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IN BRASILIA

Green fiscal policies

An armoury of
instruments to recover
growth sustainably

Camila Gramkow



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Camila Gramkow



E C L A C

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Abstract

The present study seeks to explore how fiscal policies can be employed to deliver both socioeconomic and environmental dividends with a focus on Brazil as a case study. In the current context where the global economy in general and Brazil's economy in particular are struggling to reinvoke, whereas disregarding environmental concerns is a hazard for long-term economic development itself, the focus is thus on reviewing the recent literature that seeks to reconcile a stronger economic and social performance based on fiscal instruments that foster sustainable investments. An overview of the theoretical and conceptual literature on green fiscal policies is presented, and the recent on the ground applications of such policies are also discussed. Both the theoretical framework and the international experiences provide useful insights and lessons learned to analyze the case of Brazil. Brazil's vast territory, which is home to the world's 8th largest economy and to the most biodiverse ecosystems in the planet, makes an interesting case study of how an armory of green fiscal policies could be implemented to recover growth sustainably.

Introduction

The current context is marked by a double challenge. On the one hand, economies worldwide are challenged with plateaued growth rates, with harsh impacts on employment levels and quality and signals of poverty and extreme poverty resurgence. The socioeconomic gains obtained in the previous years, such as prosperous, fast-growing trade and decreased social inequality in many developing countries (including in Latin America), can be at risk if countries are indeed embarking in what can be a period of very slow process of economic recovery. On the other hand, there is growing evidence that urgent, path-changing action must be taken to effectively avoid the worst impacts of climate change and the environmental crisis. We are living in a unique moment, in which there is still time to act to limit global warming by up to 2°C, as established in the Paris Agreement, and to restore natural capital to avoid exceeding planetary boundaries. This double challenge, the socioeconomic and the environmental, implies that there is an urgent need for structural transformations in development styles that ought to be more sustainable economically, socially and environmentally.

The present study aims to explore how fiscal policies can be employed to deliver both socioeconomic and environmental dividends with a focus on Brazil as a case study. What may initially seem as opposing objectives are analyzed from the viewpoint of their synergies, which is little explored in the literature. Namely, the extent to which fiscal policies to foster sustainable investments could be a driver of a new cycle of (an investment-led) economic growth is an area of research that presents enormous potential for development.

This study is structured as follows. Section I discusses the relations between fiscal, socioeconomic and environmental systems. These systems are interrelated and mutually impact one another. It is argued that not acting to prevent environmental disasters and hazards is an imminent fiscal liability. The recent paradigmatic shift in the economic debate about the environment and development is also discussed, including a brief analysis of the relations of economic growth and the environmental sustainability of development and an overview of the main concepts and approaches that aim to reconcile economic recovery and reduction of emissions of greenhouse gases and other pollutants, such as the Green New Deal. The “Big Push for Sustainability” approach development by the United Nations

Economic Commission for Latin America and the Caribbean (ECLAC) is presented, which is explicitly focused on Latin American and the Caribbean's development specificities and historical gaps and opportunities. Following a discussion of convergence points and differences between the diverse recent concepts and approaches, Section I ends by making the case for green fiscal policies.

In Section II, an analytical framework of green fiscal policies is presented, whereby the definitions and the theoretical background are presented. The possibilities, from a theoretical viewpoint, of delivering multiple dividends, for example by tackling the "double externality problem" (over-concentration of the economy in polluting activities and under-investments in innovation and technological development), are discussed.

In Section III, the discussions land in reality, by building on the analytical framework presented in Section II to analyze the policy agenda regarding applications of green fiscal policies worldwide. Green fiscal policies are described as next-generation policy tools for environmental protection, followed by an analysis of the "waves" of adoption of green fiscal instruments globally. The global green stimulus that were put forward to combat the effects of the Great Recession 2008/2009 by fostering sustainable investments are described. National plans and roadmaps that explicitly seek to reconcile socioeconomic development and environmental progress are also covered.

In Section IV, the discussions focus explicitly on Brazil, which start with an analysis of the current state of green fiscal policies in Brazil and the legal possibilities of using fiscal policies to tackle the double challenge mentioned earlier. This section also explores how fiscal instruments have been used in Brazil for sustainable development purposes, including a review of existing applications of such policy instruments, barriers and opportunities.

In Section V, final remarks are presented, including recommendations of how green fiscal policies can be effectively used as an armory to recover growth sustainably.

I. Fiscal policies, the environment and development

A. Fiscal, environmental and socioeconomic systems are interconnected

The environmental liabilities of today are the fiscal liabilities of tomorrow. The examples are numerous. Poor management of mining waste dams can result in their bursting, with significant costs to re-build housing and infrastructure, relocate families and decontaminate areas. Much of these direct costs can be covered by the company responsible for the dam via fines and indemnities. However, indirect costs also arise that have an impact on public balances, such as triggering social spending due to increased unemployment and poverty, reduced tax collection owing to the interruption of the economic activity in the affected area, increased spending on complex life rescue missions etc. In 2015, for instance, iron ore mining in the municipality of Mariana in Brazil provoked the bursting of a dam of mining waste, which caused the death of 19 people and a wave of 34 million cubic meters of toxic mud that contaminated 663 km of the River Doce (Aires et al., 2018). Economic shutdown due to this disaster led to loss of tax revenue of R\$ 206 million in the state of Espírito Santo and R\$ 138 million in the state of Minas Gerais in 2017 alone (Samarco, 2017). Another example is inadequate access to clean water and sanitation infrastructure, which ultimately result in significant increase in public health expenditure. For every USD 1 invested in water and sanitation services, there is an estimated return of USD 4,3 due to reduced health care costs for individuals and society (World Health Organization, 2014).

Environmental liabilities, understood as potential costs due to environmental damage, risks and disasters, will be more frequent and more intense with unmanaged climate change. According to the current state of scientific knowledge, the warming of the climate system is unequivocal and it is extremely likely¹ that anthropogenic greenhouse gas (GHG) emissions have been the dominant cause of the observed warming since the mid-20th century (IPCC, 2014a). There is high confidence that nearly half of all historical (since 1750) cumulated carbon dioxide (CO₂) emissions have occurred over the

¹ With a likelihood between 95% and 100%.

course of the past four decades (from 1970 to 2010; *ibid.*). These figures indicate that human activities have been presenting a significant impact on atmospheric concentrations of CO₂ over a relatively short time span. Climate change has already caused impacts on all continents on physical, biological and human systems. These impacts include droughts, floods, altered crop yields, coastal erosion, and increased heat waves (*ibid.*). The risks and the costs of inaction regarding environmental issues are increasingly clear.

The Stern Report (Stern, 2007), one the most impactful reports worldwide about the effects of climate change on the economy, asserted that climate change is the greatest and widest-ranging market failure ever seen. It estimated that climate change will incur, if no action is taken, costs ranging from 5% to 20% of global GDP annually (Stern, 2007, p. X). If unmitigated, climate change can make 77% of countries in the world poorer in per capita terms by 2100 (Burke, Hsiang and Miguel, 2015). Because most developing countries are hotter on average, these countries will suffer more from the impacts of climate change (Burke, Hsiang and Miguel, 2015; Dell, Jones and Olken, 2014). A study has found that for a given year each 1°C of temperature rise reduces economic growth by 1.3 percentage points in poor countries on average (Dell, Jones and Olken, 2012). In addition, the conditions in which the pursuit of development and mitigation goals occur are also adverse in developing countries, including lack of knowledge of climate change risks and lack of institutional capacity to address the challenges (Scricciu, Barker and Ackerman, 2013).

Climate change reinforce and deepen the structural gaps that characterize the developing countries. Ungoverned global warming will make Brazil's semiarid larger and drier (PBMC, 2013), accentuating social and regional inequalities. Poverty increase is typical social spending trigger that can impact fiscal balances. Another example is the greater external vulnerability of Brazilian agricultural exports, as global warming will also lead to productivity losses in key crops of Brazil's export basket, such as soy, coffee, cotton and livestock (PBMC, 2013; IPCC, 2018). Crop failure and abrupt international commodity price fluctuation owing to supply disruptions, which are partly intrinsic to agriculture activity, can become more frequent and more severe with global warming. Such shocks can present significant impact on public balances, as they can trigger extensions and renegotiations of rural debts (and eventually lead to collapse of rural financing system), which is a recurrent process in Brazil that has been described as part of a "culture of not paying rural debt" (Silva, 2010). Trade imbalance is another typical trigger of government spending required to manage exchange rate fluctuations and macroeconomic stability. It can be said that addressing climate change – one of the most pressing issues of our time – adds a layer of complexity to the structural transformations developing countries need to set in motion. According to a prominent Latin-American economist, Raúl Prebisch, the situation with regard to sustainable development is that "*we are not in the face of new problems, but of old problems that have become more severe*" (Prebisch, 1980).

Because developing countries present substantial challenges, it is not unusual for environmental protection to be de-prioritized and seen as a privilege of wealthy nations (World Bank, 2012). In economic terms, environmental quality could be seen as a luxury good, which as such, would only be affordable once income is increased, because either (a) as income increases and basic needs are covered, there is increased attention to environmental quality (Grossman and Krueger, 1995; Martínez-Alier, 1995; Munasinghe, 1999); or (b) higher income levels might be connected to higher levels of environmental awareness (Azadi, Verheijke and Witlox, 2011; Martínez-Alier, 1995); or (c) higher income countries are more likely to be able to provide the resources necessary for tackling environmental issues (Martínez-Alier, 1995; Munasinghe, 1999). This kind of argument might be referred to as "too poor to be green" (Martínez-Alier, 1995).

However, it is increasingly clear from a scientific viewpoint that, on the one hand, not acting to address environmental liabilities is a choice that implies facing much more acute structural problems, including poverty, migration, food security, loss of competitiveness, and external vulnerability, all of

which imply activating public spending triggers that can represent fiscal liabilities. On the other hand, the choice to combat this crisis by making use of an appropriate mix of green fiscal policies represent a window of opportunity to tackle the structural problems of development while protecting the environment and rebuilding natural capital.

B. A paradigmatic shift in the economic debate

Over the last decade both the literature on macroeconomics of climate change and the international climate policy agenda have been marked by a paradigmatic shift (Gramkow, 2019a). For an excessively long period, the view that environmental policy, including climate policy, would entail sacrifices or limitations on economic development (Club of Rome, 1972; Daly, 1991) has dominated in the economic and the policy debate. Much of the economic literature has focused on the costs of transitioning to a more environmentally sustainable economy, including cost estimates of both action and inaction (Stern, 2016; Huberty, Gao, Mandell and Zysman, 2011). For example, the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) contends, based on the then available literature, that to achieve the concentration of CO₂ by 2100 needed to limit warming to 2°C from pre-industrial levels, there will be macroeconomic losses that vary between 2% and 15% of world GDP relative to an unmitigated baseline scenario (IPCC, 2014b). Net macroeconomic costs of mitigation, such as those reported by AR5, may lead to the misleading perception that economies perform better when no explicit action to reduce greenhouse gas (GHG) emissions is taken and that mitigation policies are necessarily costly in macroeconomic terms. This literature has been increasingly criticized for underestimating both the costs of not managing the climate crisis and the benefits of the transition to a low carbon economy (Stern, 2016; Stoerk, Wagner and Ward, 2018; Dietz et al., 2018; Burke, Hsiang and Miguel, 2019; Pindyck, 2013; Scricciu, Rezai and Mechler, 2013). Because there is an extensive debate in literature about the compatibility between economic growth (in terms of GDP) and environmental sustainability, the next section is dedicated to this topic.

1. Are green and growth mutually exclusive terms?

Economists have long defined economics as the study of how scarce resources are used to produce and distribute valuable goods (Samuelson, 1948). Hence, scarcity has been a present element of economic studies. In spite of early approaches, such as the Malthusian controversy (Malthus, 1798), it was not until the late 1960s that impacts of degradation and finiteness of natural resources has become its own strand in economic studies (Holt, Pressman and Spash, 2009). The question of whether economic growth (in terms of GDP) and environmental sustainability are mutually exclusive or not has been subject to a controversial debate amongst economists and non-economists.

The hypothesis that economic growth will eventually be limited by the availability of natural resources gained impetus with seminal work by Nicholas Georgescu-Roegen (Georgescu-Roegen, 1971). Georgescu-Roegen (1971) brought new viewpoints to economics by making a parallel between the economic system and the Second Law of Thermodynamics (The Entropy Law). According to his work, the mainstream (Neoclassical) economics is firmly based on the First Law of Thermodynamics, in the sense that the economy is assumed to function as a closed circular flow of inputs and outputs. Materials and energy resources are neither created nor destroyed but are transformed within the economic flow. This mechanical view of the economic system is challenged when the Second Law of Thermodynamics is considered, because materials and energy resources used in the production process disperse or diminish. In the economic process, there is a progressive deterioration of materials and energy resources from a useful to a useless state. Georgescu-Roegen (1971) goes on to argue that nature

presents a limited resilience or regenerative capacity. Thus, the economy could only grow up to a certain level of activity, determined by the thermodynamic limit, after which, high entropy would provoke economic system collapse.

Another influential work about the limits imposed by the finitude of natural resources on economic activity is a report by the Club of Rome (Club of Rome, 1972). The fundamental message of this report is that global society is on track to grow (in terms of human ecological footprint) beyond planet Earth's physical limits (i.e. overshoot), because of significantly delayed responses of the global economy to these limits. This delay is caused by several factors, including the time it takes to identify and agree on global physical limits, institutional inertia that hampers decision-making and the time that the results of actions take to become apparent and demonstrable. The report also asserted that overshooting planetary natural boundaries can be avoided through policy measures that stabilize world population and industrial output per person and that promote deployment of technologies that improve resource use efficiency.

In a seminal paper (Daly, 1991), Herman Daly alleged that macroeconomics should seek an optimal scale of economic activity (i.e. a scale within the carrying capacity of the planet) as a macroeconomic goal, which would certainly (sic) conflict with other macroeconomic goals that require further growth.

A recent strand of research contends that the economy should follow a de-growth path (see for example Schneider et al (2010)) or a-growth path (see for example Jackson (2009)), because economic growth would be environmentally unsustainable and would not be a condition for human progress. According to Schneider et al. (2010, p. 512), de-growth is defined as "an equitable downscaling of production and consumption that increases human wellbeing and enhances ecological conditions at the local and global level, in the short and long-term." De-growth would be a transitional process towards a sustainable steady-state that would be both environmentally and socially beneficial.

Among those affirming that there is compatibility between economic growth and environmental sustainability are the OECD and UNEP (OECD, 2001a; UNEP, 2011a), which have advanced the concept of decoupling environmental degradation from economic growth. According to UNEP (2011a, p. XV), "decoupling means using less resources per unit of economic output and reducing the environmental impact of any resources that are used or economic activities that are undertaken." Jackson (2009) distinguishes between relative and absolute decoupling. The first is defined as a reduction of environmental pressure per unit of economic output. Relative decoupling entails that the environmental impact might continuously increase if GDP grows faster than environmental depletion. Absolute decoupling is a stronger concept in that it implies a dissociation of absolute environmental impact from economic growth.

In the present study, it is argued that it is obtuse to debate the environmental sustainability of economic growth (as measured by GDP), because GDP itself is a theoretical and statistical construction that provides very limited (if any) information about the sustainability of the economy or its production, consumption and distribution processes.

Firstly, it is important to define what GDP is. According to one of the most disseminated economics textbooks (Mankiw, 2011, p. 494), "GDP is the market value of all final goods and services produced within a country in a given period of time." Put simply, GDP is essentially a metric of activities in the economy, and in particular those that are monetarily transacted in the market (Stiglitz, Sen and Fitoussi, 2010). Any information attributed to GDP beyond this definition is prospective, including whether economic (GDP) growth and environmental degradation are compatible or not.

It is important to highlight the context in which GDP has developed into a key economic statistic. Even though academic formulations were developed as early as the 17th century, it was not before the

Great Depression in the 1930s that official macroeconomic statistics began to be produced, with the USA being one of the leading developers headed by Simon Kuznets (Marcuss and Kane, 2007). In the early 1930s, the scale, scope and the mechanisms that were perpetuating the economic crisis were unclear for policy makers and the wider public. The following passage indicates how limited macroeconomic statistical information was, which curbed not only the understanding of the economic crisis, but also a more precise assessment of how policy measures could best tackle the depression:

"How extensive was the contraction in the volume of economic activity, year by year, from the peak attained in 1929? What was the impact of the current depression upon the various industrial branches of the economic system, and upon the various factors of production? These questions cannot be answered fully, even with the most skillful utilization of the available data... there are marked gaps in information concerning important areas of the national economy" (Kuznets, 1934).

It was in this context of considerable gaps in the data on the economy that early frameworks which led to modern understanding and measurement of GDP were built. According to Marcuss and Kane (2007), the Great Depression of the 1930s and World War II were the main triggers for the developments of national economic accounting. The primary motivation behind the construction of such frameworks was related to dealing better with, and avoiding, economic depression. World War II was also important for the construction of national macroeconomic statistics since it has required a better understanding of the effects of different allocations of limited economic resources, particularly the effects (on jobs, provision of basic commodities, among others) of shifting significant proportions of the labor force, inputs and capital goods to a specific sector (the defense industry; *ibid.*).

It is possible to conclude that the main purpose of GDP and national accounting systems more broadly was to serve as an indicator of economic performance for policy makers and other stakeholders. For this purpose, GDP can be considered a useful measure, but it is a very weak measure of other relevant aspects, such as welfare and sustainability (Jakob and Edenhofer, 2014; Stiglitz, Sen and Fitoussi, 2010). Some of the main limitations of GDP as an indicator of welfare are (i) disregard for distributional issues, (ii) omission of elements of human activity or well-being for which no direct or indirect market transaction is available (including the depletion of natural capital) and (iii) as a measure of flows, GDP diverts the focus from stock levels, including natural capital (Stiglitz et al., 2010).

The debate about the weaknesses of using GDP as an indicator of the overall welfare and environmental sustainability of countries is not new (see for example Nordhaus and Tobin (1972)). In fact, during early stages of GDP development, such limitations were already subject to debate. According to Kuznets (1946), the measures necessarily involve errors of both commission (e.g. the inclusion of commodities that are not goods in the sense that they do not scientifically or ethically contribute to the satisfaction of needs) and omission (e.g. the exclusion of activities such as household services that are not traded in the market, but would constitute a good). Kuznets (1946) states that the limitations in the interpretation of macroeconomic data should be stressed, particularly in analysis of the longer-term economic trends. "It warns us against too easy an acceptance of the thesis that a high national income is the sole desideratum in theory or the dominant motive in fact in a nation's economy ... omission renders national income merely one element in the evaluation of the net welfare assignable to a nation's economic activity" (Kuznets, 1946, pp. 127–128).

Assessments of GDP should be carefully conducted and not include characteristics beyond its very definition. With regard to environmental sustainability, GDP does not add much information, because it does not include details about the sustainability of production, distribution and consumption processes. It is possible that GDP growth might not be harmful for the environment. In fact, there are studies presenting evidence that climate protection might result in GDP growth (see for example Barker et al. (2012)). Another study shows that GDP growth based on the intellectual economy, i.e. grounded in ideas, art, literature, music etc., and which does not indefinitely increase material consumption is

both feasible and desirable (Hepburn and Bowen, 2012). The literature (Barbier, 2009a; Barker et al., 2012; Green New Deal Group, 2008; Huberty, Gao, Mandell, Zysman, et al., 2011) suggests that the right mix of policy measures can help reconcile environmental sustainability with socioeconomic development, which implies decoupling of economic growth from GHG emissions. In addition, recent research shows that holding the current level of per capita GDP constant alone (i.e. without any additional investments in modern low carbon technologies) would not avoid dangerous climate change and would still require improvements in carbon intensity (Hepburn and Bowen, 2012). Furthermore, less economic growth does not avoid the risk associated with using controversial mitigation technology options, such as carbon capture and storage, nor is it the most economically efficient way of reducing GHG emissions (Jakob and Edenhofer, 2014). Finally, a stagnant world economy without a major redistribution of global income would deny developing countries the opportunity to converge with countries that had a head-start in industrialization (Jakob and Edenhofer, 2014).

In conclusion, it does not seem a propos to sustain a linear relation between GDP growth and environmental sustainability in one or another direction, as GDP provides few (if any) parameters for a consistent assessment of its sustainability. It is clear that economic activities should not exceed planetary boundaries given the finiteness of natural resources and nature's limited carrying capacity. However, it should not be assumed a priori that GDP growth would lead to environmental degradation, nor that environmental protection necessarily requires a shrinking GDP. GDP should be interpreted as one indicator of economic performance within a dashboard of green growth indicators that also include other economic, environmental and social indicators.

2. Diverse new concepts and proposals

In the 2000s key reports were released, which measured the extent and magnitude of the effects of climate change with major repercussions (Boykoff, 2011). In 2007, the IPCC released its Fourth Assessment Report (AR4), which concluded that global warming is unambiguous and that most of the observed increase in global temperatures since the mid-twentieth century is due to rising anthropogenic GHG concentrations (IPCC, 2007). Simply put: the report confirmed that there is no doubt that global warming exists and that human actions are its main cause. Also in 2007, the Stern Report (Stern, 2007), one of the most influential studies on the effects of climate change on the economy, was released and, as described earlier, stated that climate change is the largest and most extensive market failure ever seen. One of the key findings of the report is that the benefits of strong and early action to curb climate change far outweigh its costs. These reports helped build momentum for a growing awareness regarding an imminent global climate crisis, such that the 2007 Nobel Peace Prize was awarded to the IPCC and Al Gore Jr *"for their efforts to build up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed to counteract such change"* (The Nobel Peace Prize, 2007).

With regards to biodiversity loss, studies presented no less alarming outcomes. In 2005, the Millennium Ecosystem Assessment (MEA, 2005) was presented. This report revealed that, over the last 50 years, humans have been changing ecosystems faster and to a larger extent than in any other comparable period of human history. Later on, The Economics of Ecosystems and Biodiversity (TEEB, 2010) reports were launched, demonstrating the risks and costs stemming from biodiversity and ecosystem services loss, as well as opportunities associated with their conservation and sustainable use. TEEB (2010, p. 25) contended that the destruction of nature has reached levels where serious social and economic costs are becoming noticeable and will be felt at an ever-increasing pace if no action is taken.

Growing awareness was underway, supported by new evidence from such reports about the impending global climate crisis when the Great Recession of 2008-2009 broke out, the largest economic crisis since the Great Depression of the 1930s (IMF, 2017). The upward trend in global GDP growth that

had been under way since the 1960s was halted and in 2009 world GDP fell by 1.7% (World Bank, 2017a). Compared to the pre-crisis levels, 27.6 million more people became unemployed, increasing the unemployment rate from 5.6% in 2007 to 6.2% in 2010 (ILO, 2011). It is in this context of significant tensions related to economic performance and the potentially harmful effects of climate change and biodiversity loss on well-being and the economy that proposals for tackling both environmental and economic crises gained international recognition. In 2010, it was agreed at the 64th UN General Assembly² that the green economy in the context of sustainable development and poverty eradication would form one of the two themes for the 2012 United Nations Conference on Sustainable Development (Rio+20). The debate about the need to “green” economies is, however, not new and has been in place for some decades in the academic agenda, particularly in the fields of environmental and ecological economics (see, for instance, Pearce et al. (1989)). Nonetheless, it is only in recent years that this debate has intensified, largely owing to the effects of the Great Recession 2008-2009 and underpinned by growing scientific evidence of the damage to well-being and the economy caused by environmental issues. The narrative of green growth has since been increasingly adopted over the discourse of sustainable development that prevailed in the 1990s and early 2000s, possibly because it rules out the (unpopular) sacrificing of economic gains for the sake of long-term sustainability (Jakob and Edenhofer, 2014).

Since then, several reports have been produced seeking to reconcile economic growth and environmental sustainability, within which, terms such as “green recovery” (Barbier, 2009b; Pollin et al., 2008), “green stimulus” (Barbier, 2009a; Bowen et al., 2009), “green investments” (Robins, Clover and Singh, 2009) “low carbon development” (OECD and IEA, 2010) and “big push for sustainability” (ECLAC, 2016), among others, were recurrently deployed. At least one consensus seems to prevail throughout these documents: the perception that the economy ought to shift to a more sustainable model, which should not only ensure environmental sustainability—with a focus on climate protection—but also encourage economic recovery. It is underlined that this debate is one of a global nature, and not focused on developing countries solely. According to ECLAC (2016), the current debate departs from a recognition in most countries that the current development patterns are not sustainable economically, socially and environmentally. As such, the overarching question countries are trying to understand is what shifts ought to be made to achieve more sustainable development styles (*ibid.*).

In 2008, the Green New Deal Report (Green New Deal Group, 2008) was launched in the form of a call to action as urgent and far-reaching as the USA New Deal in the 1930s. Even though it was focused on the UK, it proposed a positive course of action to save the world from economic and climate collapse. This would require a structural transformation of financial system regulation (both national and international) and changes in national tax systems. Furthermore, it would be necessary to support a programme of sustained investments in renewable energy and energy efficiency, accompanied by effective demand management. Also in 2008, the Center for American Progress commissioned the report “Green recovery: a program to create good jobs and start building a low-carbon economy” (Pollin et al., 2008). The report proposed a fiscal package to stimulate investment in six green infrastructure areas in the USA as an engine for job creation, economic recovery and to prepare the way for the transition to a low-carbon economy.

In 2009, the UN Environment Programme commissioned the report “Global Green New Deal” (Barbier, 2009a, 2009b). In an allusion to the 1930s New Deal, the report proposed a package of policy measures, but on the global scale and embracing a broader and greener approach. It contended that the correct mix of global economic policies, investments and incentives can reduce carbon dependency and protect ecosystems, while stimulating economic growth, creating jobs, reducing the vulnerability of the poor and providing sustainability of the recovery (*ibid.*). According to the report, governments

² Resolution 64/236.

worldwide should eliminate fossil fuel subsidies, which on its own would reduce GHG emissions by up to 6% and increase GDP by 0.1% globally. If the financial savings from this measure are redirected to investments in clean energy R&D and energy efficiency, for example, there could be further economic gains. In addition, the report recommends actions at the national level, for example that middle- and high-income countries spend at least 1% of their GDP on reducing carbon dependency, through measures such as investments in renewable energy, energy efficiency and low carbon transportation. It is also recommended, *inter alia*, that developing countries improve the sustainability of their primary production activities, for example, by re-investing the financial gains from primary production into diversifying the economy and making investments targeted at the poor. At the international level, the report recommends, among other things, reforms to the governance of the financial system, increased funds for development assistance and expansion of innovative financing mechanisms for clean investments (*ibid.*).

The idea of a “green new deal” has been gaining traction with proposals being discussed in the United States of America (USA) and Europe. In the USA, the report “A Green New Deal: a progressive vision for environmental sustainability and economic stability” (Carlock, Mangan and McElwee, 2018) puts forward a broad and ambitious package of new policies and investments in communities, infrastructure, and technology to help the United States achieve environmental sustainability and economic stability. These are proposals for an equitable transition to a 21st century economy and clean energy revolution that guarantees clean air and water, modernizes national infrastructure, and creates high-quality jobs. In Europe, the report “Blueprint for Europe’s just transition” (Adler, Wagan and Prakash, 2019) presents a pragmatic and comprehensive policy package based on three core proposals: Green Public Works (an investment programme to kickstart Europe’s equitable green transition), Environmental Union (a regulatory and legal framework to ensure that the European economy transitions quickly and fairly, without transferring carbon costs onto front-line communities) and Environmental Justice Commission (an independent body to research and investigate new standards of ‘environmental justice’ across Europe and among the multinationals operating outside its borders).

In 2011, the UN Environment Program (UNEP, 2011b) launched the report “Towards a green economy: pathways to sustainable development and poverty eradication,” which may be considered as the cornerstone of a more precise delimitation of the concept of a green economy. According to the report, a green economy is “one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. In its simplest expression, a green economy can be thought of as one which is low carbon, resource efficient and socially inclusive” (*ibid.*). The report advocated for government and business to stimulate investment-driven increases in income and employment, through investments which would reduce GHG emissions and pollution, and increase efficiency in energy and resource use, while maintaining ecosystem services. These investments would be promoted and directed by targeted public spending, policy measures and regulations. The report also argued for the maintenance, improvement and reconstruction of natural capital, seen as a critical asset and a source of social benefits, particularly for poor groups whose livelihoods and security depend on nature. UNEP asserted that investments worth 2% of the GDP globally should provide enough finance to kick-start the transition to a green economy with positive results on both the environment (by enhancing stocks of renewable resources and reducing environmental risks) and economic performance (by increasing income and creating jobs) in the long-run compared to business-as-usual.

Also in 2011, the OECD launched the report “Towards green growth” (OECD, 2011), in which a strategy for green growth for OECD countries was defined. In the report, green growth was defined as one that “fosters economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies” (*ibid.*). To do this, the report goes on, it must promote investment and innovation which will boost sustained growth and lead to new economic opportunities. It would also require more efficient use and management of resources

to minimize environmental impacts, which would in turn involve changes in fiscal policy and regulatory interventions.

Table 1 provides a sample of the multiple definitions for these concepts. The numerous new concepts and terms are symbolic of a reinvigorated global debate on how to redesign the economic model to achieve the overarching goal of sustainable development (UNDESA, 2012). The variety of concepts is related to the uncertainties, risks and challenges involved in this debate in the lead up to the Rio+20. One of the concerns raised is that the concept can be misused by focusing primarily on economic and environmental dimensions and regarding social concerns as a secondary dimension of sustainable development (UNDESA, UNEP and UNCTAD, 2011). Criticisms also include concerns about one-size-fits-all approaches, green washing, green economic policies as a new form of protectionism, a green technological race as a source of global inequality, financialization of nature and new green conditionalities on developing countries for aid, loans and debt relief (*ibid.*).

Table 1
Concepts and definitions of green economy and green growth

Concept	Definition
Green economy	<p>1. One that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. It is low carbon, resource efficient, and socially inclusive. In a green economy, growth in income and employment should be driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystem services (UNEP, 2011b).</p> <p>2. A system of economic activities related to the production, distribution and consumption of goods and services that result in improved human well-being over the long-term, while not exposing future generations to significant environmental risks or ecological scarcities (Barbier, 2009a).</p> <p>3. An economy that results in improved human well-being and reduced inequalities, while not exposing future generations to significant environmental risks and ecological scarcities. It seeks to bring long-term societal benefits to short-term activities aimed at mitigating environmental risks. A green economy is an enabling component of the overarching goal of sustainable development (UNCTAD, 2010).</p> <p>4. A resilient economy that provides a better quality of life for all within the ecological limits of the planet (Green Economy Coalition, 2011).</p> <p>5. An economy in which economic growth and environmental responsibility work together in a mutually reinforcing fashion while supporting progress on social development. Business and industry have a crucial role in delivering the economically viable products, processes, services, and solutions required for the transition to a green economy (International Chamber of Commerce, 2011).</p> <p>6. The green economy is not a state but a process of transformation and a constant dynamic progression. It does away with the systemic distortions and dysfunctionalities of the current mainstream economy and results in human well-being and equitable access to opportunity for all people, while safeguarding environmental and economic integrity in order to remain within the planet's finite carrying capacity. The economy cannot be green without being equitable (The Danish 92 Group Forum for Sustainable Development, 2012).</p> <p>7. Green economy can be seen as a lens for focusing on and seizing opportunities to advance economic and environmental goals simultaneously (UN, 2010).</p> <p>8. An economy that aims to improve human welfare and social equity, and concurrently reduce environmental risk and ecological scarcities. At its simplest, a green economy can be characterized by low carbon use, resource efficiency and social inclusion. It is driven by public and private investments that contribute to reducing carbon emissions and pollution, enhancing energy and resource efficiency, and preventing the loss of biodiversity and ecosystem services. Such investments are driven by national policy reforms and international policy and market infrastructure (UNECA, 2011).</p>

Green growth	<p>1. Aims to foster economic growth and development while ensuring that natural assets and environmental services are protected and maintained. The approach places a premium on technology and innovation –from smart grid systems and high-efficiency lighting systems to renewable energies including solar and geothermal power– as well as on improving incentives for technology development and innovation (High Level Panel on Global Sustainability, 2012).</p> <p>2. Fostering economic growth and development, while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies (OECD, 2011).</p> <p>3. It is an implementing strategy to achieve sustainable development that focuses on improving the eco-efficiency of production and consumption and promoting a green economy, in which economic prosperity materializes in tandem with ecological sustainability. Green growth provides a positive agenda for pursuing the three pillars of sustainable development – economic growth, social inclusiveness and environmental protection – by seeking to develop synergies instead of focusing on the trade-offs and trying to balance them. It is a way to generate and sustain development gains and achieve higher and better-quality growth in the medium- and long-term (UNESCAP, 2011).</p> <p>4. Green growth is aimed at creating a new development paradigm in which the conflicting goals of economic growth and protection of the environment are no longer seen as such. It engenders a complementary relationship between the two ideals. Broadly defined, green growth seeks to advance the transition from quantitative growth to qualitative growth and the shift from the traditional, fossil-fuel dependent socioeconomic structure into a low carbon one (GGGI, 2011).</p> <p>5. Green growth encompasses the notion that broad-based economic growth has been and continues to be the most effective contributor to poverty eradication. At the same time, it is appreciated that, in the twenty-first century, growth will need to be associated with far less intensive energy and resource use and less pollution than historically (UN, 2010).</p> <p>6. Growth that is efficient in its use of natural resources, clean in that it minimizes pollution and environmental impacts, and resilient in that it accounts for natural hazards and the role of environmental management and natural capital in preventing physical disasters. And this growth needs to be inclusive. Inclusive green growth aims to operationalize sustainable development by reconciling developing countries' urgent need for rapid growth and poverty alleviation with the need to avoid irreversible and costly environmental damage. Efforts to foster green growth must focus on what is required for the next 5 to 10 years to sustain robust growth, while avoiding locking economies into unsustainable patterns, preventing irreversible environmental damage, and reducing the potential for regret (World Bank, 2012).</p> <p>7. Means job creation or GDP growth compatible with, or driven by, actions to reduce GHG emissions (Huberty, Gao, Mandell and Zysman, 2011).</p>
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Source: Adapted from UNDESA (United Nations Department of Economic and Social Affairs) (2012), "A guidebook to the green economy. Issue 1: Green economy, green growth, and low-carbon development - history, definitions and a guide to recent publications."

3. Big Push for Sustainability: an approach for Latin America and the Caribbean

In 2016, the UN Economic Commission for Latin America and the Caribbean (ECLAC, or CEPAL in its Spanish or Portuguese acronym) launched the document "Horizons 2030: Equality at the heart of sustainable development" which would mark its thirty-sixth session and beyond (ECLAC, 2016). It is a key contribution of ECLAC, which marked the definitive centrality of the environmental dimension in recent ECLAC thinking. In the document, ECLAC maintains that Latin American and Caribbean countries should build a trajectory of progressive structural change, a process of productive transformation characterized by the threefold efficiency: (i) the 'Schumpeterian efficiency', whereby a productive matrix that is more integrated, complex and knowledge-intensive generates positive externalities from learning and innovation throughout the value chain, (ii) 'Keynesian efficiency', which highlights that there are increasing gains of scale and scope of productive specialization in goods whose demand increases relatively faster than others, and (iii) 'Sustainability efficiency', which concerns economic viability, social fairness, institutional stability and environmental sustainability. These guiding principles are the cornerstones of an alternative development path. That is, the environmental theme emerges at the core of the very definition of structural change in recent ECLAC thinking. At the national level, ECLAC argues that a path of progressive structural change can be driven from a Big Push for

Sustainability as a means of implementing a new style of sustainable development with equality. This is the first time ECLAC has explicitly put climate policy as the engine of economic development in Latin America and the Caribbean.

Achieving environmental sustainability requires advancing the same elements necessary to achieve socioeconomic sustainability: productive diversification and the increasing weight of the most technologically intensive sectors in the economy. The Big Push for Sustainability can support the construction of a high value-added, low environmental impact economy based on modern, flexible and intelligent technologies such as information and communication technologies, biotechnology, nanotechnology, renewable energy, low carbon agriculture, circular economy (energy efficiency and use of materials, recycling etc.), bioeconomy etc. The rich biodiversity and traditional knowledge of Latin America and the Caribbean can be an inspiration and build the foundations for green innovation and increased value added. This can happen, for instance, with the development of nature-based solutions (for water management and agroecology, for example) and even innovative high-tech products that mimic some natural process, a process called biomimicry (e.g. incorporating morphological characteristics of whales) in the blades improves the hydrodynamic and aerodynamic performance of, respectively, submarines and wind turbines for wind energy; Fish (2009)).

Investments are the most important component of the Big Push for Sustainability, both for its potential for boosting aggregate demand and for its transformative potential of the production structure. As stated by ECLAC (2016), today's investment explains tomorrow's productive structure. Significantly increasing investment levels to accelerate capital accumulation and expand technological capacity building is therefore the nerve center of the Big Push for Sustainability. In a nutshell, the Big Push for Sustainability focuses on policy coordination to unlock domestic and foreign investment not only in sustainable practices, technologies, industries and infrastructure but also in technological capabilities and education to equip the workforce with the necessary skills for the future (Gramkow, 2019b, 2019a). Coordination is both the critical challenge and the key opportunity for the Big Push for Sustainability. If a wide range of policies (public and corporate, national and subnational, sectoral, tax, regulatory, fiscal, financing, planning, etc.) is aligned and cohesive with the cornerstones of a new development path, a favorable enabling environment to mobilize the required investments is created, building on reduced uncertainties, corrected price signals and an adequate policy mix. The increase in sustainable investments leads to a virtuous cycle of economic growth, job creation, development of productive chains, reduction of environmental footprint and environmental impacts, while at the same time recovering the productive capacity of the natural capital.

The Big Push for Sustainability approach differs from other initiatives aimed at reconciling the recovery of economic growth with the mitigation of the climate crisis due its long-term, structural focus on development styles (Gramkow, 2019b). Overall, the approaches other reports seek to provide answers to the double crisis (economic and climate), based on the realization that there is an urgency both to regain the dynamism of the global economy and to combat global warming. Like the Big Push for Sustainability approach, these reports also propose Keynesian elements, such as green stimulus packages for sustainable investments, that can simultaneously boost the economy and protect the environment. While some of these reports also address social and inequality issues, what really sets the Big Push for Sustainability apart from these documents is its explicitly structural and long-term approach. In the Big Push for Sustainability, Keynesian elements go beyond short-term "green" countercyclical policy, but also incorporate at least two other key Keynesian issues. The first is international coordination to sustain effective demand levels, reduce recessionary bias, and lessen the uneven impacts of international adjustment. The second is Keynesian efficiency (see definition above), which refers to building a type of external insertion that is less dependent on products that have less dynamic world demand, that is, the relief of structural external constraints on long-term economic growth. In addition to this longer-term (Post Keynesian) approach, the Big Push for Sustainability

approach also brings in fundamental Neoschumpeterian structural elements, related to Schumpeterian efficiency (see definition above), which refer to the development of technological and innovative capacities to generate solutions appropriate to the specificities of Latin American problems, to build sustainable bases of long-term competitiveness and to diversify the economy. These two efficiencies, Keynesian and Schumpeterian, are therefore transversal and oriented towards a third efficiency, the sustainability efficiency (see definition above).

The Big Push for Sustainability is being built within the framework of ECLAC thinking and is thus explicitly focused on structural problems that are particularly relevant to the region, such as structural heterogeneity, incorporation of technical progress and its benefits, external expertise, high levels of inequalities (social, gender, etc.), among other structural gaps in development. It is, therefore, its long-term approach, aimed at helping to address structural development gaps, that makes the Big Push for Sustainability attractive to Latin America and the Caribbean.

4. Convergences points and differences between concepts and approaches

Overall, one of the main convergence points of the various conceptualizations targeting the environmental and socioeconomic sustainability of development is the development of instrumental approaches as a means to achieve the end objective of sustainable development. In addition, the role of investments in green technologies and green innovation in reducing GHG emissions and in boosting socioeconomic development is also commonly raised in these definitions. It is noteworthy that all studies reviewed in this study make the case for changing the policy framework to reconcile economic growth and environmental sustainability. This suggests unanimous agreement regarding the pivotal role of public policies in the transition to a greener economy.

There are three main differences between these conceptualizations. Firstly, these concepts vary according to the degree to which social aspects are explicitly considered (Barbier, 2009b; World Bank, 2012). Terms such as "inclusive green economy" and "inclusive green growth" have become more frequently used in recent publications so that the social dimension is made explicitly relevant (see for example World Bank (2012)). Regarding the ECLAC concept of the "environmental big push", the approach is explicitly designed to achieve equality and sustainability in development (ECLAC, 2016). Secondly, some concepts explicitly include a reference to ecological limits or planetary boundaries (see for example Green Economy Coalition (2011) and ECLAC (2016)) whereas other concepts, especially those related to green growth, do not refer to such limits or boundaries (UNDESA, 2012). Finally, the various concepts vary with regard to the degree to which low carbon investments might foster job creation and/or economic growth. According to Huberty, Gao, Mandell, and Zysman (2011), green growth concepts vary according to their level of ambition as transformational driver. The concept of green growth may: (a) maintain that economic growth is compatible with emission reductions in contrast to the view that environmental sustainability poses a constraint to ever increasing GDP; (b) contend that low carbon investments in technology and infrastructure can become a source for job creation in a context of economic recovery; (c) assert that green investments are not only a source of job creation, but a new engine for economic growth, which could underpin a new green industrial revolution as transformative as earlier eras of economic change.

C. A window opportunity for green fiscal policies

The international debate seems to be undergoing a paradigmatic change, whereby the right mix of policies to tackle climate change provides opportunities for socioeconomic development. Taking

advantage of the cyclical downturn in the world economy, including in Brazil, green fiscal policies could be used with both countercyclical and environmental protection roles. It is necessary to take advantage of the windows of opportunity presented to engender a process of progressive structural change towards a sustainable development style. Green fiscal policy can thus cease to be an obstacle and become yet another engine of economic development and a new front for expansion during this window of opportunity that may quickly cease to exist (Gramkow, 2019a). Even though the consensus in the literature seems to be that policies should be country specific, general policy recommendations have been put forward (Barbier, 2009a; OECD, 2011; World Bank, 2012; ECLAC, 2016; UNEP, 2011b). The studies show a variety of policy recommendations, ranging from the Global Green New Deal (i.e. a package of policy measures similar to the US New Deal of the 1930s, but on the global scale and embracing a broader and greener approach; Barbier, 2009b) to UNEP's Green Economy (i.e. targeted public spending, policy measures and regulations to catalyze green investments amounting to 2% of GDP; UNEP, 2011c) and ECLAC's Big Push for Sustainability (i.e. policy coordination and articulation to leverage investments towards a sustainable development style; ECLAC, 2016).

The international community committed to holding the increase in global average temperature to 2°C above pre-industrial levels for the first time in 2010 in the outcome document of the 16th Conference of the Parties (COP) of the UNFCCC, known as The Cancun Agreements (UNFCCC, 2010). In 2015, the Paris Agreement marked a more stringent commitment, by "holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels" (UNFCCC, 2015). In 2015, Brazil's mitigation target was voluntarily set in its Nationally Determined Contribution (NDC), whereby the country committed to GHG emissions reductions of 37% by 2025 and 43% by 2030 in relation to 2005. Compared to other major developing countries, Brazil was the only emerging economy to commit to an absolute target compared to a baseline year (Tobin et al., 2018). Having ratified the Paris Agreement in 2016³, the commitment became legally binding in the country. The substantial investments needed to achieve Brazil's NDC which range between USD 890 billion (BID, 2017) and USD 1.3 trillion (IFC, 2016) by 2030, could boost a new cycle of more equal economic growth in the country.

³ Legislative Decree n. 140, 16/08/2016.

II. Green fiscal policies: definitions and theoretical background

A. Definitions

According to the International Monetary Fund (IMF), fiscal policy is defined as "the use of government spending and taxation to influence the economy" (Horton and El-Ganainy, 2012). In other words, governments can use both sides of public finance (i.e. public expenditure and taxes that generate public revenue) to influence economic outcomes. In this study, green fiscal policies (GFPs) are defined broadly as the use of fiscal instruments (i.e. government spending and taxation) that induce the uptake of green technologies, following Gramkow and Anger-Kraavi (2018). This definition explicitly includes spending and taxation instruments, such as taxes, subsidies, grants and government's spending decisions more widely (Milne and Andersen, 2012).

On the taxation side: green, eco, environmental, or environmentally related taxes or fees, charges, or levies are "any compulsory, unrequited payment to general government levied on tax-bases deemed to be of particular environmental relevance. Taxes are unrequited in the sense that benefits provided by government to taxpayers are not normally in proportion to their payments" (OECD, 2001b). The internationally agreed-upon OECD definition thus considers a carbon tax to be a green tax, but a water consumption fee is not a green tax because in the latter case taxpayers enjoy a proportional benefit provided by the government in relation to the payment (Milne and Andersen, 2012). The definition of GFPs in the current study thus covers the OECD definition of green taxes as a subset of GFPs, because it refers to taxation instruments only and does not address public spending instruments.

When the introduction of a green tax is accompanied by reductions of other taxes or distortions in the economic system, usually in the form of taxes on labour or social security, it is often referred to as green, ecological or environmental tax reform (ETR) (Clinch, Dunne and Dresner, 2006; Milne and Andersen, 2012). The rationale of an ETR is that taxation can change market signals in such a way that it induces more environmentally friendly conduct by businesses or consumers. "Environmental taxation

embodies the concept of using the tax system to adjust prices in a way that will influence behavior in an environmentally positive manner” (Milne and Andersen, 2012). ETRs are also a subset of GFPs, because even though ETRs address spending some portion of the revenue raised from green taxation on reducing other taxes, they do not present a focus on broader aspects of public spending, such as subsidies and grants (Milne and Andersen, 2012).

This definition thus encompasses a broad range of green fiscal policy instruments, which include:

- Eliminating environmentally perverse subsidies, such as fossil-fuel subsidies, thereby creating fiscal space for green stimulus;
- Providing financial support for the uptake of green technologies, such as reduced capital costs, provision of public capital and tax credits;
- Introducing targeted tax incentives, e.g. tax deductions and exemptions for green technologies;
- Implementing fiscal disincentives to discourage use of polluting technologies, for example a carbon tax or an emissions trading system; and
- Public investments in green infrastructure, such as railroads, sanitation, energy and public transport.

GFPs can promote a long-term investment enabling environment when the macroeconomic and political conditions are stable are adequate and when there is a balance between early competition exposure and protective support for infant green industries and technologies.

B. Theoretical background

The idea that the state can improve economic welfare by using fiscal policies to address market imperfections is not new in economics. Pigou (1932, p. 192) argued that the state could remove the divergences between private and social net costs, which are the cause of externalities, by means of “extraordinary encouragements” or “extraordinary restraints” and the “most obvious forms [...] are, of course, those of bounties and taxes”. While the Pigouvian approach was widely disseminated, it was not an easy approach to put into practice due to the challenges involved in obtaining the value of the optimal tax (i.e. the true social cost).

Another approach originally formulated by Baumol and Oates (1971) sustained that a socially acceptable standard of pollution could be defined, and a tax or subsidy could be set at a level that would lead to the achievement of that standard. Through an iterative process, government would have the experience necessary to estimate the tax levels that are appropriate to achieve the pollution standard. The tax would set a uniform price for pollution emissions. In this way, firms with the lowest abatement cost would reduce their pollutant emissions more compared to those with the highest abatement cost until the standard is achieved, which is a least-cost optimality property (*ibid.*). The authors aimed for this approach to “be as close as an approximation as one can generally achieve in practice to the spirit of the Pigouvian tradition” (Baumol and Oates, 1971). In this sense, it is not a complete departure from Pigou’s formulation – mainly in that the least-cost abatement approach assigns to the market the main role of resource allocation with taxes and subsidies. Indeed, some references in the literature to the Pigouvian tax refer to the least-cost approach (Milne and Andersen, 2012).

The uptake of green technologies or green innovation (GI), defined as defined as the implementation of a new or significantly improved product (good or service), or process, or a new

organizational method in business practice which benefits the environment and contributes to environmental sustainability (Kemp and Pearson, 2007; OECD, 1997; Oltra, 2008; Gramkow and Anger-Kraavi, 2018), is under-provided because of the "double externality problem". On the one hand, private agents (e.g. firms) under-invest in new technologies, R&D and innovation, because the private rewards are quickly transferred from the innovator to other firms (e.g. via technological spillovers) and customers (e.g. via reduced prices). On the other hand, innovative firms do not privately enjoy the full environmental benefits accruing from GIs. The "double externality problem" exposes market failures (owing to positive knowledge externalities and negative environmental externalities) that causes markets to under-invest in GIs (Dechezleprêtre and Popp, 2015; Horbach, Oltra and Belin, 2013a; Mazzanti and Zoboli, 2006; Horbach, Oltra and Belin, 2013b; Oltra, 2008; Walz, 2010; Rennings and Rammer, 2010). Therefore, this "double externality" problem justifies the introduction of fiscal policies to increase investments in GIs.

However, it is not only by internalizing externalities that fiscal policies can improve economic outcome. Fiscal policies, by contributing to the maintenance of high aggregate demand levels, are an important macroeconomic instrument for both short- and long-term economic development (Kaldor, 1985). According to Post Keynesian theory, the economy is demand driven and supply constrained and there is no automatic mechanism that ensures that demand is sufficient to underpin high levels of economic activity (Kaldor, 1957, 1972, 1985; Keynes, 1936). Fiscal policy is the primary economic policy to maintain aggregate demand levels, which would otherwise be too low, and thereby sustain economic activity and employment levels, given the limitations of monetary policy in influencing demand levels, e.g. the liquidity trap (Arestis, 2012; Arestis and Sawyer, 2003, 2010). The state should therefore use public spending and taxation to combat unemployment and inflation (*ibid.*). By boosting aggregate demand, fiscal policy stimulates investments, whereby future productive capacity of the economy is increased, which not only contributes to combating inflation, but also results in a long-term impact on the economic structure. Therefore, targeted GFPs would not only contribute to shifting the incentives regime of the economy towards GIs but would also sustain demand and employment levels.

C. Multiple dividends from green fiscal policies

The hypothesis that using GFPs results in two types of welfare gains, one related to environmental improvements and the other related to better economic performance, is known as "double dividend" in the literature (Jaeger, 2012; Milne and Andersen, 2012). The second dividend (better economic performance) has been defined in various ways in the literature, ranging from increased employment, mainly in European studies to reduced tax distortions, mostly in the USA (Jaeger, 2012; Milne and Andersen, 2012). The term was first coined in 1991 by David Pearce (Pearce, 1991) and since then it has been subject to debate. According to a recent review of the literature (Jaeger, 2012), there is agreement that a double dividend can be obtained when green tax revenues are recycled back into the economy by reducing pre-existing distortionary taxes.

The Post Keynesian approach provides theoretical grounding for win-win situations, i.e. those in which protecting the environment does not come at the cost of economic development, which is vital in the context of the reconciliation of socioeconomic development with environmental sustainability. GFPs can help alleviate structural rigidities that lead to under full employment (and out of equilibrium) situations. For example, fiscal incentives for investments in GIs (e.g. acquisition of green capital goods) can contribute to economic growth, encourage job creation and thus reduce involuntary unemployment both in the short- and in the longer-term, while supporting the achievement of environmental protection goals (Perkins, 2003). In this sense, the double dividend hypothesis can be considered a Post Keynesian hypothesis. Neoclassical Economics assumptions, such as perfectly competitive markets

(including the labour market) and perfect information, entail clearing of markets and full employment in the economy in the long run, including the baseline scenario. Under such assumptions, there is no room for a double dividend (Clinch, Dunne and Dresner, 2006). The implications of Neoclassical Economics assumptions in modelling of macroeconomics of climate change are discussed in Box 1.

Box 1

Standard equilibrium and Post Keynesian models in macroeconomics of climate change

Standard equilibrium models are grounded on Neoclassical Economics (NCE), which present a supply-led approach to the economy via the interaction of consumers and firms in the market. Under standard NCE assumptions, such as perfect competition, constant returns to scale, rational behavior, and perfect foresight, an optimal economic equilibrium is reached, in which demand equals supply for every commodity (markets clear) and all resources (including labor) are fully employed in the long-term (Scricciu, Barker and Ackerman, 2013; Löschel, 2002; Mercure et al., 2019). The implication is that, if an optimal equilibrium is obtained in the baseline scenario, a shock (including the introduction of climate policies) will lead to a sub-optimal equilibrium in which economic levels are worse off (Gramkow and Anger-Kraavi, 2019). In the latest IPCC Assessment Report, thirty out of the thirty-one models employed in the report are equilibrium models, and all mitigation costs reported are positive and increase with the stringency of the mitigation target (IPCC, 2014b).

The treatment of money and the financial sector is also an aspect whereby Post Keynesian models differ from standard equilibrium models owing to different theoretical foundations. In Post Keynesian models, such as E3ME (Cambridge Econometrics, 2014), the money supply is endogenous whereby financial institutions (e.g. banks) can create money through new loans (up to the levels allowed by past regulations that are embodied in the model's econometric parameters) to address new investments (Pollitt and Mercure, 2018). As a result, there is no full crowding out of investments, which is consistent with its theoretical foundation. In standard equilibrium models, in contrast, the money supply is exogenous, and there is full crowding out of investments because new investments must be financed either by increased savings that reduce consumption or by reducing investment elsewhere. Notwithstanding, the different ways through which green investments can be financed in macroeconomic models of climate change are insufficiently explored, and so far, there are scarce models that present explicit treatment of money and the financial sector (Pollitt and Mercure, 2018; Anger and Barker, 2015; European Commission, 2016).

The dominance of models based on the NCE tradition has been associated with a deeper problem in the economics discipline: that it offers little space for pluralism and alternative academic traditions to coexist (Scricciu, Rezai and Mechler, 2013; Spash and Ryan, 2012). It should be noted that NCE tradition itself presents theoretical variations and developments, but these occur around core concepts and assumptions that essentially do not change, such as optimizing behavior, perfect rationality and equilibrium assumptions (Scricciu, Rezai and Mechler, 2013; Courvisanos, Doughney and Millmow, 2016). There are diverse equilibrium models in terms of model structure, content and assumptions relating to energy, the environment and economics. This is partly explained by the complex nature of the problems being addressed by these models and the lack of consensus in the economics discipline (Haynes, Linder and Sewell, 2011). The insufficiencies of methodological monism and the benefits of using a variety of approaches are becoming increasingly recognized in the discipline (Courvisanos, Doughney and Millmow, 2016; Dow, 2004; Davis, 2014; Garnett Jr., 2006).

Source: Prepared by the author.

GFPs thus have the potential to deliver multiple socioeconomic dividends when properly designed, such as sound fiscal policy, reduced tax distortions, increased demand and investment levels (Edenhofer et al., 2017; Klenert et al., 2018; Milne and Andersen, 2012; Freire-González and Ho, 2018; Monasterolo, Roventini and Foxon, 2019; Scricciu, Barker and Ackerman, 2013). By increasing the burden of pollution emission, for example via a carbon tax, GFPs encourage the development and diffusion of GIs, which helps escape carbon lock-in (Unruh and Carrillo-Hermosilla, 2006; Unruh, 2002), improves energy security (by reducing reliance on price-volatile fossil fuels that are also subject to supply disruptions; IEA (2014)) and alleviates external constraints to economic growth by reducing the pressure on balance of payments, since fossil fuel imports tend to be reduced and GIs tend to increase the competitiveness of exports (Barde and Godard, 2012; Withana et al., 2013; Gramkow and Anger-Kraavi, 2019). Therefore, GFPs can be an armory of instruments to foster long-term economic development.

III. Green fiscal policies worldwide: from debate to policy

GFPs are one of the main next-generation policy tools for environmental protection, marked by the primacy of economic incentives over command-and-control regulations (Milne and Andersen, 2012). Until the late 1980s, environmental protection policy was dominated by direct regulation (or command-and-control) instruments, such as uniform environmental standards across large regions and mandatory implementation of specific pollution-abatement methods (Harrington and Morgenstern, 2004; Sairinen, 2012; OECD, 1999). It soon became clear that such inflexible instruments were costly and difficult to implement (OECD, 1999). In the USA, for example, command-and-control instruments implemented in the 1970s were perceived as requiring detailed, complex regulations often leading to litigious court cases (Harrington and Morgenstern, 2004). Similarly, Northern European countries such as Germany, the Netherlands and Nordic countries experienced extensive direct regulation covering air, water, waste and noise in the 1970s and, in the 1990s, the limitations of command-and-control policies triggered the design and implementation of second (or next) generation environmental policy (Sairinen, 2012). It should be noted that GFPs, however, are not necessarily grounded in deregulation. In fact, “[environmental] taxes require very precise and strong hard-law regulation and are often applied as complementary to other instruments. Thus, far from acting as deregulation, they have represented additional norms in society” (Sairinen, 2012).

A. The “waves” of ETRs

ETRs are Environmental Tax Reforms characterized by the introduction of a green tax and the reduction of other taxes or distortions in the economic system, usually in the form of taxes on labour or social security. The first ETRs were introduced in the 1990s by Nordic countries (Finland, Norway, Sweden and Denmark) and followed by other European countries (Sairinen, 2012; World Bank, 2017c). After a “first wave” of adoption of carbon taxes, the creation of the EU ETS (Emissions Trading System) has shifted attention from ETR to ETS (World Bank, 2017c). However, since the late 2000s, there has been a renewed interest in carbon taxes (and ETRs) with a number of developed countries (e.g. Australia and

Japan) and, for the first time ever, developing countries, such as Chile and India using this policy instrument to mitigate GHG emissions (*ibid.*). This “second wave” of ETRs has been attributed to increased global ambition to tackle climate change (*ibid.*), which may be linked to the emergence of the green growth agenda following the Great Recession of 2008-2009.

Box 2

Next-generation green fiscal instruments: ETR and ETS

There are advantages in using fiscal incentives such as ETRs compared to other next-generation instruments such as ETS in the context of climate policies (Parry and Pizer, 2007; World Bank, 2017c). For example, by taxing a specific value per unit of pollution, the price of each unit of pollutant emission is stable, while the permit price can be highly volatile—and often smaller—under an ETS. Price stability reduces an important uncertainty element, which is fundamental to encourage emissions-reducing investments (*ibid.*). Price stability is also an advantage when ETR is used as one instrument in the policy mix, because the carbon price holds even in the presence of additional mitigation incentives (World Bank, 2017c). In addition, ETR presents greater flexibility to abate larger amounts of emissions in moments of the economic cycle where abatement is cheaper, and hence, when more resources to invest in abatement are available, in contrast to ETS (Parry and Pizer, 2007). Furthermore, by raising revenue for governments, while most ETS have distributed free permits, ETR can help reduce economic distortions, by reducing distortive taxes, such as taxes on employment, for example (*ibid.*). Moreover, upstream carbon taxation presents reduced institutional requirements compared to ETS, which requires new institutions that allow permits to be smoothly traded, which may be costly (World Bank, 2017a). It has also been argued that price-based mechanisms such as ETR are less susceptible to corruption compared to quantity-based mechanisms such as ETS (Robb, Tyler and Cloete, 2010). Finally, there is a non-negligible chance that the permits market under ETS would be dominated by a few (large) firms, which could use permits strategically to monopolize their markets and thereby cause inefficiencies (*ibid.*).

Source: Prepared by the author.

Whereas up until 2008 only a handful of European countries had implemented carbon taxes, by 2017 a total of 24 countries and subnational jurisdictions have implemented or scheduled the implementation of such taxes (World Bank, 2017a). An ex post review of international experiences with ETR has been conducted by Withana et al. (2013). The study provides a detailed assessment of experiences with carbon and energy taxes in nine countries and one subnational jurisdiction (Australia, British Columbia in Canada, Denmark, Finland, Germany, Ireland, the Netherlands, Norway, Sweden and the UK). The report finds that ETR has been effective in reducing GHG emissions and fossil fuel consumption in all country cases. For instance, in Denmark, CO₂ emissions were reduced by 24% between 1990 and 2001 and emissions per unit of industrial product showed a 25% reduction from 1993 to 2000 (*ibid.*). The study concludes that, even though there are important variations across countries, ETRs have led to CO₂ savings of up to 1% per year, with similar (though slightly lower) levels of energy savings. The study highlights that despite its observed environmental effectiveness, ETR alone is unlikely to deliver the 2°C target mainly because of exemptions and reliefs granted due to competitiveness and social concerns. Therefore, it is important (and usually the case) to integrate ETR with other instruments in the policy mix.

With regards to economic impact, in terms of GDP and employment, Withana et al. (2013) reveals that ETR can generally lead to positive effects on GDP, even though there is limited ex post literature on this aspect. The report goes on to assert that the studies that indicate a negative effect of ETR on GDP do not generally take revenue recycling into consideration. British Columbia’s economy, for example, has outperformed other provinces in Canada during the period in which ETR was implemented, but it is debated to what extent the ETR was the leading cause of a positive impact on GDP (*ibid.*). In the UK, the Climate Change Levy has led to slightly higher GDP and employment (*ibid.*). In Germany, it was estimated that ETR has led to positive employment effects from 0.15 to 0.75% (*ibid.*). The economic impacts of ETR go beyond GDP and employment, which suggests the multiple dividends that it can provide. For example, in Finland the ETR has had contributed to encouraging green

innovation, helping escape carbon lock-in, improving the balance of payments position (by importing less fossil fuels) and enhancing energy security (*ibid.*).

The project "Competitiveness Effects of Environmental Tax Reforms" (COMETR), sponsored by the European Commission, estimated both ex post (from 1994 to 2002) and ex ante (from 2003 to 2012) effects of ETR in six countries in the EU (Denmark, Finland, Germany, the Netherlands, Sweden and the UK) by using the Energy-Environment-Economy model for Europe (E3ME) (Andersen et al., 2007). The advantage of such a study is comparability, since a common methodology is deployed in all country cases. The study shows that, compared to a reference scenario without ETR, an ex post reduction in fuel demand of up to 4% was observed in all cases with similar reductions in GHG emissions (though Finland exhibited higher reduction). ETR has had a positive ex post effect in the economy with an increase of up to 0.5% of GDP, except in Sweden, where GDP presented a decrease of less than 0.2%. All country cases presented a slight ex post increase in employment (up to 0.5%). This study thus provides evidence in favor of the double dividend hypothesis. The report highlights that, in the absence of revenue recycling mechanisms, the double dividend would not be likely to be observed.

Developing countries, including South Africa, Mexico, Chile and India, have started to implement carbon taxes since the 2010s (World Bank, 2017c). India, for example, implemented carbon taxes on coal (at USD 6/tCO₂e) in 2010, whose revenues have been used to finance the National Clean Energy Fund, which funds projects on clean energy initiatives, environmental remediation, and research on clean energy technologies (*ibid.*). Chile has begun taxing direct carbon emissions from large boilers and turbines from 2017 (at USD 5/tCO₂e) to finance education and health (*ibid.*). These examples show that GFPs are flexible policy instruments, which can be adapted to national priorities and specificities of each country. Because these policies are new, no study was found that assessed their ex post impacts so far.

The findings in the ex-ante literature also help shed light on the potential effectiveness of GFPs. Bosquet (2000) assesses modelling evidence from 139 ETR simulations coming from 56 different studies. It is noteworthy that the paper includes all kinds of modelling methods (partial equilibrium, general computable equilibrium, econometric, etc.) and all kinds of ETR simulations (different degrees of revenue recycling, different tax shifts, etc.), which makes it difficult to interpret the results. The study reports that 84% of the simulations indicate that ETR can be environmentally effective in the sense that it reduces carbon emissions. It also shows that 73% of the simulations return a positive effect of ETR on employment, i.e. net job creation. Patuelli, Nijkamp and Pels (2005) updates and extends the assessment conducted by Bosquet (2000), by analyzing 186 simulations from 61 studies, which only includes simulations assuming some kind of revenue recycling. The simulations seem to agree that ETRs reduce CO₂ emissions with an average reduction of 9.7% compared to a baseline scenario. The study also reports a positive impact on employment with an average increase of 0.44% compared to the baseline. Other economic indicators such as GDP and business investment respond differently to ETR in different simulations, but the magnitude of their impact is small (less than 0.95% upwards or downwards). The differences between outcomes of ex ante assessments are due to both the varying (internal) nature of the models, such as whether technological change is endogenous in the model, and different (externally) assumptions and scenario building exercise, such as the level of the carbon tax and the type of revenue recycling.

The ex post and ex ante evidence on ETRs seems to agree that fiscal policies are effective policy instruments in reducing GHG emissions. The literature also indicates that, in addition to improved environmental performance, enhanced economic performance can be achieved by recycling carbon tax revenues back into the economy, by reducing other distortive taxes, for example (Bosquet, 2000; Patuelli, Nijkamp and Pels, 2005). Thus, evidence seems to support the statement that GFPs can play a critical role in achieving GHG reductions and improving socioeconomic performance.

B. Global green stimulus packages

The conceptual discussions of the Post Great Recession 2008-2009 presented earlier landed in reality, i.e. in the policy agenda. Stimulus packages to contain the economic crisis worldwide explicitly included, for the first time ever, a green fiscal component comprising investments in renewable energy, energy efficiency, public transport, railways, water infrastructure, environmental protection, etc. (Barbier and Markandya, 2013; Robins, Clover and Singh, 2009). Governments (almost exclusively members of the G20) have allocated over USD 520 billion for green recovery, which represented 15.7% of total fiscal stimuli and 0.7% of GDP globally (Barbier and Markandya, 2013). The leading countries in terms of absolute volume were China (with USD 221.3 billion) and the USA (with USD 112.3 billion) and in terms of proportion South Korea represented the largest with 80.5% of fiscal stimulus packages dedicated to green investments (Robins, Clover and Singh, 2009). Table 2 presents global green stimulus packages.

Table 2
Global green stimulus announced from the end of 2008 to the beginning of 2009

Country	Total	Specific green measures included
Australia	USD 7.25 billion	Support to energy efficiency by providing free insulation to around 2.7 million Australian homes.
China	USD 221.3 billion	Investments in energy efficiency, environmental improvements, rail transport (as a lower carbon alternative to road and air transport) and new electricity and grid infrastructure.
Denmark	USD 1.83 billion	Investments in energy research. Binding incremental emission caps in Danish industry. Revenue to be used in a green tax reform that decreases taxes on labour and increases taxes on pollution.
France	USD 7.1 billion	Investments in railway infrastructure, renewable energy and energy efficiency. Incentives to scrap older vehicles and buy new, more environmentally friendly models.
Germany	USD 29 billion	Funds available for renovation work on buildings aimed at cutting CO ₂ emissions. Subsidized expansion of rail and waterways. A doubling of the amount that is tax-deductible for housing repairs and modernization. New cars to be tax free for one year and those with low emissions to be tax free for two years.
Italy	US 1.3 billion	Railway infrastructure investments. Tax deduction from building renovations. Implementation of a scheme for new (and more energy efficient) car replacement.
Japan	USD 12.4 billion	Tax cut relative to immediate depreciation of investment in energy-saving and new energy equipment.
South Korea	USD 36 billion	Support to develop railroads and mass transit, fuel efficient vehicles and clean fuels, energy conservation and environmentally friendly buildings, restoration of rivers and forests, management of water, recycling of waste and development of a green information system. Creation of a renewable energy fund to attract private investment in solar, wind and hydroelectric projects.
United Kingdom	USD 30 billion	Subsidized insulation and heating system improvements. Expansion of railway networks and 200 new carriages. Additional loans available for automotive industry to invest in low carbon vehicles. Investment in flood defenses. Support for renewable energy (mainly wind).
United States	USD 112.3 billion	Tax cuts and credits for clean energy and carbon capture and storage. Incentives for renewable energy investments. Support (tax credits and finance) for energy efficiency actions, including modern buildings, low carbon vehicles, modal shift to rail and modernizing the electricity grid.

Source: Prepared by the author based on Barbier (2009b, 2010) and Robins, Clover and Singh (2009).

Even though the commitment of members of the G20 to green growth marked a new stage of the environment becoming a significant issue on the international agenda, G20 countries failed to promote worldwide green recovery as proposed in the Global Green New Deal (Barbier and Markandya, 2013). The announced green stimuli were insufficient to meet the target of 1% of GDP set by the Global Green New Deal (Barbier, 2009a) and the Stern Report (Stern, 2007), or the UNEP (2011b) 2% of GDP target (Barbier, 2010). In addition, G20 economies failed to coordinate their green stimulus measures (especially in removing counteracting fossil fuel subsidies) and to increase assistance to developing countries (Barbier and Markandya, 2013). It remains unexplored what the impact of the green stimuli was at the global scale. No follow-up study was found that assessed if the green stimuli were actually spent by governments as announced, nor any systematic analysis of the environmental and economic impacts of green stimulus globally.

Overall, it seems that most countries were cautious in adhering to the green recovery in the Post Great Recession 2008-2009. Some countries —Brazil included— did not implement any green stimulus measures (Barbier and Markandya, 2013). While it is difficult to pin-point the reasons for such caution, possible causes include skepticism about the effectiveness of green fiscal spending in both improving the environment and in helping the economic recovery, lack of political will and concerns about fiscal impact on government budget deficits (*ibid.*). However, green spending was not uniform across countries. For example, in South Korea and in China green stimulus comprised 5% and 3% of the country's GDP, respectively, whereas in European countries, and in the USA, they comprised 0.2% and 0.9%, respectively (Barbier and Markandya, 2013). However, the debate on "green new deal" proposals are gaining traction in recent years, with USA and Europe actively leading the debate.

C. National strategies and roadmaps

Even though green economy, green growth and other proposals to reconcile socioeconomic development with environmental sustainability are relatively new concepts, several countries have released their national green growth strategies or roadmaps. Examples are Chile's National Green Growth Strategy (Chile, 2013); Ethiopia's Climate-Resilient Green Economy Strategy (Federal Democratic Republic of Ethiopia, 2011); South Korea's Road to Our Future (Presidential Committee on Green Growth, 2009a); Indonesia's Green Planning and Budgeting Strategy for Indonesia's Development (Republic of Indonesia, 2015); Rwanda's Green Growth and Climate Resilience National Strategy for Climate Change and Low Carbon Development (Republic of Rwanda, 2011); South Africa's Green Economy Accord (Republic of South Africa, 2011); France's National Sustainable Development Strategy 2010-2013: towards a green and fair economy, and the Energy Transition for Green Growth Act approved in 2015 as part of the National Strategy for Ecological Transition to Sustainable Development 2015-2020 (Republique Francaise, 2010, 2016); Cambodia's National Strategic Plan on Green Growth 2013-2030 (RGC, 2013) and Vietnam's Green Growth Strategy (Socialist Republic of Vietnam, 2012). These national strategies and roadmaps are symbolic of green growth as an emerging agenda in policy making.

South Korea and Cambodia are examples of countries presenting very different profiles and that put forward a national green growth strategy. Korea is a high-income country that experienced rapid transition from a developing country to one of the most thriving economies in the world (World Bank, 2017b). South Korea became the first and only country in the world to design and operationalize green growth as a long-term development strategy at the national level (i.e. the National Strategy for Green Growth 2009-2050), backed up by explicit laws, high-level institutions and comprehensive goals under short- and long-term timeframes (GGGI, 2011, 2015; Presidential Committee on Green Growth, 2009b; Zelenovskaya, 2012). The first Five-Year Action Plan of Korea's National Strategy for Green Growth was

implemented from 2009 to 2013, during which Korea spent USD 12 to 15 billion (approximately 2% of the country's GDP) yearly on green growth programs (Presidential Committee on Green Growth, 2009b, 2009a). Korea was successful in setting-up the institutional framework for green growth policies and in consolidating its international influence as a green growth leader (GGGI, 2015). However, no significant improvements in energy and carbon intensity have been observed, especially within manufacturing sectors in Korea following the first Five-Year Plan (*ibid.*). This finding illustrates how challenging it can be to escape carbon lock-in, given Korea's high dependence on fossil fuel intensive technologies. It can be argued, notwithstanding, that it is premature to seek to analyze transformational outcomes that underpin the structural shift implied by the Korean National Strategy for Green Growth.

Cambodia is essentially an agricultural economy and has historically been classified as a low-income country (World Bank, 2017b). The Kingdom of Cambodia presented its National Green Growth Roadmap in 2009 (RGC, 2009). Building on the policy recommendations of the National Green Growth Roadmap, in 2013 Cambodia's government presented the National Policy on Green Growth and the National Strategic Plan on Green Growth (2013-2030) (GGGI, 2016; RGC, 2014). Even though it is at an early stage, the Cambodian green growth framework is being received with optimism and early initiatives show evidence of success from several interventions (OECD, 2013). However, Cambodia has not yet been able to mainstream green growth as a development strategy, which would involve coordinating policies and bridging financial and capabilities gaps (GGGI, 2016). These issues illustrate how challenging it can be to prioritize relatively meagre resources that are available to developing countries for the green growth agenda.

Brazil, in terms of economic development, is positioned half-way between Korea and Cambodia. As a middle-income country (World Bank, 2017b), it can be argued that Brazil may present similar challenges in implementing a green growth strategy as both Korea and Cambodia. For example, Brazil is an industrialized country with a concentration of its industrial competences on less technologically intensive, and on more natural-resource intensive, sectors (Gramkow and Gordon, 2015; Nassif, Feijó and Araújo, 2015). As such, there can be some degree of carbon lock-in in these sectors, which can imply that, similar to the Korean case, Brazil may face challenges in transitioning to green technologies. On the other hand, Brazil is a developing country, which, similar to Cambodia, faces the challenge of addressing multiple development fronts with limited financial and technical resources.

The diversity of countries that have put forward a policy agenda that seeks to boost economic activity and job creation based on sustainable investments suggests that this is a plural and flexible framework, which can be adapted to the peculiarities of each national context, including both developed and developing countries. Examples can also be found in Latin America (see Box 3). Most national strategies and roadmaps are, however, at scoping or early implementation stage. The literature is scarce with regards to ex post assessment of these strategies. Future studies will be able to assess their impact so long as strategies are implemented, and their impacts are measured and tested.

Box 3**The Energy Big Push in Uruguay**

Uruguay is a relatively small country in terms of global economic expression, which traditionally did not present significant amounts in sustainable investments and, in addition, has no significant reserves of oil, natural gas or any other sources of fossil fuels (MIEM, 2017; OPP, 2019). Until recently, the country had an energy supply matrix composed mainly of fossil sources. According to the Uruguayan National Energy Balance (MIEM, 2017), in 2005, 55% of Uruguay's primary energy supply was supplied by oil and its derivatives, 3% by natural gas, 18% by biomass and 19% by hydroelectric sources. whereas the rest (5%) Uruguay imported from other countries in the region in the form of electricity. That year, Uruguay imported 64% of the total primary energy supply (*ibid.*). In addition, the share of unconventional renewable sources (solar and wind) in the primary energy supply was only 1% in 2013 (MIEM, 2017), very low standards for a country with large potential for renewable energy sources (*ibid.*).

The considerable external dependence on energy sources made Uruguay energetically vulnerable to variations in international supply from these sources and economically vulnerable to price fluctuations in their sources in the foreign market. There were concrete risks of electricity supply disruption, leading to last-minute and unplanned imports of fossil energy inputs, aggravated by long droughts that prevented full generation of hydroelectricity. Fossil fuels were a relevant component of the country's imports (having reached 30% of the imported goods agenda in 2008; World Bank, 2017). Given the relative inelasticity of energy consumption, the prices of these fuels could significantly impact Uruguayan external accounts. In 2008, Uruguay emitted 2.5 tons of carbon per capita (for comparison, Brazil emitted 2.1 tons per capita in the same year), the highest value reached by the country since 1960 (World Bank, 2017). This increase can be attributed to a growth in energy consumption (almost doubled from 2005 to 2017) led by non-renewable sources, related to an elevation in production in various sectors of the economy, accompanied by an increase in real wages, employment and a sharp reduction. poverty in Uruguay during this period (OPP, 2019).

In short, the country was in a situation of significant fragility in terms of both its energy security and sovereignty and its external economic vulnerability and did not contribute to efforts to mitigate global warming. It was in this context that Uruguay introduced the Energy Policy 2005-2030 (PE2005-2030). PE2005-2030 consists of strategic guidelines, targets to be achieved (short, medium and long term), lines of action and a situation analysis of the energy sector. To implement the PE2005-2030, a set of instruments was introduced through ministerial decrees and resolutions. In a short period of time, Uruguay has become considered a global leader in clean energy and a set of global trends in renewable energy investments (WWF, 2014). As a result, Uruguay was able to mobilize significant investments for the country, which made it the world leader in renewable energy investments in proportion to its Gross Domestic Product (GDP) in 2012 (REN21, 2014). These investments have structurally shifted their energy mix towards greater participation of renewable sources and reduced dependence on fossil fuels. An example of this transformation is the rapid expansion of wind energy. If in 2014 Uruguay had only 6.2% of wind generation, in just four years this number increased fourfold, reaching 33% in 2018 (MIEM, 2017).

Source: Prepared by the author based on Gramkow, C., Brandão, P. & Kreimerman, R. (2019), "O Big Push Energético no Uruguai", Studies and Perspectives - Brasília, No. 4, Brasília.

The findings reported in the present study are in line with a review on green growth led by the OECD. According to the report "What have we learned from attempts to introduce green-growth policies?" (OECD, 2013), despite some progress, green growth frameworks have remained limited in scope. Pricing instruments have been widely used in green growth strategies but have also been complemented by regulations or subsidies that can address market and information failures while being more politically acceptable. The report states that innovation is critical and therefore a mix of policies is required within a coherent framework that includes technology transfers. It points out challenges such as coordinating policies, developing indicators and instruments to monitor implementation progress and mobilizing additional financing. The report concludes that green growth policies are likely to have beneficial welfare effects in the long-term, but short-term transition costs may have hampered their implementation.

However, it can be stated that nations worldwide, from the developed to the developing world, are seeking to build more sustainable development styles in its economic, social and environmental tripod. Furthermore, they are seeking to do by promoting massive sustainable investments. This approach is aligned with ECLAC's Big Push for Sustainability.

IV. Green fiscal policies in Brazil

The context in which green growth and green economy concepts emerged was one in which the sustainability (both environmental and economic) of the fossil-fuel intensive development model was challenged following the Great Recession 2008-2009, and amid the growing scientific evidence for the detrimental effects of climate change on well-being and the economy. Brazil hosted the Rio+20, with the green economy as one of the two themes of the conference. In the lead-up to Rio+20, there has been debate about what a green economy would mean for Brazil (see for example Gramkow and Prado (2011)). However, the debate has not extended into action, since Brazil has not yet put forward a national strategy to recover growth and create jobs while strengthening environmental sustainability.

In 2015 Brazil's real GDP fell by 3.8% (Ipeadata, 2019), and over 2.5 million jobs were lost (World Bank, 2017a), and the exact reasons for that decline are still debated but are most likely due to fears of economic instability (see Carvalho (2018) for a review). Since then, Brazil's economy has plateaued with, in 2018, real GDP growth rate at 1.12% and unemployment rate at 11.6% (Ipeadata, 2019). Along with other developing economies, Brazil faces the challenge of recovering economic growth to address its sizeable socioeconomic issues in the current global context where reducing GHG emissions is critical to the achieve climate mitigation goals of the Paris Agreement (UNFCCC, 2015). As a developing country, Brazil presents socioeconomic development fronts, which represent an opportunity to adopt green technologies early on and to avoid lock-in of carbon intensive technologies. At the same time, by presenting relatively established industrial capabilities, Brazil also presents cumulated technological competencies and expertise in sustainable technologies. The country does not embark on this policy agenda from scratch, since, as is argued, Brazil has been starting to apply some GFP instruments.

A. Context and legal overview

GFPs were not seen as important instruments in the environmental protection policy mix in the country until less than a decade ago (Gramkow and Anger-Kraavi, 2018). Brazil's tax system is federative, which

implies that the federal government at the national level, each of the 26 states (plus the Federal District) and each of the municipalities under states' jurisdictions (over 5,000 in total) are allowed to introduce and amend taxes. In 2011, subnational taxes corresponded to 29% of the total tax revenue raised in Brazil, which is more than twice the average (of 12%) observed in OECD member countries (OECD, 2014). In addition, indirect taxes are the main source of tax revenue in Brazil. Taxes on goods and services accounted for 44.1% of all tax revenues raised in Brazil against an average of 32.9% within the OECD (ibid.). Direct taxation on income and profits accounted for 21.7% of total tax revenue in Brazil and 33.5% in the OECD (ibid.). Brazil has put mechanisms in place to avoid distortions caused by cascading (or cumulativeness) of indirect taxes, by, for example, introducing value added taxes. However, in practice this has created a debit and credit system in which the liability of the tax paid by an upstream company becomes a credit for the downstream business that can take several months and sometimes years to be refunded, which creates distortions that are transmitted throughout the supply chain and up to the final consumer (CNI, 2014; FIESP, 2010).

Consequently, Brazil's multilevel intricate tax system is considered the most complex in the world (World Bank and PwC, 2014). Although Brazil's total tax burden is similar to the OECD average (total tax revenue corresponded to 34.9% and 34.1% of GDP, for Brazil and the OECD, respectively, in 2011 (OECD, 2014), the time Brazilian businesses spend on ensuring they comply with taxation is ten times the world average (World Bank and PwC, 2014). Given the peculiarity of Brazil's fiscal system, a discussion of the feasibility of GFPs from a legal viewpoint is required to ensure realism of the analysis.

According to the Brazilian legal system (i.e. Brazil's Federal Constitution (Brazil, 2012a) and National Tax Code (Brazil, 2012b)), the core objective of taxes is their fiscal function, which refers to raising revenues for the funding of the State. Put differently, taxes are primarily designed to generate income gained by government – and not to influence individuals, firms, macroeconomic or any other behavior. Notwithstanding this, taxes can also present a secondary —named extra-fiscal— function when they exhibit an additional objective to that of raising revenues, such as influencing macroeconomic outcomes (Brandão, 2013; Fortes, 2010; Leles, 2011). In summary, Brazilian Law departs from the liberal viewpoint, in the sense that taxes serve primarily the purpose of raising revenues without influencing the economy, but also foresees an active role for the State in the economy, as it allows the use of fiscal instruments to pursue additional objectives (ibid.).

Brazil's Constitution and Tax Code do not allude explicitly to using taxes as a policy instrument to induce environmentally friendly behavior (Brandão, 2013; Leles, 2011). However, environmental protection is a pillar of the social order (Art. 225) and a principle of the economic order (Art. 170) of the Constitution, which allows the State to employ taxes to interfere in the economy by resorting to the extra-fiscal function of taxes, i.e. to the secondary objective of protecting the environment (ibid.). Other authors (Amaral, 2007; Blanchet and Oliveira, 2014; Brandão, 2013; Leles, 2011; Grau Neto, 2012; Maia, 2011; Motta, Oliveira and Margulis, 2000; Scaff and TUPIASSU, 2004; Schneider, 2013; Trennepohl, 2006) share a similar understanding with regard to the Brazilian Constitution and agree that fiscal policies can and should be used to support environmental protection. In addition, a similar conclusion was found in a report (GVces, 2013) that assessed the legal feasibility of GFPs in Brazil and concluded that "there is no need for a fiscal reform in order to use taxes for environmental protection" (GVces, 2013).

Based on the prevailing legislation (namely the Constitution and the Tax Code), Brazilian taxes can be grouped into five categories (Amaral, 2007; Leles, 2011; Lima, 2009) that are briefly summarized below:

- **Levies (*impostos*):** taxes that are obtained with the main purpose of generating revenue for the general budget of the State. Levies are not dependent upon a specific counterpart service from the State, i.e. the revenue generated by levies cannot be earmarked for specific expenditure.

- Fees (*taxas*): taxes that are collected for services provided by the State, such as water provision. Fees can only be charged as the State exercises its regulatory/police power (e.g. by performing compliance checks and granting permits) and/or provides a specific, divisible service for the benefit of the taxpayer. The amount that is charged to taxpayers must be equivalent to the cost of the public service.
- Contributions for interventions in the economic domain – CIED (*contribuições de intervenção no domínio econômico*) are taxes aimed at intervening in the economy, i.e. their extra-fiscal function is intrinsic. Their revenues must be destined for a specific, pre-determined purpose. For example, the CIED Combustível is a CIED levied on oil, oil derived fuels, natural gas, natural gas derived fuels and ethanol fuel, whose revenue is earmarked for the financing of subsidies for alcohol fuel, natural gas, natural gas derived fuels and oil derived fuels; environmental protection projects related to the oil and gas industry; and transport infrastructure development (Cunha & Bezerra, 2011).
- Improvement contributions (*contribuições de melhorias*): when the government executes public works (for example, road pavements), collective benefits are generated (e.g. everyone can use a paved road), but some individuals benefit more than others (such as owners of real estate near a newly paved road). The government is allowed to charge an improvement contribution (equivalent to the cost of the public work) on those who benefitted individually (through an increase in their real estate value) from public works.
- Compulsory loans (*empréstimos compulsórios*): in the face of extraordinary circumstances (such as calamity or war) or the need for public investments that are urgent and of national interest, the government is allowed to charge compulsory loans. These are a temporary source of revenue, as the resources must be returned to the taxpayers.

Every tax in Brazil must fit into one of these categories. Given the above legal definitions, there are opportunities for, and limitations to, each of these tax types to form part of a GFP in Brazil (Table 3).

Table 3 shows that there are numerous opportunities for GFPs in Brazil. There is potential for all tax types with no exception to contribute to greening the economy, even though they would be used in different ways and to varied extents. This applies both to existing taxes (for example, by adding environmental performance criteria to taxes that are in place, as is the case of the ICMS discussed in the next section) and to new taxes (for example, by creating a new carbon tax as proposed by Appy (2013)). This result supports the finding that there is legal grounding to use GFPs in Brazil (GVces, 2013).

However, the Brazilian Tax Code does not allow for the use of taxes as sanctions against illicit acts. In other words, taxes cannot be confounded with fines and penalties. Fortes (2010) contends that the Tax Code contradicts the Polluter Pays Principle, a principle present in the Constitution (Art. 225), as GFPs could be a sanction against polluters. On the other hand, Blanchet and Oliveira (2013) argue that the implementation of GFPs that are circumscribed to licit activities would be viable. Indeed, if a certain practice is illicit, such as discharging hazardous chemicals into the environment, it would not be necessary to tax this specific pollutant as its emissions are limited by specific regulation. Fortes (2010) goes on to assert that GFPs would involve a moral and ethical problem by legitimizing the right to pollute via the payment of taxes. This, however, would be a misinterpretation of GFPs that are designed to induce environmentally friendly behavior (Milne & Andersen, 2012). In addition, the environmental effectiveness of GFPs may be at risk if the revenue raised through green taxes were used to subsidize industries that damage the environment (Fortes, 2010). This point emphasizes that government spending and taxation should be coordinated, which is challenging given the high level of complexity of Brazil's fiscal system.

Table 3
Opportunities and limitations for greening existing fiscal instruments

Tax types	Opportunities	Limitations
Levies	Levies could be used to favor environmentally friendly behavior through fiscal incentives, by means of tax exemptions and deductions for less-polluting activities. They could also place a higher burden on polluting activities, for example by using pollution as a component of the tax base.	Revenues raised from levies must be allocated to government's general budget and there is no legal guarantee that they would be used for environmental protection. If the revenues from green levies were used to promote the fossil fuel industry, for example, this type of taxation could be ineffective. Levies tend to be less socially accepted because they are not directly assigned to specific counterpart public services.
Fees	Fees could be used to finance additional government action to protect the environment. For example, fees could be charged on potentially polluting businesses to finance an inspection system of pollution levels. Also, new fees could be created to finance, for example, provision of environmental recovery programmes.	Revenues raised from fees must be clearly linked to the exercise of regulatory/police power (e.g. pollution inspection system) and/or provision of a public service that is specific and divisible (e.g. sewage treatment). Resources raised from fees can only be used to cover the cost of the associated public service and cannot be channeled into other environmentally friendly activities.
CIED	CIED could incentivize environmentally friendly behavior, for example by relieving tax on sustainable businesses and/or placing a higher tax burden on polluting activities. Revenues raised could be earmarked for further environmental improvement, such as subsidizing the uptake of green technologies.	Earmarking must be directed to economic activities related to the sector from which the revenue originated and therefore might not be directed where they could bring most benefits. Only the federal government is allowed to introduce CIED and they might have other interests and less background knowledge than the local governments.
Improvement contributions	Public works that lead to environmental improvements, such as the creation and improvement of natural parks or environmental remediation, could be financed by improvement contributions without generating public deficit.	Such taxes could only be charged when the public work in question also leads to an increased value of nearby real estates. Revenues raised from improvement contributions could only be spent on compensation for the cost of the associated public work and not on other environmental expenditure that could be more urgent.
Compulsory loans	Extreme environmental events or ecological disasters, such as floods and hurricanes, could justify the creation of compulsory loans that finance measures to address their negative effects on people, infrastructure and the environment.	Whether compulsory loans would legally count as taxes is debatable, because they could also be considered as public finance and/or lending. The revenue raised could only be spent on activities related to the calamity and not on any other environmental activities. Revenues from compulsory loans must be short-term and returned to the taxpayer, which is an additional burden on the government finance. Only the Federal government can introduce compulsory loans. However, their procedures are more complex, and they might have other interests and less background knowledge than the local governments.

Source: Prepared by the author based on Amaral (2007), Appy (2013), Blanchet and Oliveira (2014), Brandão (2013), Fortes (2010), Grau Neto (2012), Leles (2011), Lima (2011), Maia (2011), Motta et al. (2000), Scaff and Tupiassu (2004), Schneider (2013) and Trennepohl (2006).

Numerous proposals exist in the legal literature detailing how the Brazilian fiscal system ought to be amended to promote a green economy. There seems to be a consensus regarding avoiding the introduction of further complexities into Brazil's tax system (Blanchet & Oliveira, 2014; Brandão, 2013; GVces, 2013). However, the recommendations for establishing GFPs are diverse. For example, some

proposals (Brandão, 2013; GVces, 2013) focus on fiscal incentives for sustainable activities that would either reduce the overall tax burden or be revenue-neutral (by taxing polluters), while others (Grau Neto, 2012) recommend that a higher tax burden should be imposed on polluters. Furthermore, in the context of GHG emissions, some studies suggest the incorporation of environmental performance criteria into existing taxes (Blanchet & Oliveira, 2014; GVces, 2013) and others recommend the creation of a new tax (Appy, 2013; Grau Neto, 2012). In terms of new taxes, such as a carbon tax, jurists seem to converge in recommending CIED as the ideal tax type because of their intrinsic extra-fiscal nature (that allows assigning them to environmentally damaging behaviors) and because the design of CIED foresees earmarking revenues to further support environmental protection (Amaral, 2007; Fortes, 2010; Grau Neto, 2012; Leles, 2011; Lima, 2009).

There is no unanimous agreement, from a legal viewpoint, on which fiscal instruments could best drive green behavior and technologies in Brazil. However, at least three remarks should be made on the legal literature. First, the growing number of legal studies on GFPs signals that the importance of fiscal policies in the environmental protection policy mix is increasing. Second, there is agreement that the existing legislation provides sufficient elements to legally ground the implementation of GFPs in the country. Third, economics can complement these studies in assessing the impacts of GFPs, which can help identify the most effective fiscal instruments in driving the uptake of sustainable technologies and practices.

B. Application of GFPs in Brazil

According to Sairinen (2012), GFPs implementation is characterized by three distinctive stages. The first is the ad hoc stage, in which a particular environmental tax, such as charges on air pollution, would be introduced as an individual experiment and without being part of a broader policy strategy. The second stage is one of expansion and relates to the introduction of multiple environmental taxations as well as tax incentives. It is also marked by assigning some portion of public revenue for environmental spending. The third and final stage is characterized by environmental fiscal reforms, which shift the tax burden toward pollution-intensive practices and technologies (such as increased fossil fuel taxation) in a revenue-neutral way, i.e. without increasing the overall tax burden.

In Brazil, a growing number of fiscal instruments has been used for environmental protection purposes led by a few subnational governments, which kick-started the implementation of GFPs ahead of the federal-level government (Gramkow and Anger-Kraavi, 2018). These instruments comprise mainly ICMS exemptions and deductions for reverse logistics technologies but also an innovative green fiscal transfer mechanism (see Box 4). The need to address environmental issues at a local scale, such as reducing waste, may explain the larger number of GFPs found at the subnational-level (compared to the federal-level). Additionally, approving tax amendments at the local level can be easier to achieve in comparison to passing complex, potentially contentious amendments at the National Congress (Scuff & Taciassu, 2004). This suggests that subnational measures can be a more viable path for GFPs in the short-term, while federal-level tax incentives can be implemented as part of a longer-term broad, coordinated GFP strategy.

Federal-level GFPs have not only been implemented later, but they were also short-term in nature, in spite of significant increase in environmental spending from 2003 to 2013 (Gramkow, 2018). The IPI is a national-level value added tax paid by manufacturers at the time of sale (Deloitte, 2010). The tax rates are defined in the IPI tax incidence table (Tabela de Incidencia do IPI – TIPI) by the federal-level executive power. Because the TIPI can be amended at any time by simple decree and no grace period is required, changes to IPI tax rates are frequent and from 2001 to 2008 the TIPI was amended 73 times

(Paes, 2015). This volatility in the IPI tax rates generates costs and uncertainties that contribute to the complexity of Brazil's tax system (Gramkow and Anger-Kraavi, 2018). There was no reference to environmental performance criteria as a determinant of the IPI tax rates on any of the 73 amendments. It is noteworthy that the federal government began to adopt GFPs in the late 2000s, by incorporating environmental performance criteria into IPI.

Box 4
Green uses of ICMS

In 2003, 11 states and the Federal District agreed to grant ICMS exemptions for businesses that deploy used PET bottles as input for adhesives in the plastics and packing industry. According to Denny et al. (2013), this incentive has increased the recycling of PET bottles that would otherwise contaminate the environment and has promoted job creation and social inclusion (as most of the used PET bottles are collected by cooperatives of waste pickers). Due to the tax exemption, the plastics and packing industry receives 10% to 20% cheaper used PET bottles that are repurposed as inputs in its production process, which ultimately also improves their cost competitiveness (*ibid.*).

Other states have individually introduced further ICMS incentives for GI, such as the state of Ceará, which, since 1997, allows businesses that manufacture products made from recycled materials (e.g. plastic, paper, rubber, metals etc.) to reduce the tax base by 58.82%, which is equivalent to a reduction from 17% to 7% in the tax rate (Cavalcante and Pacobahyba, 2014). By reducing the tax burden, and thereby the cost, of recycled inputs, this tax incentive favors GIs related to reverse logistics technologies in Ceará (*ibid.*).

In addition, Brazilian states have introduced the ecological ICMS (or ICMS-e), a pioneer green fiscal transfer mechanism (Cassola, 2010; May et al., 2012). Strictly, ICMS-e is not a GFP (as it is neither green taxation nor green spending) and it has been mainly used to increase protected areas (such as natural parks), and not to spur GI in productive sectors.

The ICMS is an example of how subnational governments are using fiscal instruments to induce GI. Most of the green ICMS incentives seem to be related to reverse logistics, particularly by reducing the tax burden on recycled materials used in manufacturing. In addition, in recent years nine states have introduced state-level climate change legislation that explicitly allows for the introduction of fiscal incentives for low carbon technologies uptake (GVces, 2013). For example, in 2007 the state of Amazonas introduced the first Brazilian state-level climate change legislation, which authorized ICMS exemptions and deductions for biodigesters, biofuels and energy from waste, among other low carbon technologies.

Source: Prepared by the author based on Gramkow, C. & Anger-Kraavi, A. (2018), "Could fiscal policies induce green innovation in developing countries? The case of Brazilian manufacturing sectors", Climate Policy, vol. 18, No. 2, Taylor & Francis.

In 2009 the Brazilian government announced a series of short-term IPI tax reliefs aimed at reconciling economic recovery and environmental sustainability in response to the Great Recession of 2008-2009. This is the first record found of federal-level fiscal instruments being deployed with the double-objective of recovering economic activity while encouraging sustainable best practices. IPI tax rates for white goods (washing machines, cookers, refrigerators and freezers) that met energy efficiency standards were reduced between 50% and 75% (depending on the goods and the energy efficiency standard achieved). However, this green tax incentive was highly volatile as it only lasted for three months (from November 2009 to January 2010), was reintroduced in December 2011 for another three months and then was successively renewed numerous times (see Table 4 for a summary). The impact of this measure has not yet been analyzed. However, the high frequency of the changes to the IPI rates leads to uncertainty that can hinder investments in energy efficient industries and thereby reduce the effectiveness of the measure. Similar IPI tax reliefs were applied to flexible fuel engine, hybrid and electric vehicles (Decrees 7.796/2012, 8.950/2016 and /2018). This example illustrates that the Federal government has begun to adopt GFP instruments, but the extent, and therefore the potential, of these in greening the economy is limited.

Table 4
Green IPI tax rates

	Decrees	In effect until	Cookers	Refrigerators and freezers	Washing machines
Reference rates	6.006/2006, 7.660/2011 and 8.950/2016	Indefinite	4%	15%	20%
IPI rates for products that achieve level "A" energy efficiency standard	6.996/2009	Indefinite	2%	5%	10%
	7.660/2011	31/03/12	0%	5%	10%
	7.705/2012	30/06/12	0%	5%	10%
	7.770/2012	31/08/12	0%	5%	10%
	7.796/2012	31/12/12	0%	5%	10%
		31/01/13	0%	5%	10%
	7.879/2012	30/06/13	2%	7.5%	10%
		Indefinite	-	10%	10%
	8.035/2013	30/09/13	3%	8.5%	10%
		Indefinite	4%	10%	10%
	8.950/2016	Indefinite	4%	10%	10%

Source: Prepared by the author.

Even though the use of taxes as GFPs is at an early stage, the available evidence indicates that their impact on GIs can be meaningful (see Gramkow and Anger-Kraavi, 2018). It follows that countries can kick-start the implementation of GFPs by introducing environmental performance criteria to existing taxes, including taxes at the subnational level that do not require complex, politically contentious legal proceedings. This can help governments experiment and build capacity to expand the use of GFPs and prepare for a long-term green fiscal reform.

The above analysis indicates that Brazil entered the second stage of GFPs in the 2000s, thus establishing the legal feasibility of GFPs in the country. It also indicates that Brazil needs to coordinate fiscal instruments across states and federative levels to achieve a broader green fiscal reform that is characteristic of third-stage GFPs. Finally, it shows that Brazil has remained at the margins of the "green stimulus" policy agenda. In effect, there are significant subsidies for fossil fuel production in Brazil, which amounted to R\$ 85 billion in 2018 (INESC, 2019). This amount represents 1% of Brazil's GDP and 24 times the allocated budget to the Environment Ministry in the country (*ibid.*). Progressively eliminating fossil fuel subsidies could be an opportunity to open fiscal space for green fiscal policies in Brazil.

Green fiscal policies can be effective in helping deliver a more sustainable development style due to the multiple dividends they can offer. These findings imply that Brazil should pursue its own context-specific policy mix as part of its green growth strategy. GFPs could be part of Brazil's mix, given their potential to deliver multiple benefits.

Box 5
Recommendations for GFPs in Brazil

There are many opportunities to green existing taxes in Brazil, based on econometric results obtained in a recent study (Gramkow and Anger-Kraavi, 2018). The ICMS could be a more effective GFP instrument if all subnational governments implemented ICMS incentives for green technologies and practices, for example, by reducing the ICMS tax burden on biofuels and other low carbon technologies. Subnational governments should seek coordinated green ICMS incentives across, and within, all federative levels to create a systemic, coherent structure of incentives that enhances policy effectiveness, while avoiding adding further complexities to Brazil's tax system. The II could become an important fiscal policy to foster GI, by reducing the tax burden on imports of components of green technologies that Brazilian companies do not yet have expertise in, such as batteries for electric vehicles, as part of Brazil's common tariff exceptions list under Mercosur. The IPI has incorporated environmental performance criteria in recent years. However, the federal government could improve the effectiveness IPI as a GFP, by implementing foreseeable, longer-term IPI incentives for green technologies. While subnational taxes seem to be a more viable path for GFPs in the short-term, federal-level fiscal measures should be implemented as part of a longer-term, third-stage GFPs.

Existing fiscal incentives that support innovation, such as tax exemptions and deductions for businesses that perform R&D, subsidized public finance for innovation projects led by businesses, for innovation projects in partnership with universities and research institutes and for capital goods, also play an important role in promoting GIs. These incentives are an efficient way of supporting GI because industries' uptake of GI outpaces government incentives for innovation due to more-than-proportional effects, including spillovers, positive feedbacks and increasing returns to scale.

Strengthening policy incentives for GIs is pivotal for sustainable development in Brazil and other developing countries, as, in addition to helping protect the environment, they promote economic competitiveness gains and support the accumulation of indigenous technological capabilities. Of major importance are increasing the supply of low cost (i.e. subsidized) public funding for early stage, high-risk innovations and introducing additional incentives for innovation projects, which include a component of improving the environmental performance, into existing innovation policy incentives, from development to demonstration and commercialization stages. For example, innovation projects that improve energy efficiency, reduce water intensity or diminish pollutant emissions should have priority in accessing subsidized finance. Similarly, there should be further subsidies translated into lower cost finance for capital goods that involve improving environmental performance, such as machinery that are energy efficient, consume less materials and/or generate less waste. In addition, the provision of public grants for GI should be increased, as it seems that demand exceeds supply. These types of incentives for innovation are known to Brazil and other countries. There is a structure in place (from legal apparatus to organizational and institutional capabilities) that can be used to target the incentives for green innovation.

It can be concluded that fiscal policies have an important role in promoting the transition to a green economy in Brazil and potentially in other developing countries.

Source: Prepared by the author based on Gramkow, C. & Anger-Kraavi, A. (2018), "Could fiscal policies induce green innovation in developing countries? The case of Brazilian manufacturing sectors", Climate Policy, vol. 18, No. 2, Taylor & Francis.

V. Final remarks and recommendations

Taxes can be a powerful means of inducing both individual and firm's behavioral change by imposing a burden on conduct that is considered harmful to society and/or by rewarding behavior that is perceived as socially desirable (Milne and Andersen, 2012). Taxing pollution emission or non-renewable resource use (e.g. fossil fuels), for example, creates a disincentive for using unsustainable inputs and technologies. In response, businesses may adopt green technologies, such as those that improve resource efficiency, employ renewable materials over non-renewable inputs, change product design such that less material is required, remove unnecessary packaging, reduce discharges and contamination, better employ by-products in the production process, etc. (OECD, 2010; Porter and van der Linde, 1995). Similarly, fiscal incentives such as tax reliefs to reward industries that meet certain environmental performance criteria (e.g. voluntarily meeting an energy efficiency target) can help engage businesses in sustainable practices and technologies.

Public spending in the form of policy incentives also plays an important role in spurring sustainable innovation, which is an uncertain, risky and costly activity. Public spending can be used to foster sustainable investments, for example, by provisioning low cost public finance in multiple forms—such as grants or soft loans for R&D, demonstration and commercialization projects, acquisition of green technologies (e.g. new green technology embodied in capital goods, materials etc.), among others (Mazzucato, Semieniuk and Watson, 2015).

Fiscal policies, within their double role of raising revenues (for instance, via taxation) and public spending, present an invaluable potential to foster sustainable development. Taxing economic "bads" (e.g. pollution) and introducing fiscal incentives (i.e. reducing the relative cost) of sustainable investments can (an economic "good") can be a powerful means to drive development into the right direction in its economic, social and environmental tripod.

The international experience is rich in examples of deployment of various instruments and combinations of green fiscal policies. Even though there is no “one size fits all” solution, what is clear is that each national context can implement a mix of instruments that is appropriate to their specificities. Indeed, a key lesson learned from the literature reviewed is there is no silver bullet. In other words, no single policy instrument alone (be it a carbon tax, an emissions trading system etc.) will have the necessary traction to put in motion the necessary uptake of investments to both boost economic recovery and lead us all onto a less GHG emissions-intensive development path. However, another conclusion that can be drawn from the present analysis is that the use of the revenues from carbon pricing instruments are determinant of the socioeconomic impacts of GFPs. Put differently, a double (or multiple) dividend can only be obtained if resources are recycled back to the economy, for instance, to reduce pre-existing distortionary taxes.

Perhaps one of the main conclusions that can be drawn from the analysis in the present study is that combination and coordination of fiscal instruments is vital, in line with ECLAC’s “Big Push for Sustainability” approach. If there is an armory of fiscal instruments (from tax reliefs and concessional finance alternatives for sustainable investments to discouraging and increasing the tax burden on pollution) that is coordinated, synergic and coherent towards sustainable development, the inevitable result is a thriving business environment in which sustainable investments prosper, thereby creating a virtuous cycle of economic growth, job creation and transition to a lower carbon production matrix.

Brazil not only has relevant cumulated technological and industrial capabilities upon which a Big Push for Sustainability could be built, but it also has been experimenting and accumulating policy expertise and capacities for the employment of green fiscal policies at both federal and subnational levels. Taking advantage of the cyclical downturn in the world economy, including in Brazil, green fiscal policies could be used with both countercyclical and environmental protection roles in a context in which there is still time to act to avoid the most severe impacts of climate change. The present moment marks a unique window of opportunity to engender a process of progressive structural change towards a sustainable development style.

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