present, the extortion charge might also apply to the intergenerational case. I think that extortion could do some work for other reasons mentioned by Gardiner -e.g., the vulnerability of future generations- and I am going to tackle these other reasons below. My plan in this chapter is to examine carefully all the reasons that Gardiner puts together against the principle of borrowing from the future, starting with the most significant one: the extortion case against BFF.

5.3 Extortion

Gardiner defines extortion as the attempt at something valuable through wrongful use of force, intimidation, or the undue or illegal exercise of power. Therefore, we can usefully think about extortion according to the following simple model by Konrad and Skaperdas (1998: 462):

> "Extortion proceeds as follows. The gang asks the shopkeeper for a tribute amount (X). Then the shopkeeper decides on

whether or not to pay. If he does not pay, he will suffer a damage (Y) with some probability qε(0, 1)."

If we take this model into account, Gardiner's account of intergenerational extortion turns to be inadequate for the same reason that he considered Broome's description of BFF as bribery to be a misleading description of the principle of efficiency without sacrifice. First, the gang (the current generation) cannot ask the shopkeeper (future people) for a tribute amount because future people do not exist yet. As Gardiner correctly claims, it is instead that the present generation can unilaterally shift resources from the future to the present, but it cannot ask anything of future people. Rather, it has to figure out a justification for them. For the same reason, future shopkeepers cannot decide whether or not to pay because they do not exist yet. Again, the present generation might think about how much future people will be willing to pay to convince the present generation to take climate action. Still, I think Gardiner's case against intergenerational extortion falls due to the problem of the non-existence of future people.

Recall Gardiner's view that issuing debt today that future people will pay off is a form of intergenerational extortion. Suppose future presently non-existing people only accept to compensate the present generation for taking climate action under duress. In that case, that is, under the threat of suffering the negative effects of climate change if they do not do it, this constitutes a case of intergenerational extortion. However, there is a minimally necessary condition that Gardiner's account fails to meet. That condition involves some kind of communicative relationship between the extorter and the extorted, such that the extorter can effectively issue a threat, and the extorted can potentially alter her behavior in response to that threat in a way that benefits the extorter. The non-existence of future people means that this communicative relationship cannot hold. Although it might hold in some same-generation cases or even in overlapping generations cases. For that reason, it might be good to think about BFF between overlapping

generations and then see if we can put some light on the non-overlapping intergenerational case of extortion that Gardiner uses against the principle of BFF.

Imagine a society divided between two overlapping generations, the young and the adults, and that the adults borrow money from the young to mitigate and adapt to climate change. According to Gardiner, if the young accept only under duress, that is, under the threat that the adults might impose catastrophic climate change on them, this implies the exercise of intergenerational extortion between overlapping generations. In this case, the coexistence of the young and the adults makes Gardiner's extortion objection possible, e.g., communication is possible between them. However, if we think about distant non-existing generations, his account fails because of the inexistence of this minimal condition of communication between generations necessary for extortion to exist. Gardiner seems to acknowledge this problem in footnote number 22, but it does not offer any plausible answer to this problematic lack of communication between distant generations. Also, in footnote 14, the same issue arises. When making a few points, Gardiner claims that he doubts that extortion (b) must involve communication or interpersonal address but does not provide in the article any plausible justification for these doubts to arise. Having had the opportunity to discuss this problem with Gardiner, I think he now acknowledges that extortion might not be the right way to characterize the moral problem he thinks is involved in BFF (zoom meeting, 29/10/21). Nevertheless, Gardiner expresses this moral worry well in three other forms of objection to BFF that I will discuss in what follows. First, I will return to the distinction between concessive and enthusiastic arguments that I borrowed from him to see the difference between the charge of extortion and theft he distinguishes and my defense of BFF as promoting intergenerational distributive justice.

5.3.1 Concessive vs. Enthusiastic Argument

To begin with, it is important to notice a key distinction I have used all across the thesis, and he first formulated that. Gardiner (2017) distinguishes two types of arguments for borrowing from the future. Concessive arguments claim that although borrowing from the future is unjust because the present generation should bear the costs of mitigation and adaptation to climate change, it is defensible in light of the alternatives (Broome 2012, Maltais 2015). In contrast, enthusiastic arguments like Rendall's (2011), claim "that making the grandchildren pay brings about a moral improvement" because it "can help create morally preferable distributions of resources across generations" (Gardiner 2017: 377).

The distinction between concessive and enthusiastic arguments is important when discussing Gardiner's extortion objection to BFF. My basic response to that objection is that the present generation cannot issue effective threats to non-overlapping future generations, which applies in either concessive or enthusiastic cases. But it is not clear to me that the enthusiastic argument commits us to claim that BFF is the only way to get the present generation to act on climate change. It is just that it is a tool or mechanism that can allow the current generation to act quicker. And the argument that BFF is the only way to get the present generation to act seems to be a necessary element of the claim that extortion is involved, i.e., the extortion objection rests on the claim that we will not act unless we are able to shift costs into the future. So, it seems to me that for that reason, and this is just my interpretation, Gardiner formulates the objection to enthusiastic arguments in terms of theft instead of extortion.

Consequently, Gardiner, when considering enthusiastic arguments in favor of BFF based on equality of welfare or a fair distribution of benefits and burdens, argues that even if BFF constitutes a just distribution of burdens, it is a form of theft, but not extortion. It is not

extortion because, in this case, the reason to apply the principle of BFF is not justified in the claim that otherwise, we will not assume our duty to take action to tackle climate change in the first place. It is crucial then not only to defend that my case holds and that the extortion objection is unreasonable but also to clarify the series of objections to the principle of BFF, starting with the view of borrowing from the future as a form of theft.

Broome (2012) acknowledges that efficiency without sacrifice is unjust to the extent that "receivers in effect bribe emitters not to harm them" (Broome 2012: 46). In response, Gardiner correctly notes that future people cannot in fact, bribe the present generation because future people do not yet exist. So, what is really going on in proposals that involve issuing debt today that future generations will pay is that the current generation shifts resources to its own consumption and away from the future in order to compensate itself for some of the costs of mitigation. But we cannot know how much future generations are willing to pay for those mitigation efforts. At most, what we can claim, Gardiner suggests, is that we shift resources in a way that future people will endorse, and he is absolutely right to claim that this requires justification, as I tried to do in chapter 4. Crucially, the author claims, if future people do not accept the shift of resources in favor of the present generation, this will constitute not bribery, as Broome suggests, but theft. And if they do accept it only because of the menace that the present generation will only engage in climate action if it benefits from it, that will mean not only theft but extortion, which it seems that, according to Gardiner, is morally even more problematic.

Therefore, we have three views about the moral standing of the principle of borrowing from the future. There is first Gardiner's view that issuing debt today that future people will pay off is a form of intergenerational extortion. Suppose future presently non-existing people only accept to compensate the present generation under duress. In that case, that is, under the threat of suffering the adverse effects of climate

change if they do not, this constitutes extortion. On the other side of the spectrum of views about the moral acceptability of the principle of borrowing from the future, there is the view I defended in chapter 4. I argued that borrowing from the future promotes a fair distribution of the burdens to mitigate and adapt to climate change across generations. I defend that there is no reason why future people should not accept to help out to pay the costs of climate change mitigation and adaptation. And in between these two views, there is the idea that even making our grandchildren pay is a fair distribution of the mitigation and adaptation costs across generations, it constitutes a form of theft and therefore is procedurally unjust.

In that case, the present generation designs a fair distribution of the costs of mitigation and adaptation to climate change and imposes burdens on future non-existing generations. Still, Gardiner claims that if they do not accept them, this constitutes a form of intergenerational theft. Thus, this chapter aims to assess these two different objections to the idea defended so far that borrowing from the future is morally permissible because it distributes fairly the burdens of climate action across generations, as well as some other concerns expressed by Gardiner that I will address below. Therefore, the way I deal with Gardiner's objections, in my understanding of Gardiner's article, is to associate the extortion objection with concessive arguments and the accusation of theft and procedural unfairness only with enthusiastic arguments. Having already discarded the extortion charge, I now turn to the charge of theft or procedural unfairness against BFF.

5.4 Theft

If we set aside the extortion frame, due to its inapplicability to non-overlapping generations, what might be left of Gardiner's worry that BFF is morally impermissible? That is what I am looking for now - and I will

identify and reject three possibilities, starting with the theft claim. Gardiner claims that if future people do not accept the shift of resources in favor of the present generation, this will constitute theft. Still, it would seem morally inappropriate to borrow money from the future if this is considered a form of theft.

As I re-construct it, Gardiner's argument involves a case of procedural unfairness. Gardiner seems to claim that even if BFF reduces welfare inequalities between future richer generations and the current poorer one, it is procedurally unfair because it constitutes a form of theft. To illustrate this point, Gardiner recourse to the case of Robin Hood and the moral permissibility of his actions. Even if Robin Hood re-distributes money from the rich to the poor heroically, there is something objectionable in violating people's entitlements. In the case of Robin Hood, this violation of entitlements is justified and laudable because of the broader social context. Specifically, Gardiner claims that the way BFF accomplishes the purpose of distributive justice is procedurally unfair because it violates the entitlements of future people. Like Robin Hood, we steal money from them to distribute amongst the present poorer generation under the threat of causing harm to them, violating essential values relevant to intergenerational justice. Instead of heroes, the members of the present generation become the "Intergenerational Mafia" (Gardiner 2017: 399), allegedly because Gardiner believes that the broader social context is entirely different.

One might respond to Gardiner that the rich people from whom Robin Hood steals money would not be entitled to this money if a fair distribution of resources was in place, and this is the line of response to Gardiner's argument that I offer here. The idea is that we must see intergenerational justice as a cooperative venture for the mutual advantage of all generations. In that case, each generation plays its part in building and upholding just institutions like a WCB or a green central bank and achieving a just society over time. Let's think of a line of cooperative generations. We conclude that each generation is not entitled

to their productive entitlements because each generation's disposable income, what we normally calculate in GDP or welfare, is due partly to the cooperation of all the previous generations that have been building and upholding just institutions and saving for the future. In this case, we might argue that each generation is only entitled to its fair share of the surplus created by cooperation between generations.

We can draw on Murphy & Nagel's view of taxation to understand this view. Against the neo-liberal position that taxation is immoral because it is a form of theft, Murphy & Nagel (2002: 34) argue that:

> "[T]axation does not take from people what they already own. Property rights are the product of a set of laws and conventions, of which the tax system forms a central part, so the fairness of taxes can't be evaluated by their impact on preexisting entitlements. Pretax income has no independent moral significance. Standards of justice should be applied not to the distribution of tax burdens but to the operation and results of the entire framework of economic institutions".

Similarly, future generations are not entitled to their welfare or disposable income, and standards of justice should not be applied to each generation's GDP before sharing the costs of building and upholding just intergenerational institutions. That is, future generations are not entitled to a level of GDP before the distribution across generations of the costs of sustaining just economic institutions, which must include institutions to mitigate climate change and reduce the emission of greenhouse gases. If they enjoy the benefits created by previous generations, they should also pay their part of the slack. The idea is that to maintain intergenerational institutions, there is a cost that we must distribute across all generations. If future generations receive benefits from previous generations, they should also pay part of the costs of intergenerational cooperation. We might want to share these costs progressively. Presumably, future generations will be better off than the current generation if climate change does not result in a catastrophe that

could make them the worst-off generation of all times. However, suppose we take quick and decisive action to combat climate change. It makes sense that they pay some of the costs of mitigation because they will benefit from the investments made by all previous generations to mitigate and adapt to climate change.

When we apply the principle of borrowing from the future by implementing institutions like the WCB and the green central bank, we might aim at promoting a fair distribution of costs between generations. We redistribute the costs of mitigation and adaptation in a just manner, according to which those that are richer and technologically more advanced pay more. However, my approach does not need to commit to intergenerational equality. This thesis has been non-committal to any theory of intergenerational distributive justice, and therefore I try to create an overlapping consensus (see section 4.6) between different and prominent theories of intergenerational distributive justice in favor of borrowing from the future

On this overlapping consensus view, we do have reasons to claim that each generation has a duty to cooperate and uphold intergenerational institutions. Therefore, we have no reason to consider that future people assuming a part of the costs can be a form of theft. Each generation has its entitlements and duties. According to these legitimate entitlements, the principle of borrowing from the future is just an instrument to distribute resources or whatever metric we consider the currency of justice.

This very same point is made by Rawls when justifying the Just Savings Principle. In Rawls's original position the parties do not know to which generation they belong. As Catriona McKinnon (2012:31) puts it:

> "If we believe – as we should – that a person's color, religion, class, IQ, status, etc. should make no difference to what they are owed by others as a matter of justice, then the same must be true of a person's generational membership. From the point of view of justice, the point in time at which a person is born is

just as morally arbitrary as the other characteristics just listed."

In Rawls, the Just Savings Principle requires that each generation saves for future generations, but Rawls distinguishes two stages. In the first stage, when justice has not been achieved, each generation is required to save for the next one in order for them to be able to uphold just institutions and a fair system of cooperation that protects basic liberties and ensures that inequalities are arranged to maximize the benefits of the worst-off members of that generation. In this sense, we might consider that previous generations are required to save resources such as a clean atmosphere for future generations. However, Rawls' conception of intergenerational justice has a second stage in which society has achieved justice and therefore is not required to save for subsequent generations. These fortunate not-yet-existing generations will live in a steady economy. They will only be required to refrain from dis-saving so that the next generation can sustain and uphold just institutions and live in a just society over time. Presumably, better-off future generations will not be required to save more 'clean air' because they have received a more advanced technology that will not require the emission of GHG.

However, Rawls acknowledges that this seems to violate a principle of equality between generations. Rawls argues that applying the difference principle, or any egalitarian principle of justice, is impossible between generations. Egalitarian principles across generations are impossible because there is no way in which presumably richer future generations can help the least fortunate earlier generations that are required to save more (Rawls ((1971) 1999): 254). Therefore, McKinnon (2012: 41) argues that earlier poorer generations save for future richer generations because "it is that such saving delivers to them the important social good of cooperation to create a just society."

When we look at the problems of climate change and future people as a problem of cooperation between generations to build and uphold just institutions to ensure a just society over time, the problem of moving

resources from the future to the present to take climate action looks morally acceptable. First, it provides a way to transfer resources from presumably richer generations to poorer earlier ones that have an obligation to reduce their emissions of GHG. As said earlier, it seems that Rawls did not think about it, because he argues we cannot apply a distributive principle between generations *à la* difference principle. Rawls claims that there is no way that future people can help worse-off earlier generations. But there is a way! We can apply the principle of borrowing from the future to take climate action now and avoid further harm to future people. Secondly, (a) earlier generations have a duty to save for the benefit of future ones -even if earlier generations are poorer- because this duty delivers to them the social good of cooperation between generations, and (b) BFF allows future generations to deliver this same social good of cooperation between generations -even if they do not coexist with them- because BFF benefits earlier generations.

Once we know that we can create institutions to make our grandchildren pay, we can set up a different principle in the intergenerational original position that allows us to redistribute resources between future and earlier generations. For example, suppose we apply the principle of borrowing from the future. In that case, we can make sense of the analogy between Murphy & Nagel's point about taxation, the lack of entitlement of present people to their pre-tax income, and the distribution of the costs of mitigating and adapting to global warming. Applying this same argument between generations, we can conclude that future people are not entitled to their welfare prior to applying an intergenerational distributive principle to share the costs of climate change mitigation and adaptation across generations.

I am defending that through BFF, different generations cooperate with each other to ensure a just distribution of the burdens of climate change. However, it is not obvious that cooperation between nonoverlapping generations is possible "given that they never meet, and goods seem to flow only in the direction of the future, never back"

(Karnein 2022). Karnein claims that cooperation amongst nonoverlapping generations requires (i) they should have shared aims, (ii) they should be responsive to each other in pursuit of these aims, and (iii) interactions between nonoverlapping generations should be mutually beneficial in a way required by cooperation. The main problem has always been finding ways to benefit earlier generations from the future ones. Karnein (2022) argues that it matters to evaluate the present generation's lives and whether the aim of mitigating climate change will succeed in the future. Our aim at tackling climate change depends, therefore, on the future, and our success or failure will be determined after all of us have died. Karnein (2022) calls this 'benefit as actual success,' and it has a salient normative dimension, "for the way the aim is pursued and, ultimately, realized (…) [i]t matters to individuals that the impact they have on the future [by taking climate action now] with regards to the projects they value [e.g. mitigating climate change][33] is not only casual, but also normative."

In a more tangible way, which also implies benefits from the future generations to earlier ones, BFF to tackle climate change meets the three requirements abovementioned. First, (a) nonoverlapping generations share the aim of mitigating climate change. Secondly, (b) earlier generations should take climate action now to be responsive to future generations. In exchange, future generations should be responsive to the earlier ones in pursuing these aims by paying part of mitigation costs through BFF. And third, (c) when earlier generations tackle climate change -something more feasible if they can borrow from the future- they benefit future ones.

On the other hand, future generations benefit earlier ones by paying their share of the costs through BFF. Thus, BFF is the perfect mechanism to show that cooperation between nonoverlapping generations is indeed possible and mutually beneficial. As Karnein (2022) puts it:

> "[A]s soon as each group acknowledges that it really needs (…) others to complete this project [mitigate and adapt to climate

[33] Between brackets are my additions.

> change][34], there seems to be more than mere, independent, participation by each cooperator. At this point, mutual responsiveness appears to be the only rational way of pursuing the aim."

Thus, the key component of social cooperation is present through BFF because it "makes a better life for all than any would have if each were to live solely by his own efforts" (Rawls, 1971). Suppose each generation needs to protect the legitimate entitlements of the next generation. In that case, the present generation has a duty to save "enough clean air" for the next generation and make it possible for future people to live on a planet with a clean atmosphere not contaminated by greenhouse gases. We apply here the first stage of the Just Savings Principle that creates an obligation to save resources for future generations. When doing so, the present generation makes a sacrifice, given the level of technology inherited, to invest in an energy system that will allow future generations to be wealthier with fewer emissions. These future people will benefit because all previous generations have cooperated to create a just society in which climate change does not threaten their existence anymore. Thus, we can see the problem of climate change as a matter of cooperation between generations (Rawls 2001, Gaspart and Gosseries 2008, McKinnon 2012). We can make our grandchildren pay to help the present generation to pay the costs of mitigation and adaptation. We have reasons to do it and apply the principle of BFF, and this cannot be seen as a form of theft, as Gardiner claims, but as a form of social cooperation between generations.

Thus, if we come back to the two different duties of climate justice mentioned at the beginning, on the one hand, we apply the Just Savings Principle to the emissions of GHG, and we require the present generation to take action to stop global warming. On the other hand, a principle of redistribution between richer and poor generations, like the principle of borrowing from the future, allows us to distribute these costs in a

[34] My addition.

substantially and procedurally fair way. This makes possible what Rawls thought was impossible: we can change the direction of the time arrow between generations and move resources from future richer generations to the earlier generations that have an obligation to save resources for posterity. However, it is also true that future generations are to some extent involved through BFF in producing the benefits that taking climate action now might render to them. Moreover, our task to tackle climate change will only be successful if future generations continue acting to stop global warming, taking seriously our reasons to do so. Following Karnein remarks, we benefit from future generations' actual success in mitigating climate change.

In this section, I tried to identify a version of the extortion objection that does not just collapse back into the PPP vs. APP debate. Part of the point here is that the theft version of the objection does just lead us back to questions about the substance of intergenerational justice. BFF should not be seen as a form of theft imposed by the intergenerational mafia. Instead, BFF delivers intergenerational cooperation, bringing benefits from future generations to the present. Also, in Karnein's more normative -and less monetary- sense, future people benefit us as cooperating members of a society that includes several generations by taking our reasons to tackle climate change and continuing our tasks. Thus, future generations cooperate and benefit earlier by "acknowledging the contributions of past generations and consciously continuing the project embarked by those who came before" enabling earlier generations to have a lasting impact on the shared project of combating climate change.

5.5 The Tyranny of the Contemporary

The charge of intergenerational extortion can be understood, also in Gardiner, as another important objection that he raises against BFF. First, Gardiner suggests that by creating institutions like the WCB or central banks implementing Green QE to transfer costs to future people

is problematic because of our temporal privilege. Second, Gardiner makes the important point that the present generation can unilaterally impose burdens on future ones through BFF without their approval. Gardiner then argues that BFF is an illegitimate exercise of this intertemporal power.

If BFF implies a problematic use of intergenerational power due to the temporal asymmetry between the present generation and future ones, it could still be morally impermissible. The idea here is that we should preserve generational sovereignty, an issue that has been discussed regarding constitutional constraints. Gosseries (2016) argues that a future generation has "effective sovereignty during its period of existence to the extent that it is free from extra-generational jurisdictional claims by other generations *and* has enough material resources to actually be able to decide among meaningful options." On this view, historically, some authors have argued that future generations should be treated as independent entities. Thus, it is illegitimate to exercise extra-generational power over them (see Locke 1689, Kant 1784, Jefferson 1789 or much more recently Otsuka 2003, Gosseries 2016, Karnein 2022).

I think the different policy schemes proposed here can legitimately restrict future generations' choices. We leave enough space for future generations to exercise their generational sovereignty. Thus, Green QE enhances generational sovereignty in two ways. First, it helps us to take climate action now and leave enough resources in terms of a clean atmosphere to the future, i.e., leaving a cooler planet expands the meaningful options available to future generations. Secondly, once the central bank enters into the picture of BFF, our proposals allow us to preserve the generational sovereignty of future generations, with the option for non-repayment or partial repayment of public debt across generations. In this sense, the range of options of the policy proposals left open to future generations whether to enforce repayment or not and preserve their generational sovereignty. The point here is that we leave them some freedom of choice over how to balance competing costs/risks.

In particular, they could choose to cancel some debt, gamble on higher inflation or less economic competitiveness, and write off some of the climate debt. This choice is important, again, when we think about cooperation between nonoverlapping generations. Karnein (2022) argues that when setting up an intergenerational original position, we do not know what generation we are going to be. Thus, when deciding which principles we should choose for an intergenerational cooperative project for the mutual benefit of all generations, we must consider these 'benefits of actual success.' Therefore, if we were earlier generations, we would like our reasons for pursuing our particular aims to be considered by later generations. Still, if we were future generations, it would be important for us to what extent we would "want earlier generations to have left room for a change of direction or reversal of previously made choices regarding the pursuit of the shared aim." In this regard, Green QE delivers a normative power to future generations that the WCB or Sachs model cannot provide. Future generations would probably appreciate that we leave them a significant degree of freedom to make their own choices.

I want to stress now a second normative point. There is a way in which we can defend that we can implement BFF without violating generational sovereignty. The idea can be called the "zipper argument" (Gosseries 2016, Ghaeus 2016) and can be explained as follows. We retake the model of 4 generations. It is clear that generations 1 and 4 are not overlapping, but generation 1 (that issues climate debt) will overlap with generation 2. If the latter wants to withdraw from the climate debt, it can reach an agreement with generation 1. The only thing they need to do is to achieve a political majority that approves such withdrawal of the debt. The same holds for generation 3 with generation 2 and between generations 3 and 4. The zipper argument, in my view, shows that there is a sequence of overlapping generations that cooperate for the mutual advantage of all generations. This zipper argument also supports my entitlements' view (the analogy with Murphy & Nagel's view) and the idea that cooperation between non-overlapping generations is possible. Even if they cannot live together simultaneously, there is a sequence of

overlapping generations that always have the option to reach a political majority to decide whether they want to keep the climate debt.

Maybe Gardiner could use this same zipper argument to defend that communication between non-overlapping generations is possible. Therefore, intergenerational extortion should still worry us as a problem with proposals that imply borrowing from the future. This line of argument is a problematic for the following reason. If generation 1 (the old) extorts generation 2 (the young) by making them pay to stop causing global warming, the young have the chance to convince them and reach a political majority that does not enforce a duty to pay some of the costs of mitigation. The young have a say in the political process to implement BFF between G1 and G2, and assuming that either G1 and G2 have an equal say, the extortion charge cannot succeed not because of lack of communication but because of the absence of an illegal exercise of power. The same happens between G2 and G3 and the latter and G4. Therefore, I think the zipper argument still leaves less margin for the moral charge of intergenerational extortion. Even if it is the case that two generations always overlap in a sequence of several generations, it fails because the subsequent generation always has the democratic choice to convince the earlier generation to reshape the project and withdraw the climate debt.

5.6 The Consequentialist Argument

The third important objection by Gardiner -other than the extortion charge- is illustrated with a dialogue in The Soprano's TV show. At one point in *The Sopranos,* a show of the beginning of the 2000s, the wife of Tony Soprano has an interview with the Dean of a University her daughter is hoping to join for her college studies. At some point, the Dean asks Tony's wife for a contribution to the University that will facilitate her daughter's enrolment. The dialogue Gardiner reproduces goes like this:

"Carmela: But there's not enough to make sure your own daughter is protected?

Tony: I won't pay. I know too much about extortion.

Carmela: I think you should pay him, Tony.

Tony: No fucking way!

Carmela: What, your daughter's future isn't worth 50,000 dollars?

Tony: That's not it. That motherfucker's full of shit. He's shaking me down.

Carmela: No, he's not.

Tony: Oh, yeah? Who knows more about extortion, me or you?"

The Sopranos case tries to show a different objection to the BFF. According to Gardiner, once we apply the principle of BFF, it is not clear that the present generation will stop at any given point. If we allow the present generation to act like this, we might well end up imposing all kinds of burdens to future generations to solve problems the current generation faces. A case of extortion opens the door for new cases of extortion in the future, Gardiner claims. That is the point of Tony Soprano when he says: "Who knows more about extortion, me or you?" and "He's shaking me down." According to Gardiner, Tony Soprano knows well that once you accept to pay under duress, the extorter can do it again and again, as he usually does with his victims of extortion, or at least this seems to be Gardiner's point about this dialogue in the TV show.

Gardiner argues that if we create institutions to shift resources from the future to the present, "(s)uch institutions may provide strong incentives for the present generation to find creative ways to generate new threats to future generations" (2017: 382). Seen like this, BFF risks leading to spiraling efforts to shift costs into the future. Concerning the consequentialist argument, that is the idea that BFF opens the door to new and creative forms to transfer any costs to future generations. In

short, my response is that, of course, we should shift other costs onto future generations. I am expanding my enthusiastic argument here, but there is always a but. In this case, I defend that we can shift costs other than mitigation and adaptation to climate change ones, if and only if they are agent-neutral. The justification of this response to the consequentialist worry needs a bit of explanation. In chapter 4, I argued that the scope of the PPP is limited because there are emissions for which the present generation is not responsible (e.g., those made by the dead). In addition, other emissions are causally attributable to the present generation, but that does not mean we should pay the costs. Recall the fair share limit I defended in the previous chapter.

Therefore, I think Gardiner's consequentialist worry is only justified in the case of costs attributable to the present generation. But suppose there are other costs, not related to climate change, for which the present generation is not causally responsible, or for other reasons we cannot attribute responsibility to us. In that case, that is the idea behind agent-neutral costs- it is morally permissible to shift some of these costs onto the future if they are made for the benefit of all generations.

I guess that Gardiner's objection points to a more complex problem. He is saying that we might not stop at the costs for which the present generation is not properly held responsible. It can be read it as a slippery slope worry: If we start doing this, in cases in which it is justified, and set up institutions to do it, we are going to be tempted to, or there will be institutional pressures, to do it, in cases where it is not justified. I think Gardiner is right on this since we do not want to use BFF for impermissible causes. It is, therefore, necessary to set up institutions that represent and protect the interests of future people. The central concern underlying Gardiner's worry can be seen as a worry about short-termism—the priority given to present net benefits at the cost of future ones. Democratic institutions are too often tempted to pass such costs on to the next generations, thus failing to adopt the required policies (González & Gosseries 2016). There are various determinants of short-

termism—which can also come in degrees, depending not only on how heavily future benefits are time discounted, but also on whether it is the near or the remote long term that is discounted. MacKenzie (2016) distinguishes various determinants of short-termism, depending on whether they originate from voters, politicians, interest groups, or the absence of future generations. Gardiner is right and we should design institutions for future generations. Therefore, a green central bank that borrows from the future should be checked by some of the institutions that have been proposed to protect future people's interest, i.e., an ombudsman of future generations (see Beckman and Ugla, 2016), that might even have veto power over any proposal to BFF.[35]

5.7 Concluding Remarks

In this chapter, I have done some work unpacking and critiquing Gardiner's extortion charge against borrowing from the future. Some of the author's counterarguments collapse in an unqualified defense of the PPP, but I did not address this worry since it is something I have done in previous chapters. Then, I have moved to the main argument presented by Gardiner, the idea that BFF is a case of intergenerational extortion. I argued that this argument fails due to the non-existence of future generations. Therefore, the lack of communication between the present and distant generations makes it impossible since communication is necessary for any case of extortion. Setting aside the extortion frame, due to its inapplicability to non-overlapping generations, I dealt with what is left of Gardiner's worry that BFF is morally impermissible.

I identified and rejected three possibilities, starting with the theft claim. The charge that borrowing from the future is a form of theft is unreasonable and leads us to discuss substantive aspects of

[35] See for the different institutional proposal to protect the interest of future people, González-Ricoy, I., and Gosseries, A. (eds) *Institutions for Future Generations* (Oxford: Oxford University Press, 2016).

intergenerational justice. I presented a case to defend BFF as a form of social cooperation between the present and future generations that benefit them all. By BFF, the present generation acknowledges that it really needs other generations to complete the project of mitigating and adapting to climate change. On the other hand, future generations cooperate and benefit to earlier ones by acknowledging their contributions and continuing the project of tackling climate change by those who came before, enabling earlier generations to have a lasting impact on the success of the shared task of combating climate change.

The second charge made by Gardiner was to see BFF as a form of what he calls the 'Tyranny of the contemporary.' The latter worries about the present generation's privileged use of intergenerational power due to the temporal asymmetry between the present generation and future ones. Here, I replied that Green QE enhances future generations' sovereignty in two ways. First, it helps us to take climate action now, and leaving a cooler planet expands the meaningful options available to future generations. Second, the policy proposals made in chapter 3 allow for the preservation of future generations sovereignty, with the opportunity for non-repayment or partial repayment of public debt across generations.

Finally, I addressed Gardiner's consequentialist worry. First, I argued that it could be reasonable to impose some costs unrelated to climate onto future people if these costs are agent-neutral -that is, they are not attributable to the present generation. Furthermore, Gardiner suggests that BFF to tackle climate change might also derive in imposing unjustified costs to future people -that is, costs attributable to the present generation. I agree with Gardiner on that point, and I think we should set up an institutional design of BFF that protects the interests of future generations. I gave the example of an ombudsman of future people that could have veto power when discussing other forms of BFF.

6 Conclusion

6.1 Introduction

Today is July 21st, 2022, and in the outskirts of Barcelona, Sant Feliu de Llobregat, where I live, we have reached temperatures above 30ºC almost every day during the last two months. Nights are torrid, and we hardly go below 24ºC between the sunset and the sunrise. My sister told me they reached 36ºC the other day in Bristol, something never seen before. I think that, right now, only my auntie -who is 86- and the Supreme Court of the United States[36] do not believe that we need to take quick and decisive action to stop global warming and advance the date of technological transition. That is the date when our annual global emissions will be absorbed by natural or artificial sinks every year.

When this date arrives, we will still suffer climate change since GHG remain in the atmosphere for decades, and in some cases, for centuries. That means that young people today will certainly face the consequences from our unconscious burning of fossil fuels. However, the point of making our best efforts to advance the date of technological transition is to avoid the rapid acceleration of climate change. Moreover, the acceleration of global heating might lead to unprecedented changes in the climate system, like agricultural disruptions that can create more famines or rising sea levels that might force climate migrants to move to other places far away from their current cities or islands at the sea-level. Finally, if we continue to do almost nothing, there is a risk that climate change turns to be catastrophic because we might reach a tipping point where the effects of climate feedback and create even more dangerous climate change. Ultimately, if we do not take measures soon enough,

[36] https://www.cnbc.com/2022/06/30/-supreme-court-says-epa-lacks-authority-on-climate-standards-for-power-plants.html

climate change might even cause the extinction of humankind and many other species.

When I was an undergraduate philosophy student about 25 years ago, the curriculum focused on the history of philosophy and continental philosophers. At that time, it seemed to me that philosophy was a discipline making very interesting questions that, in the end, were irresoluble. Because of my interest in politics (and some family pressures), I moved to study Law. I did an MA in Corporate Finance before starting a -not very successful- career as a practicing lawyer. I ended up disappointed with my job and life. At some point, I decided to enroll in the university again and begin a Master in Political Philosophy at Pompeu Fabra University. I met there some people that became very important in my academic life, like Paula Casal, Serena Olsaretti, Camil Ungureanu, and Andrew Williams. They taught a very different kind of political philosophy, namely analytical philosophy, which -I was really surprised- made not only exciting questions but also provided the answer to normative problems. After doing my Ph.D. at UPF under the supervision of Andrew Williams, I have visited and worked in several international universities and research centers like the University of California, Los Angeles (United States), the Hoover Chair of Economic and Social Ethics (Belgium), the Centre de Recherche d'Éthique (Canada) or the Central European University (Hungary).

Some moral philosophers like to develop hypothetical cases in ideal circumstances. The point of these cases, as Shue (2014) very graphically explains, is to isolate a relevant factor to see its importance in a moral problem. I enjoy this kind of philosophical puzzle, but I have a different political theory approach. During the last decade or so, my research has focused on several normative questions regarding independent central banks and monetary unions: political legitimacy, distributive justice, and in this thesis, intergenerational and climate justice. I am mainly interested in the normative issues raised by the politics of finance and, more generally, in a kind of political theory well informed by social science

and economics. In my view, this interdisciplinary approach is best suited to respond to public policy problems. Also, I believe that if a social scientist or an economist has a perfect model after collecting all the relevant data but does not have the right normative approach, her research is wrong all the way down.

In this research, I have retaken this path, focusing on a real problem of the real world. In the introduction, I stopped to explain the normative significance of central banks, and I have given an overview of what they do to fight against climate change. I introduced a distinction between two kinds of principles of intergenerational climate justice. Type 1 principles tell us to mitigate climate change, and type 2 principles tell us how to share mitigation costs fairly. The thesis has offered a range of policy options that central banks can implement to respond to type 1 and type 2 issues of climate justice. One of the main contributions was to introduce what I termed Intergenerational Green QE as a menu of policy options that help us to distribute the burdens of mitigation across generations and, therefore, can be seen as instances of borrowing from the future. Other policy proposals do not fit so well in this framework. Still, I think it was worth mentioning them as policy options at the disposal of central banks to cut emissions in a way that would be less costly and more efficacious than introducing a global carbon tax, a global cap-and-trade emissions market, or the World Climate Bank envisaged by Broome & Foley.

6.2 Concessive Arguments in favor of BFF

In this thesis, I have argued that central banks can, and should, serve intergenerational climate justice by implementing policies that cut emissions and thereby reduce the climate burden on future generations. I also argued that some of these policies justly shift some of the financial costs of mitigation onto future generations. In chapter 2, however, I started examining B&F's concessive argument in favor of BFF, and the

institutionalization of the principle of efficiency without sacrifice through a World Climate Bank.

I rejected their concessive argument in the thesis and defended BFF on enthusiastic rather than concessive grounds, following Gardiner's classification. Their concessive argument was supported by an empirical claim and a normative one. The former had negative and positive aspects. In my view, both are controversial. First, because an international effort exists to unite forces to combat climate change exists, and if summers continue to be like this, a global carbon tax might be in force sooner than we now think. However, they are right to some extent. During the last three to four decades -since we have scientific evidence that climate change is anthropogenic and risks the well-being of future people- we have not reached enough international coordination to stop increasing, year by year, the total global emissions of GHG.

Regarding their positive empirical claim that efficiency without sacrifice is more feasible than any other alternative, I offered three distinct responses in this thesis. First, I highlighted the feasibility problems of a WCB as the institution that can implement efficiency without sacrifice. Second, I agreed with Lawlor that there is no 'no sacrifice' option for the present generation. Third, I have also argued that Green QE faces fewer feasibility problems than the WCB they envisage. Finally, I also rejected their normative claim; namely, that BFF is unjust. One of the main points defended here is that it offers the possibility to promote justice across generations and serves type 2 climate justice issues.

There was a final problem with B&F's concessive argument. In this case, the problem was to reduce climate justice issues to reach efficiency or eliminate an externality. This view is misleading, if not dangerous because it seems to reflect a position in which we have no duty to respect the basic rights of future people and other species or duties of distributive justice towards them. Moreover, it might leave no place for the intrinsic value of nature and our planet.

6.3 Green Quantitative Easing

In chapter 3 I presented a range of policy proposals, grouped under the name of Green Quantitative Easing, as policy tools to serve both kinds of principles of intergenerational climate justice. Starting with more mild proposals already made by distinguished scholars and finishing with more radical but realistic proposals that we elaborated with Alexander Mihailov. To my knowledge, the term Green Quantitative Easing was coined by Anderson (2015). Still, even myself -let me be a bit parochial- proposed, when writing about the political legitimacy of independent central banks in my first dissertation (submitted in December 2016), that the government should constrain the powers of the central bank to avoid the depletion of natural resources:

> "What is needed is that the delegation of powers in favor of independent financial institutions comes from a law passed by the legislature, which can indeed impose limits on the institution. If we come back to the case of natural resources, the law can forbid some kind of investments to the independent body handling with natural resources."[37]

As far as I can remember, I first presented the idea of limiting the central bank's freedom to purchase only green bonds in a workshop in Cambridge on the Philosophy of Finance held in September 2015. I met Clément Fontan at that time, who was screening ECB's balance sheet and its exposure to "brown assets." The book he co-authored with Dietsch and Claveau, "Do Central Banks Serve the People?" reflects his first findings on the topic.

In chapter 3, I started distinguishing between Standard Green QE and Progressive Green QE. The former requires central banks to change

[37] See Ferret, J., "Distributive Justice, Political Legitimacy, and Independent Financial Institutions" (PhD Dissertation, Pompeu Fabra University, 2016).

their eligibility criteria and buy bonds and stocks only from companies that are not “brown.” The latter implies that the central bank prints money to buy bonds from a public investment bank. It usually is part of projects such as the New Green Deal. The investment bank then directs programs aimed at reducing CO2 and CH4 emissions. I described these two ways of Green QE as borrowing from the near future since the maturity of the bonds included in these programs is generally within a range of 10 to 30 years. Nevertheless, nothing impedes that Progressive Green QE can be applied to bonds issued by a public investment bank with longer maturity dates, encompassing several generations.

Then I moved to two more radical - but still realistic and feasible - policy proposals, the Climate Bad Bank and Greening Compensatory Transfers, which should not be normally understood as borrowing from the future, but as policies imposing fewer costs to the present or future generations. However, they also share some traits of borrowing from the future. Using money supply for these purposes requires a degree of cooperation across generations to uphold and maintain institutions like central banks or tax schemes. In the end, there is an opportunity cost to use money supply to fund a Climate Bad Bank or Greening Compensatory Transfers for the present or future generations since the monetary base should remain sustainable if we do not want to create inflation surges or risk economic competitiveness in the future. Ultimately, the central bank’s power to create money depends on the existence of future taxpayers, and it is the kind of institution that requires cooperation across time. Furthermore, there is also an opportunity cost since we could use the central bank’s power to create money to fight other significant moral problems like poverty or unemployment. The point is that there is no ‘no sacrifice’ option for the present generation.

I then presented Generation-Shared Green Bonds, the proposal that best fits with the remaining normative chapters of the thesis - because it is an instance of BFF that serves type 2 climate justice. One

crucial aspect of this kind of intergenerational Green QE is that it provides future generations with the option of full or partial non-repayment of the climate debt. Again, I showed that if future people use this option, there will also be some associated costs since writing-off debt is economically not ideal. Once more, there is no 'no sacrifice option' for future generations either.

Introducing intergenerational Green QE and central banks in the picture of BFF is a superior strategy to a global carbon tax or the usual forms of thinking about BFF. In this more traditional form of BFF, the government or the WCB issues bonds that will be paid by future taxpayers, as in Sachs (2015) and B&F (2016). This superiority derives from having fewer feasibility constraints because the central banks have the power to issue money out of nothing to buy climate bonds and hold them on their balance sheet. Second, it can adapt to changes in the ability to pay future generations, and third, it respects future generations' generational sovereignty more.

6.4 The Enthusiastic Argument

From a normative point of view, intergenerational Green QE is a form of Borrowing from the Future, or making our grandchildren pay -although a superior strategy to the traditional forms of BFF. I claimed in chapter 4 that BFF promotes fair distribution of mitigation and adaptation to climate change costs. It is useful here to recall again Caney's (2014) response to the claim that BFF is unjust. A such argument starts with the plausible assumption (P) that justice requires that polluters should not engage in harmful activities. Concessive arguments then appear to infer from this conclusion (C) that justice requires that the would-be polluters should absorb the cost of not engaging in this harmful behavior. But this conclusion does not necessarily follow. According to Caney, one can hold that the present generation should not emit GHG while also

thinking that the sacrifice involved in achieving type 1 climate justice should not be borne exclusively by the present generation.

Caney, thus, makes a negative claim against the force of the Polluter Pays Principle. Then I followed from there with a positive defense of BFF as a principle that promotes justice to future people rather than efficiency alone. If we endorse the negative argument against the PPP, it seems there is no reason not to follow with a positive, enthusiastic argument favoring BFF. In order to make this enthusiastic argument, in chapter 4, I examined different candidate burden-sharing principles to distribute the costs of mitigation and adaptation to climate change and presented an original enthusiastic argument in favor of BFF that relies on the intergenerational application of the Ability to Pay Principle (IGAPP). If we use the IGAPP, presumably, richer generations should pay more. Still, I also offered a pluralistic account of the interplay of the Intergenerational Polluter Pays Principle and the IGAPP that should guide us in distributing the costs of mitigation and adaptation of climate change across generations.

In Caney, the PPP has lexical priority, but the APP applies to what he calls the Remainder. Drawing on this view of the interplay of the PPP and APP in the intragenerational case, I first argued for a broader scope of what he calls the Remainder. I departed from him because he set up a basic needs limit to the PPP while I defended a fair share limit. I argued that we should look at polluters first, but only at those above the level of primary goods, resources, or any other metric we use, that they would be entitled to under an ideal distribution. That makes a case for more space for the APP, already in the intragenerational case.

When applying these principles across generations, I also offered a pluralistic account in which the intergenerational PPP has lexical priority over the IGAPP. First, the IGPPP should be modeled according to what I called the Ability Not to Emit. This ability not to emit implies that each generation is responsible for its emissions of GHG according to the technology inherited from the previous generation. Second, in this case,

the Remainder is even more significant because each generation is entitled to emit whatever it needs to reach its fair share under an ideal distribution of whatever currency of intergenerational justice we decide to use. Thus, the costs derived from these emissions to reach each generation's fair share should be distributed according to the IGAPP.

I also claimed that we should integrate burden-sharing principles with broader theories of intergenerational justice. Still, I remained non-committal to any particular theory of intergenerational distributive justice, and I defended an ecumenical case in favor of BFF. According to this ecumenical case, three prominent theories of intergenerational distributive justice - sufficientarian, prioritarian, and egalitarian- can accommodate the enthusiastic defense of the IGAPP and borrowing from the future. Finally, I addressed two major caveats to the defense of BFF.

First, there is the objection that claims that future people might not be richer than us due to the effects of climate change. The second objection claims that some people in the future might be poorer than the currently rich, even if the overall future generation is more affluent than us. Regarding the first objection, I emphasized the superiority of implementing Green QE because it allows the option of partial or full non-repayment of debts by future people if they are poorer than us. However, there was a problem with this non-repayment option that can be seen as a leveling-down objection. If they can use the partial or full non-repayment option, why should they not use it if there is no cost associated with it? Therefore, using it would make no one worse off while making future generations better off. I offered two kinds of responses to this leveling-down objection. First, following Maltais (2015), I argued that it is fair that future generations share some of the costs of mitigation and adaptation to climate change partly if they are richer than us. Then, we should constrain their options and attach some strings to the climate bonds so they are obliged to pay their share if they are richer than us. Secondly, I showed that there are, in fact, some costs associated with

writing off some of the climate debt. Thus, once again, there is no 'no sacrifice option' either for future generations.

Wirth respect to the second objection posed by Rendall (2019), we certainly have to take into account the future poor, avoiding that the climate burden falls onto them. In my moderate integrationist view, intragenerational and global justice theories should moderate the application of the IGAPP. This moderate integrationism suggests that the future poor should not pay, even if future generations are more prosperous than us. It is enough that future states have in place a fair system of redistribution and social insurance that ensures that the future poor will not have to pay. As a more general point, even if I have not tackled issues of intragenerational justice within future generations in this thesis, I do not see any reason, given the policy proposals labeled as Green QE, for costs to fall on the future poor. If the central bank holds the debt, as Mihailov and I propose, Green QE becomes a less costly strategy for the future poor than issuing debt today that future taxpayers should pay. On the other hand, the effects of future inflation in the distribution of wealth in the future, something that Green QE tries to avoid by its implementation through a sequence of business cycles, and other economic effects of a large-scale policy like Green QE in the future are uncertain. They cannot be fully anticipated at the present moment.

6.5 Is BFF Morally Impermissible?

In the last chapter of the thesis, I have addressed Gardiner's extortion charge against borrowing from the future. Gardiner's main argument is the idea that BFF is a case of intergenerational extortion. I argued against that because the extortion charge fails due to the non-existence of future generations. Therefore, the lack of communication between distant generations makes the extortion case inapplicable because communication is necessary for any case of extortion to arise. Furthermore, leaving aside the extortion frame, due to its inapplicability

to non-overlapping generations, I addressed three other charges present in Gardiner's argument: (a) the charge that BFF constitutes theft; (b) the idea that BFF implies a wrongful use of the privileged intergenerational power we have due to the temporal asymmetry between the present generation and futures ones; and (c) the consequentialist worry.

The charge that borrowing from the future is a form of theft leads me to the discussion of substantive aspects of intergenerational justice. In response to Gardiner, I presented BFF as a form of social cooperation between the present and future generations that benefit them all. Combating climate change is a task that involves several generations, and by borrowing from the future, the present generation acknowledges that it needs other generations to complete this project. On the side of future generations, BBF allows them to cooperate and benefit earlier generations by recognizing their contributions to tackling climate change, also enabling earlier generations to have a lasting impact on the success of the shared project of combating climate change.

Concerning the Tyranny of the contemporary worry, I replied that Green QE enhances future generations' sovereignty in two distinct ways. First, it helps us to take climate action now, and leaving a safer planet expands the options available to future generations. Second, the policy proposals defended in chapter 3 preserve the generational sovereignty of future generations, granting the opportunity for non-repayment or partial repayment of public debt across generations.

Finally, I also addressed in chapter 5 Gardiner's consequentialist worry. First, I argued that it can be reasonable to impose costs on future people if these costs are agent-neutral -that is, they are not attributable to the present generation. However, Gardiner suggests that BFF opens the door to imposing unjustified costs on future people -that is, costs that are attributable to the present generation and should not be shared with future people. I agreed with Gardiner on that slippery slope worry. Second, I concluded that we should set up an institutional design that protects the interests of future generations, enacting institutions to

protect their interests, like an ombudsman of future people that could have veto power when discussing other forms of BFF. All my arguments have shown that BFF is morally permissible to promote a fair distribution of the costs of mitigation and adaptation to climate change.

6.6 Concluding Remarks

During the last four years, I have conducted an interdisciplinary research project, reflected in this thesis, that combines finance and monetary policy with philosophical debates about climate justice. I have offered a range of policy proposals that a global network of central banks can use to stop global warming and reduce harm to future people. Furthermore, I defended that some of these policies should be understood as forms of borrowing from the future and allows us to promote a fair distribution of mitigation and adaptation costs across generations. Hence, Green QE can also respond to type 2 climate justice issues -that is, it helps to respond to how we should distribute these costs across generations. I presented my own enthusiastic argument in favor of BFF, grounded in the defense of the Intergenerational Ability to Pay Principle. Finally, I responded to Gardiner's objection that making our grandchildren pay is morally impermissible.

In conclusion, I have shown that Green QE is a superior strategy to advance the date of technological transition in which we will not have to emit more GHG than those that the global natural or artificial sinks can absorb annually. It is indeed more feasible than (a) a global carbon tax or a global cap-and-trade global emissions market, and (b) the WCB envisaged by Broome & Foley or Sachs' model of a government issuing public debt that future generation will pay off. Even more, I defended that BFF through Green QE is morally desirable because it promotes climate action now. Thus, avoiding leaving future generations worse-off while shifting fairly some of the costs of doing so onto future generations as a form of social cooperation between non-overlapping generations to tackle

climate change that constitutes a benefit for all of them. Finally, there is a big assumption in what I have defended here. We should take climate action now. It is urgent and we have a duty to tackle climate change and avoid further harm to future people. Whatever it takes.

7 Appendix: Economic Model

Excerpt from Mihailov and Ferret (2021): "Green Quantitative Easing as Intergenerational Climate Justice: On Political Theory and Pareto Efficiency in Reversing Now Human-Caused Environmental Damage."

https://www.reading.ac.uk/web/files/economics/emdp202116.pdf

(…)

4 A Theoretical Framework to Analyze Climate Change Mitigation

The model set out in this appendix draws on the work of Sachs (2015). Sachs proposes similar economic arguments on climate mitigation across generations and a stylized model to analyze optimal environmental policy. He uses intergenerational fiscal transfers as a main instrument of climate change mitigation policy. In contrast, we argue in favor of central bank involvement by means of green QE, particularly our idea of greening compensatory transfers to the current generation not requiring ultimate repayment. Sachs (2015) assumes that the fundamental case for climate change mitigation applies. As he shows, he formally requires that the present value of the benefit of a unit of mitigation […] is greater than the marginal cost of mitigation. Under this perhaps plausible condition, Sachs (2015) finds that mitigation policy is Pareto-improving across the two generations, so the young generation can vote for a mitigation strategy and transfer policy financed by government debt. The next generation will repay that debt by taxes on labor income. Today's young generation is left unharmed. The second-period young generation is made better.

To study climate change mitigation under fiscal policy transfers, Sachs (2015) writes down the simplest possible model with two-period

overlapping generations (OLG). To theoretically convey and theoretically check our proposed spectrum of options within green QE, we do not need to move too far away from Sachs's (2015) framework. For this reason, we follow the structure of his two-period model. Yet, we also adapt it to highlight a few novel features in the analysis and how they generally influence the discussion on the advantages and limitations of green QE climate policies, such as long-run economic growth, nominal interest rates and expected inflation across generation spans. We, notably, amend Sachs's (2015) model to be able to account for central bank GCTs to the current generation without necessarily being repaid by future generations, rather than taxing them to repay.

4.1 Assumptions

As usual, we begin by listing concisely the main assumptions of the model.

1. We consider a global closed economy comprised of overlapping generations, where each time period has two generations that overlap: one young and working, and the other old and retired.

2. Each generation lives for two periods of time: it works in the young period and retires in the old period.

3. Subscripts to variables denote units of time, and a time period t corresponds to a generation span (say, 25 years or so).

4. Superscripts to variables denote whether the generation is young and working, if y, or old and retired, if o, in each particular time period t.

5. A generation t is denoted by the active time span when it is young and working; i.e., the combination of a subscript t with a superscript y defines generation t.

6. For our purposes, it is sufficient to focus on two generations, each living for two periods; hence, the model economy will last for three periods.

4.2 Model Setup

Generation 1 is born, works, consumes and saves in period 1, and retires in period 2, consuming only from savings made in its active period 1 out of its disposable income.

Generation 2 is born, works, consumes and saves in period 2, and retires in period 3, consuming only from savings made in its active period 2 out of its disposable income. We stop here in our theoretical analysis, although the sequence can continue forever.

Savings can be either in physical capital K or in financial capital B, and following Sachs (2015) we assume that the net real return (or interest) rate on both assets is the same constant percentage r. In each period, workers earn a pre-tax wage W_t and pay net taxes T_t.

To capture the economics of climate change in this simple model, the global economy emits GHGs, and policy could mitigate the environmental pollution. As in Sachs (2015), wages depend on climate policy since mitigation is costly, and there are two scenarios to consider: (i) business as usual (BAU), which is characterized by not activating mitigation policy, and then the concentration of emissions in period 2 is E; and (ii) a policy that activates a costly emission mitigation technology M_1, where $0 \leq M_1 \leq 1$, so that now emissions in period 2 are reduced by the degree of mitigation, and are thus given by $(1 - M_1)E$. The government or, in a broader sense, that could be the central bank or a coordinated monetary-fiscal policy, or even a specific intergenerational institution charged with implementing a long-run environmental mandate such as in the Paris Agreement chooses the degree of climate pollution mitigation to be enforced by regulatory policies prescribed to the private sector.

The market wage in period 1 is, then, the equilibrium wage W reduced by an amount devoted to mitigation in the same period:

$$W_1 = W - ¥ M_1 \qquad (1)$$

GHG concentration in the global atmosphere in period 2, G_2, evolves over time depending on the mitigation policy in period 1:

$$G_2 = (1 - M_1)E \qquad (2)$$

The market wage in period 2 is assumed to be affected by the quality of the global environment in terms of GHG concentration, as in Sachs (2015); but differently from Sachs (2015), we also allow a constant generation-span trend growth in wages, at a net % rate g, which is consistent with the secular increase in GDP per capita, income per capita and consumption per capita, as evidenced in the data .see again figures 2 and 5:

$$w_2 = (1 + g)W - \theta G_2 \qquad (3)$$

Disposable income for each working generation in any period t is standard:

$$Y_t = w_t - T_t;\ t = 1,2 \qquad (4)$$

We now model what can be broadly interpreted as coordinated monetary-fiscal policy in the long run, to mitigate the human-polluting consequences of climate change. Sachs (2015) interprets this mechanism as fiscal policy only, i.e., net transfers of the government, positive to generation 1 and negative to generation 2, so that an intergenerational government budget constraint is satisfied in present value terms:

$$T_1 + \frac{T_2}{1 + r} = T_1 + \frac{1 + \pi^e}{1 + i} T_2 = 0 \qquad (5)$$

We make the analysis explicitly dependent on (net) expected generation-span inflation π^e by using the ex-ante Fisher definition of the real interest rate in the above equation, linking also to the (net) nominal interest rate *i* What Sachs (2015) proposes is to assume that the government makes

transfers to generation 1 in period 1, i.e., $T_1 < 0$, by selling government bonds B_2, which it then redeems by taxing generation 2 in period 2; under his scenario, then, $B_2 = - T_1$ and $T_2 = (1 + r)B2 = /1+i / 1+ \pi^{e})B_2$

We shall propose variations and alternative interpretations of monetary-fiscal policy in the slightly more general context we embed here in the model.

Using (2) in (3) and then (3) in (4) for t = 2, one can express the net disposable labor income of generation 2 in period 2 in terms of the mitigation and monetary-fiscal policies implemented on generation 1 in period 1:

$$Y_2 = (1 + g)W - \theta (1 - M_1)E + ((1 + i)/(1 + \pi^{e})) T_1 \quad (6)$$

As far as saving is concerned, we follow Sachs (2015) and assume a constant saving rate s out of disposable income that presumably maximizes life-time utility. Differently from him, but without consequences for the analysis of interest here, we allow generation 2 to live for a second period, during t = 3, and thus also save for retirement. So, when generation *t* is young, it works and saves:

$$C_t^y = (1 - s) Y_t^y , t = 1,2 \quad (7)$$

Its savings are invested in a portfolio of financial assets (or government bonds, in the narrower interpretation in the model) and physical capital:

$$B_t+1 + K_{t+1} = s Y_t^y , t = 1,2 \quad (8)$$

And when generation *t* is old, it consumes out of the return on past savings:

$$C_{t+1}^o = (1 + i)/(1 + \pi^{e}) (B_t+1 + Kt+1) , t = 1; 2 \quad (9)$$

We further assume, as in Sachs (2015), that the population is constant, *L*, in each generation. The national income identity for period 1 then states that output *Q* is equal to income:

$$Q_1 = W_1L \quad (10)$$

An analogous (but richer, due to saving in period 1) identity holds for period 2:

$$Q_2 = W_2L + rK_2 \quad (11)$$

We, finally, specify the lifetime utility function U_t^l , with t = 1,2, of each generation in terms of their lifetime consumption levels:

$$U_1^1 = U_1^1 (C_1^y , C_2^0) \quad (12)$$

$$U_1^1 = U_2^1 (C_2^y ; C_3^0) \quad (13)$$

As Sachs (2015) points out, if these utility functions are well-behaved, as we assume, they can be written in terms of disposable labor income:

$$U_j^l = U_j^l (Y_t) \quad j = 1,2 \quad (14)$$

From (14), (4) and (1), the welfare of generation 1 can now be expressed in terms of mitigation and monetary-fiscal policies as:

$$U_1^1 = U_1^1 (Y_1) = W - ¥M_1 - T_1 \quad (15)$$

From (14) and (6), the welfare of generation 2 can similarly be expressed in terms of mitigation and monetary-fiscal policies as:

$$U_2^l = U_2^l (Y_2) = (1 + g)W - \theta (1 - M_1)E + ((1 + i)/(1 + \pi^e)) T_1 \quad (16)$$

4.3 Optimal Intergenerational Environmental Policy

A conventional utilitarian approach to optimal intergenerational environmental policy will assign an equal weight to each generation by not discounting the future. This leads to an intergenerational environmental social welfare criterion (IESWC) that can be written as a weighted average of generational utilities:

$$IESWC = V (U_1^1 = U_2^1) = 0.5\, U_1^1 + 0.5 U_2^1 \quad (17)$$

We can now consider three cases of intergenerational environmental policy, as proposed by Sachs (2015).

4.3.1 Balanced Budgets Create Intergenerational Conflict

This is the case of $T_1 = T_2 = 0$. It is evident from (17), after plugging (15) and (16), that

$$\text{IESWC } (T_1 = T_2 = 0) = 0.5 [W - ¥M_1 + (1 + g) W - \theta (1 - M_1) E] \quad (18)$$

and so, for the case of zero trend growth of output, income and consumption, $g = 0$, climate change mitigation policies generate an extreme intergenerational conflict of interest: as in Sachs (2015), generation 1 favors $M_1 = 0$ (i.e., no mitigation sacrifices), whereas generation 2 favors $M_1 = 1$ (i.e., excessive or complete mitigation policies). Given the equal weighting of the two generations in the IESWC, then $M_1 = 0.5$, which results in (18) becoming

$$\text{IESWC } (T_1 = T_2 = 0; g = 0; M_1 = 0.5) = -0.25 (¥ + \theta E)$$

With long-run economic growth, the welfare of generation 2, of course, increases, by an additional negative gW term in the brackets of the expression above, so there might be arguments on the ground of intergenerational climate justice, as we proposed in the earlier sections, that the mitigation policy could be somewhat milder, i.e. $M_1 < 0.5$.

4.3.2 Present Generation Voting Biases Against Mitigation Policies

It is also clearly seen that democratic societies would bias the present generation to delay mitigation policy. Indeed, if generation 1 is asked to decide by voting, instead of relying on a benevolent social planner. or an analogous institution intermediating between generations as we suggested, the economic interest reflected in the equations of the model selects $M_1 = 0$. This will be implied by the logic of the modeled behavior unless altruistic or ethical features in utility are explicitly introduced. We leave this avenue of exploration for further work.

4.3.3 Intergenerational Climate Justice as Intergenerational Pareto Efficiency

Finally, a third scenario to consider and this is the key insight from our theoretical analysis in the present section of optimal intergenerational environmental policy is when we allow for monetary-fiscal policy that may not necessarily involve balanced budgets across generations. We begin by following the case analyzed in Sachs (2015), and then make it more general. The case of no economic trend growth, $g = 0$, considered in Sachs (2015), implies a Pareto optimality of a fiscal policy that sets $T_1 = -¥M_1$. As can be verified in (18), then generation 1 is compensated completely by the net government transfer for the cost of mitigation policy, and so the latter is implemented, thanks to the intervention of the policymaker. In this scenario the disposable income of generation 1 is as high as it would have been under the BAU bias of $M_1 = 0$. Now looking at the welfare of generation 2, they have to repay back the accumulated fiscal debt due to the transfer to generation 1 that was needed to offset its sacrifice on mitigation. With $g = 0$ as in Sachs (2015), we obtain from (6) and policy $T_1 = -¥M_1$:

$$Y_2 = W - \theta (1 - M_1)E - ((1 + i)/(1 + \pi^e)) ¥M_1$$

The above expression shows that Y2 increases withM1 only if the positive influence of the middle term is stronger than the negative influence of the last term. More formally:

$$(бY_2) / (бM_1 > 0 <-> \theta E - ((1 + i) / (1 + \pi^e)) ¥ > 0$$

Hence:

$$((1 + \pi^e) / (1 + i)) \theta E > ¥ \qquad (19)$$

This is a key result in Sachs (2015), which is interpreted in the usual way: the present value of the marginal benefit (of a unit) of mitigation, (θ E) /(1+r), should exceed its marginal cost ¥. Assuming this inequality holds, which Sachs (2015) refers to as the fundamental case for climate mitigation, he then shows that mitigation policy is Pareto-improving

across the two generations. In words, generation 1 votes in favor of a mitigation policy financed by net transfer from the government to itself to offset their sacrifice; generation 1 does not suffer in this way from the costs of mitigation and implements it. Generation 2 then inherits a cleaner planet and no matter that it repays the accumulated government debt, as long as the fundamental case for climate mitigation (19) applies, it is still made better off.

4.4 Incorporating Growth, Interest, Inflation and Nonrepayment

We now can add detail and extend the analysis beyond the initial one in Sachs (2015). We shall do that in four steps, emphasizing four respective refinements in the presented theoretical intergenerational cost-benefit analysis and its potential and complementary real-world implementation strategies, institutional actors and financial instruments.

4.4.1 Economic Growth Favors Future Generations

First, we incorporate economic growth. As can be seen, the derivative sign condition (19) is not affected by allowing $g > 0$. However, secular economic growth as observed in long-run data strengthens the case of the future generation being constrained by the balanced intergenerational budget of the elected sequence of governments or of a nonelected institution with an intertemporal nature and vision such as the central bank. This is so because, as seen by the first term in (16), economic growth increases wages, and standards of living (provided an environmental catastrophe is avoided) of each subsequent generation. Being (much) richer than us, our great-grandchildren could thus bear at least a fraction of the cost of the mitigation policy implemented by our generation in the name of longevity of life on our planet, hence in part in their inherent and genuine interest too.

4.4.2 Central Banks Manage Nominal Interest Rates and Inflation Expectations

Second, we highlight the role of the nominal interest rate and expected (generation-span) inflation on the tradeoffs involved. One can see in (19) that lower nominal interest rates and higher inflation expectations improve the chances for implementing climate change mitigation policy via government bonds or monetary-fiscal transfers to the present generation because they increase the present value of its marginal benefit relative to its marginal cost. Intuitively, lower real interest rates make borrowing from the future generation(s) cheaper. In particular, central banks in the world are the technocratic or expert institutions that are responsible to manipulate nominal interest rates and to manage inflation expectations. In this sense, central banks may be better suited than a sequence of elected governments of potentially different colors and opposing policy views to be entrusted with the lead role on mitigating climate change, as envisaged in our menu of options along the spectrum of green QE.

4.4.3 The Return on Green QE Bonds Could Just Protect from Ex-Post Annual Inflation

Third, if we want to alleviate further the burden of repaying for the future generation, we could set the nominal interest rate on the bonds or transfers across generations at zero, $i = 0$. Then, as in one of our proposed (in section 5 next) green QE implementation strategies, with sharing of the costs and benefits of mitigation policies across 3-4 generations, the central bank (or government) bonds of GCT nature and long maturities will not bear nominal return and will thus be similar to Treasury inflation-protected securities (TIPS) or corporate inflation-protected

securities (CIPS) available since the late 1990s in US and international financial markets. That is, to alleviate the burden of this environmental policy intergenerational financial instrument, the issuers of the bonds (firms or households) will only repay the principal augmented by inflation (not expected, but with an annual ex-post observed indexation) and only for their lifetime. This pragmatic, or implementation, proposal of ours with regard to GCTs in particular and green QE more generally through bond issue will be discussed shortly in section 5.

4.4.4 Central Banks Could Transfer Greening Compensatory Cash to the Current Generation without Repayment

Fourth, in a still milder version of the burden for the future generations, we can modify the presented theoretical framework in a way that does not require repayment of the bonds by the future generation(s). Why is this important? As we argued when discussing in earlier sections intergenerational climate justice, if future generations are not richer than us, it could be that they may have the option to not repay anything, or repay partially as much as they deem fair, looking back from their future time to our present choices, and taking in account the damage to the planet we have incurred to them or not been able to prevent for them. Why are central banks needed in such a scenario? Because governments cannot maintain unbalanced budgets intertemporally and accumulate huge debt, whereas the central bank can simply print money at its own will and allocate it for the specific mitigation policy via GCTs, without requiring repayment (for analogous arguments, but in the post-COVID-19 pandemic context, see, e.g. Benigno and Nisticó, 2020). In such a particular version of green QE, via GCTs as we propose, central banks seem the only institutions that could implement it.

Under these considerations, the presented model can be modified in a way that sets $T_2 = 0$. Consequently, (15) remains the same but (16) now becomes simpler (as its last term vanishes):

$$U_2^1 = U_2^1 (Y_2) = (1 + g)W - \theta (1 - M_1)E$$

Sachs's (2015) fundamental case for climate mitigation (19) then simplifies too, becoming

$$(\text{б}Y_2) / (\text{б}M_1 > 0 , \theta E > 0$$

which is always satisfied, by construction; unless GHG emissions are completely controlled, and ruled out at zero, $E = 0$; and, similarly, unless future wages do not depend on GHG concentration, so that $\theta = 0$. Intuitively, the future generation in this scenario only benefits: from a cleaner environment it inherits due to the implementation of the climate mitigation policy of central banks as part of a green QE package that includes a sort of intergenerational debt forgiveness. The cost of mitigation policy is fully covered by the net transfer of compensatory cash from the central bank, or from the government but monetized by the central bank. This outcome is, again, a Pareto-optimal equilibrium, made possible with the generous institutional intermediation of central banks between generations, via GCTs and their unique function to print money without creating debt.

5 A Proposal for Issuing Generation-Shared Green QE Bonds

We here aim to propose an illustration of a possible implementation of some variant of green QE by means of an extremely long-term bond issue by households and firms as debtors of the present generation to be held by the central bank as creditor (or an analogous government bond issue monetized by the central bank, which is approximately equivalent). The point in this type of very-long-term bond issuance is that it allows sharing of the repayment burden across generations, with an option of the future -and even the present- generations to pay partly or not at all (and then the remaining debts will be written o¤). The very urgency and grand scale of environmental policy require, we think -and have also argued from the philosophical and political theory perspectives of intergenerational

climate justice as well as from the perspective of economic theory and intergenerational Pareto optimality- nonstandard measures and nonstandard financial instruments to induce that the current generation launches the saving of the planet immediately and with the necessary depth and commitment. Indeed, as e.g., Broome (2018) argues, while the inaction of the current generations for several decades may well be explained with egoism, materialism and unwillingness to sacrifice costs of their own income or welfare, that is, to internalize the polluting externality, climate mitigation is much more than a usual externality in economics: if not tackled on time, that is right now, by the current generation, in a century or two the human race may be extinguished by the destruction of the living conditions on the Earth.

If we assume that future generations will be richer than the present one, as is the historical trend, we can borrow from them to take action against climate change and protect them from further harm caused by climate change. Intergenerational green QE allows us to design bonds with several maturity dates, let us say every 25 years -which, roughly, corresponds to a generation span- over a long run of 100 or more years to come. We propose to link their yield to just cover from de facto annual inflation, protecting bond holders from inflation ex post, and reducing the borrowing costs for the present generation via not requiring to pay a nominal interest rate different from zero, as we deem fair within the logic of such financial instruments.

There is still a cost for the holder, that is, central banks as we propose, the loss of interest above the inflation rate; and there is, of course, a cost for the current and future generations in repaying, fully or partially; but we, notably, argued -in the context of GCTs, in particular- that the private sector, both living and unborn, may not bear any cost on climate change mitigation, only the central bank can bear the cost, yet it can also always print money.

Suppose for a moment that, in one possible future scenario with government-held -not necessarily central bank-held- public debt,

‘generation 4’ (say, 100 years from now) arrives at a situation in which it suffers severe climate change and still has to face a huge remaining debt repayment. The central bank, because of its potential, could then buy all the existing green bonds at that moment and write-off the green debt, as it does in a financial crisis when it considers that financial assets are bad assets with no actual value. This, of course, would have economic consequences that the future people would have to consider by themselves, as it is impossible to fully anticipate them.

We assume, as a benchmark example of our calculations regarding the potential super-long-run bond issues with shared and optional repayment across generations, a coupon bond that pays back to the creditor, that is, the central bank, a coupon of 100 monetary units at the end of every calendar year, i.e., on 31 December, augmented only with the net rate of annual inflation ex post. In the illustration, we have instead assumed a constant inflation of 2% per annum and have calculated the due inflation-augmented coupons ex ante.

The coupon is in constant face value of 100 monetary units per year. We take into account the usual in macroeconomics and finance subjective discount factor of $\beta = 0{:}96$, in annual frequency, which corresponds to an annual average return on investment of about 4% (roughly) consistent with the data. We calculate the present discounted value (PDV) of the coupon of 100 units of money in every subsequent year. Then, we introduce the constant 2% inflation expected (for the purposes of the calculation, mostly) every year from now into the future, and compute the coupon due every year that the borrower (households and firms) should repay annually topped up with this ex-ante constant inflation rate. We then calculate the PDV of this ex-ante constant-inflation-augmented annual coupon, yet in a practical implementation the ex-ante coupon, as we would recommend, should be replaced by an ex-post coupon that augments the 100 face value by observed inflation, e.g., by a usual indexation scheme.

We also provide the magnitudes of the financial variables. We have used for illustration a maturity of 100 years, but this can be split in at least 2 shorter maturities, namely, 25 years = 1 generation span or 50 years = 2 generation spans (or also 75 years = 3 generations spans). The computations will be analogous, and the face value of the 100 coupon per year will be the same as the corresponding inflation-augmented annual value. In such a scenario, the central bank (or government) will provide more flexibility on repayment options, if the 'free-lunch' GCT-only implementation we propose is not undertaken (for reasons of being rejected as extreme), as it may be expected that each generation pays for, say, 25 years, then the next generation continues, and so forth; moreover, we envisage that each generation -in a non-GCT-only implementation of this super-long-run climate change mitigation bond scheme- may pay only for 5-10-15 years, or not at all, and then the debt will ultimately be written off. That is why the central bank seems to be indeed the only institution to operate such bond scheme without any negative effects on society (such as accumulating government debt: see, again, Benigno and Nisticó, 2020, on this crucial difference between the government and the central bank, as the latter only can perform the role of 'a lender of last resort to the nation').

We think, as we argued, that it is fair to allow an option to the future generations to repay partly or not repay. As to any potential costs, mainly in the form of inflation created by the implied long-run cycles of monetary expansions, we propose that central banks issue these green QE bonds predominantly in times of recessions over the course of several business cycles -hence the long maturities envisaged, with the shortest being 25 years. Moreover, if such periodic and countercyclical monetary expansions are implemented in relation to GCTs only, as we suggested, or mostly in such a form, the inflationary consequences will be further reduced. We are aware that writing off debts is an unusual and unproductive measure in normal times that would distort financial and economic incentives and could lead most likely to a social crash with tragic and long-term consequences. Nevertheless, we believe that the

costs of writing off some such green QE debts (or bond repayment to the central bank) will be justifiably minimal compared to the vital task of saving the life on our planet.

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