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Fiscal Policy Towards Green Growth in Emerging Economies: The case of Brazil

Camila Gramkow (University of East Anglia)

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GREEN GROWTH
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FISCAL POLICY TOWARDS GREEN GROWTH IN EMERGING ECONOMIES: THE CASE OF BRAZIL

Camila Gramkow[1]

ABSTRACT

This paper discusses the role of fiscal policy as a potential catalyst for green growth in emerging economies, using Brazil as a case study. The purpose is to provide policy relevant research findings on fiscal instruments that could be implemented readily in the short term (i.e. which don't require new legislation to be approved by the Congress) and in the longer term (i.e. with new legislation being approved) as part of a green growth strategy in Brazil. In particular, it analyses effective ways in which the existing fiscal system (on both the revenue – taxes – and spending – government expenditure – sides) could be readily adapted to advance the transition to a green economy, based on opportunities within the prevailing legislation, lessons learned from the implementation of green taxation and econometric evidence of the impact of fiscal instruments on green growth; while linking short term opportunities with longer term fiscal instruments that promote green growth. A key finding is that green fiscal policy is not unattainable; in fact, there are instruments that can be readily implemented to promote green growth – some of which are already in use and have had a reported impact on environmental protection, green innovation and competitiveness. These results indicate that fiscal policy has a critical role in promoting green growth in Brazil.

[1] PhD researcher at the Tyndall Centre for Climate Change Research, University of East Anglia (UK).

INTRODUCTION

The paper builds on the growing body of literature on green growth as a development alternative in emerging economies, using Brazil as a case study. According to the World Bank (2014), in less than 10 years Brazil has doubled its share of the global GDP; from 1.5% in 2003 to 3.3% in 2011. However, Brazil`s greenhouse gas (henceforth GHG) emissions from fossil fuel burning have grown substantially whereby its share of global emissions has increased twofold; from 0.52% in 1961 to 1.25% in 2010 (*idem*). Along with other emerging economies, Brazil is confronted with the longstanding challenge of advancing economic and social progress in the current global scenario where reducing environmental risks and ecological scarcities is critical for the sustainability of development. According to a prominent Latin-American economist, with regard to sustainable development "*we are not in the face of new problems, but of old problems that have become more severe*" (Prebisch, 1980).

Green growth becomes appealing in this context not only as a source of economic development, but also as a driver for environmental protection. For the Organization for Economic Co-operation and Development green growth means "*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.9). As an emerging field, green growth presents knowledge gaps that are fundamental for its advancement in both the academic and political agendas. One such gap relates to the use of fiscal policy instruments for greening the economy in emerging economies. Even though some countries are starting to design green fiscal reforms (including China, India and South Africa), green fiscal policy (henceforth GFP) in these countries is at very incipient stage as compared to modern economies (such as Finland, Sweden, Germany and the United Kingdom)[2]. The present work contributes to this literature by presenting an assessment of the practical potential for the implementation of a fiscal policy that promotes green growth in Brazil.

The objective of this paper is to analyse the role of fiscal policy as a potential catalyst for green growth in Brazil. In particular, it aims to assess effective ways in which the existing fiscal system (on both the revenue – taxes – and spending – government expenditure – sides) could be readily adapted to advance the transition to a green economy, based on opportunities within the prevailing legislation, lessons learned from successful cases of implementation of green taxation and econometric evidence of the impact of fiscal instruments on green growth.

This paper is structured as follows. The first section presents Brazil`s fiscal system and analyses the potential of fiscal instruments for greening the economy from a legal viewpoint, by presenting the state of understanding of this topic in the legal literature. The second section presents and discusses case studies of taxes that have been implemented in Brazil with environmental protection purposes. Even though these case studies are isolated initiatives (as opposed to being part of a wider green fiscal reform), they provide useful lessons for GFP. The third section is an original contribution as it seeks to econometrically test the impact of the existing fiscal policy in Brazil on green growth, by testing how the rate of uptake of green innovation responds to fiscal policy. Final remarks on the key findings conclude.

1. FISCAL POLICY TOWARDS GREEN GROWTH IN BRAZIL

1.1 KEY FEATURES OF THE BRAZILIAN FISCAL SYSTEM

This subsection briefly outlines the key features of the Brazilian fiscal system using data from OECD member countries as a basis for comparison. According to the OECD (2014), Brazilian tax revenue amounted to 34.9% of the country`s Gross Domestic Product (GDP) in 2011, which is similar to the level found in OECD member

[2] Withana et al. (2013).

countries, where the average was 34% in the same year. The similarities between the fiscal systems basically end there.

The Brazilian tax structure is significantly different when compared to the OECD member countries. In Brazil, subnational taxes play an important role in raising revenue, corresponding to 29% of the total tax revenue, compared to 12% in OECD in 2011 (OECD, 2014). Moreover, indirect taxes are the main source of tax revenue in Brazil. Consumption taxes generated 44% of such revenues in Brazil in 2011, compared to 32% within the OECD. Direct taxation on income, profits and capital gains accounted for 22% of total tax revenue in Brazil and 33% in the OECD in that same year (*idem*). A higher role for indirect taxes in generating revenue creates more distortion throughout the production chains in the economy compared to direct taxation. Even though Brazil has put mechanisms in place to avoid the cascading (or cumulativeness) of taxes in place, 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; creating distortions that are transmitted throughout the supply chain and up to the final consumer.

Finally, it is noteworthy that Brazil`s tax system is considered the most complex in the world, according to World Bank & PwC (2014). This complexity is estimated by the amount of hours that businesses spend ensuring that they comply with taxation[3], which in Brazil is ten times higher than the world average. The report, which assesses tax systems in 189 economies, attributes the complexity of the Brazilian tax system to (a) the legal possibility of all federative levels (the Federal government, 26 states, the Federal District and over 5,000 municipalities) imposing taxation, leading to a multilevel, intricate tax system, (b) the recurrent amendments to the tax rules at all federative levels, and (c) detailed mandatory record-keeping and reporting to tax authorities.

1.2 The potential for a Brazilian green fiscal policy: legal perspectives

This subsection explores the potential of Brazil`s fiscal instruments to green the economy from a legal viewpoint, by reviewing the associated literature. It discusses in particular if (and which) taxes are entitled the attribution of inducing environmentally-friendly behaviour of taxpayers and also debates under which conditions the revenue raised by taxes could be deployed to support the transition to a green economy.

In legal terms the fiscal character of taxes is that of generating and collecting revenue that allows for the functioning of the State and enables it to seek the achievement of its constitutional goals. When a tax assumes a character other than raising resources, this is referred to as the extra-fiscal character of taxation, according to the Brazilian Law tradition (Brandão, 2013; Leles, 2011)[4]. Taxes can be a powerful means of inducing behaviour change by imposing a burden on conducts that are considered harmful to society and/or by promoting behaviour perceived as socially beneficial.

The Federal Constitution (Leles, 2011) and Brazilian Tax Code (Brandão, 2013) do not allude explicitly to green taxation. However, they enable the State to make use of the extra-fiscal character of taxes to induce desired outcomes. Leles (2011) infers from the Federal Constitution that taxation can perform an excellent role in achieving Brazil`s constitutional goals, including that of environmental protection. The author mentions (a) principles (such as the Polluter Pays Principle), (b) the qualification of environmental protection as a principle of the economic order, and (c) the attribution of environmental protection as a pillar of the social order; contained in the Constitution to sustain that green taxation is viable under the existing Brazilian legislation.

[3] This indicator reflects the number of hours it takes a medium-size company to prepare, file and pay three major types of taxes: profit taxes, consumption taxes, and labour taxes and mandatory contributions.

[4] The Brazilian legislation also allows for a category named parafiscality, which refers to raising revenue through taxes to bodies (other than the State) that perform activities of public interest. This category is not explored here as it is not subject of the present assessment.

Blanchet & Oliveira (2014), Brandão (2013), Fortes, (2010), Grau Neto (2012), Lima (2009), Maia (2011), Motta, Oliveira & Margulis (2000), Scaff & Tupiassu (2004), Schneider (2013) and Trennepohl (2006) share a similar understanding with regard to the Constitution in the sense that fiscal policy can and should be deployed to support environmental protection.

In 2011, the Centre for Sustainability Studies of Fundacao Getulio Vargas (GVces) launched a report prepared for the Brazilian Finance Ministry, which contained an assessment of the legal feasibility of a GFP in the country. The report highlights that a green tax reform must be circumscribed to the principles and other norms within the existing legislation (particularly the Federal Constitution and the Tax Code) and concludes that "*there is no need for a fiscal reform in order to use taxes for environmental protection*" (GVces, 2013).

In 2009, the National Climate Change Policy (NCCP) was approved, establishing the national voluntary commitment of reducing greenhouse gas emissions from 36.1% to 38.9% of the projected emissions to 2020. This new legislation introduced explicitly fiscal policy as an instrument to meet the goals of the NCCP, by supporting the use of "*fiscal and tax measures to stimulate the reduction of emissions and removal of greenhouse gases, including differentiated rates, exemptions, compensation and incentives*" (according to its 6th Article[5]).

There are two main qualifications with regard to the implementation of a GFP from a legal viewpoint. Firstly, the Brazilian Tax Code does not allow the use of taxes to sanction against illicit acts. In other words, taxes cannot be confounded with fines and penalties. Fortes (2010) contends that the Polluter Pays Principle (a principle in the Federal Constitution) would be in contradiction with this aspect of the Tax Code, as it would act as a sanction against polluters. However, as Blanchet and Oliveira (2013) argue, the implementation of a GFP in Brazil would be circumscribed to licit and tolerable activities. Fortes (2010) goes on to sustain that a GFP would involve a moral and ethical problem by legitimating the right to pollute via the payment of taxes. This, however, would be a misinterpretation of GFP, whose purpose is to induce environmentally friendly behaviour. Secondly, the effectiveness of a GFP may be at risk if the revenue raised through green taxes were used to subsidize industries that damage the environment, which may neutralize or even reverse the environmental benefits of a GFP (*idem*). This point emphasizes that GFP instruments should be coordinated and that some types of taxes (as discussed later) may be better suited to the purposes of environmental protection.

Overall, there seems to be a consensus in the Brazilian Law literature with regard to the legal feasibility of the existing legislation inducing environmentally friendly behaviour via fiscal policy instruments, such as green taxes. This finding implies that (i) the existing legislation is compatible with the use of taxes for environmental protection purposes, i.e. there is no need for a tax reform to introduce environmental criteria into the Brazilian tax system; and (ii) the Federal Constitution provides sufficient elements that would ground the implementation of a profound green fiscal reform in the country.

Brazilian taxes can be grouped into five types (Leles, 2011; Lima, 2009), which are briefly summarized below:

i. Levies (*imposto*): taxes that are obtained with the purpose of generating revenue for the general budget of the State. Levies are not dependent upon a specific counterpart service from the State and the revenue generated by them cannot be earmarked for specific expenditure.
ii. Fees (*taxas*): taxes that are collected as counterpart for a service provided by the State, such as water provision for example. Fees can only be charged after the State has provided a specific, divisible service for the benefit of the taxpayer.
iii. Contributions (*contribuições*): taxes whose revenues are destined for a specific, pre-determined purpose. An example of this tax is social security: resources raised from social security contributions must be spent only on social security.

[5] Lei 12.187/2009.

iv. Improvement contributions (*contribuições de melhorias*): taxes that may be collected from the implementation of public works that appreciate the monetary value of nearby real estates. This tax is aimed at compensating the State`s costs of carrying out such works.

v. Compulsory loans (*empréstimo compulsório*): taxes that are related to extraordinary circumstances (such as calamity or war) or to public investments that are urgent and of national interest. These taxes are a temporary source of revenue, as the resources must be returned to the taxpayers.

Table 1 explores how each of the existing tax types in Brazil could be used as part of a GFP.

Table 1. Opportunities and limitations for greening existing fiscal instruments.

Taxes types	Opportunities	Limitations
Levies	Levies could be adjusted to favour environmentally friendly behaviour through fiscal incentives, by means of tax exemptions and deductions for non-polluting activities. They could also be adjusted to place a higher burden on polluting activities, for example by using pollution as a component of the tax base.	Revenues raised from levies cannot be specifically destined or earmarked for environmental protection. If the revenues were used to promote the fossil fuel industry, for example, this type of taxation would be ineffective.
Fees	Resources raised from fees could finance additional governmental action to protect the environment through the provision of public services. New fees could be created to finance, for example, environmental recovery programs.	Even though revenues raised from fees could help finance public action, they would need to be clearly linked to the provision of a public service that is specific and divisible, such as sewage treatment. Resources raised from fees can only be used to cover the cost of the associated public service.
Contributions	Contributions (in the economic domain) could promote fiscal incentives for environmentally friendly behaviour, for example by relieving tax on sustainable businesses. Revenues raised through contributions could be allocated to environmental improvement.	Revenues from contributions could be earmarked to finance public activities related to environmental improvement; however, such activities must be directed to the industrial sector from which the revenue originated.
Improvement contributions	Public works that lead to environmental improvements, such as the creation and expansion of natural parks, could be financed by improvement contributions.	Such taxes could only be applied when the public work in question also led to an appreciation (in monetary terms) of nearby real estates. Revenues raised from improvement contributions could only be used to compensate the cost of the associated public work.
Compulsory loans	Extreme environmental events or ecological disasters could configure calamity and thereby justify the creation of compulsory loans that would finance measures to neutralize or alleviate their perverse effects.	It is debatable whether environmental disasters would configure as calamity. The resources would be short term and would have to be returned to the taxpayer.

Source: Prepared by the author.

A review of the Law literature reveals that there are numerous opportunities for a GFP in Brazil. There are a number of proposals detailing how exactly and to what extent the Brazilian fiscal system should be amended in order to perform its role as a policy instrument for environmental protection.

Brandão (2013), for example, sustains that a GFP should focus on fiscal incentives for sustainable activities, because this would not only support environmental protection, but also help to alleviate the overall tax burden in Brazil, which would have potential benefits including reduced prices for goods and services.

GVces (2013) recommends that a GFP in Brazil be based on the use of multiple tax types and seek revenue neutrality whereby each unit of revenue obtained from taxing polluting activities should be returned to the economy by incentivising environmentally sustainable activities. The report further recommends that if it is not possible to use multiple tax types in a revenue-neutral way then tax incentives for clean activities should be prioritized over imposing a higher tax burden on polluters.

Grau Neto (2012), on the other hand, emphasizes that green taxation should impose a burden on polluting activities as a means of internalizing externalities and recommends the creation of a tax (more specifically, a contribution to the economic domain - hereinafter CIDE) on all sources of energy generation based on the carbon content of each source whose revenue would further promote climate action by supporting protected areas via REDD+ projects.

Blanchet & Oliveira (2014) advocate the incorporation of environmental criteria (such as GHG emissions, energy efficiency etc.) into energy taxation, particularly by means of the subnational tax (ICMS), a key source of revenue through taxes and also the main tax burden on energy in Brazil.

In a study commissioned by IPAM[6], Appy (2013) presents a proposal for tax measures towards a low carbon economy in Brazil. The study recommends the creation of a new tax (more specifically, a CIDE) that would cover all fossil fuels and inefficient cattle raising, a major source of GHG emissions in the country. The revenue raised from this tax would be allocated to subsidize forestry and pasture recovery. It also sustains that certain existing taxes should be amended via the concession of tax exemptions for sustainably managed native timber and for barbed wire, which is a critical input for sustainable land and forestry management and pasture recovery.

This diversity of recommendations and proposals is symbolic of the emerging consensus about the need for a GFP in Brazil. At least two clear recommendations can be extracted from the Law literature review on GFP in Brazil: (1) the existing instruments under Brazil`s fiscal system are qualified to support environmental protection; and (2) when the creation of a new tax is proposed, the literature converges in indicating CIDE as the best approach because of its extra-fiscal nature (which allows environmentally friendly behaviour to be induced) and because its revenue can be allocated to further support the goal of environmental protection (Fortes, 2010; Grau Neto, 2012; Leles, 2011; Lima, 2009). However, as the Brazilian tax system is one of the most complex in the world and the tax burden is relatively high, more debate is needed as to whether a long term GFP strategy in Brazil requires new taxes to be created, or whether the existing taxes should be amended to incorporate sustainability criteria, or both. It is suggested that in the short term the existing taxes should incorporate environmental criteria that support green growth, while simultaneously a wider discussion should take place among government, academia, business and general civil society about the need for new taxes and/or for a profound tax reform to plan strategically for a long term GFP. This discussion should be technically informed by estimates of the potential impact of a GFP on key parameters, such as GHG emissions, employment and competitiveness.

2. Implementation of green taxes in Brazil: lessons learned

Some taxes have incorporated sustainability criteria, which corroborates the legal feasibility of a GFP in Brazil. Even though the existing initiatives have been *ad hoc* and isolated (as opposed to being part of a broader

[6] Amazon Environmental Research Institute.

green fiscal reform), the experiences of greening fiscal policy provide useful lessons, which are discussed in this section.

2.1 SUBNATIONAL TAXATION: ICMS-E

The tax on the circulation of merchandise (or ICMS to use its Portuguese acronym) is a subnational (state-level) levy. As defined in the Federal Constitution, 25% of the revenue obtained through ICMS must be allocated to municipalities. The Constitution determines that at least ¾ (of the 25%) must be allocated to municipalities based on the fiscal added value of each municipality, so that most of the revenue returns to the municipalities that contributed the most to generating the revenue (Scaff & Tupiassu, 2004). The legislation provides flexibility to states with regard to the criteria for allocating the remaining 6.25% (or ¼ of the 25%) of the revenue to municipalities. The flexibility to allocate this remaining revenue empowers states to induce behaviour and thereby to influence the economic domain. However, until recently, few states had used this instrument with the purpose of inducing behaviour (*idem*).

The ecological ICMS (hereinafter ICMS-e) provides for the adoption of environmental protection criteria to allocate the flexible portion (6.25%) of ICMS revenue to municipalities. ICMS-e presents a possibility for municipalities to raise additional resources via the protection of the environment. It is not, therefore, a new taxation, but a re-allocation of the revenue raised by an existing taxation according to environmental criteria, thereby creating an incentive for municipalities to protect the environment. The resources thus allocated to municipalities are not, however, earmarked for further environmental action as it can be used by the municipality for other purposes.

The state of Parana was a pioneer in developing the ICMS-e, after acknowledging that the criteria of fiscal added value tends to benefit urban, developed municipalities to the detriment of rural municipalities, particularly those with large extensions of protected areas, in which economic activity and therefore also the capacity to raise ICMS, is restricted. The ICMS-e was proposed not only as an instrument for environmental protection, but mainly as a criterion for a more equitable distribution of revenue amongst municipalities (Loureiro, 2002; Schneider, 2013). The Parana ICMS-e was approved in 1991 and included protected areas and watersheds as criteria for the allocation of ICMS resources. As a consequence, the state of Parana saw an increase, in terms of extension, in the order of 3389.92% in municipal protected areas and 826.44% in state protected areas in 2012 compared to 1991 (Schneider, 2013). Furthermore, protected area management and governance were enhanced and improvements in terms of biodiversity conservation were observed (Loureiro, 2002).

The success of the Parana ICMS-e became an incentive for other states to adopt a similar fiscal policy. Today, 16[7] out of 26 states have adopted some form of ICMS-e (Schneider, 2013). There is a richness of environmental criteria in each state; including combatting forest fires, waste management and basic sanitation, but the presence of protected areas in the municipality is usually one of the criteria. There is a growing body of evidence on the effectiveness of ICMS-e in enhancing environmental protection, mainly via the increase in extension and qualitative improvement of protected areas. Its effectiveness was reported in Parana (Loureiro, 2002), Minas Gerais (Fernandes, Coelho, Fernandes, & Lima, 2011), in the 5 Amazonian states that have adopted ICMS-e (Araujo, Silva, & Rodrigues, 2013) and in virtually every state that has adopted ICMS-e where data are available (Ribeiro, 2008; Schneider, 2013). The effectiveness of ICMS-e in inducing economic behaviour has motivated the expansion of the criteria for revenue allocation beyond environmental protection in some states, such as Minas Gerais, Acre and Ceara, which also include health and education criteria.

[7] Acre, Amapá, Ceará, Goiás, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Paraíba, Paraná, Pernambuco, Piauí, Rio de Janeiro, Rio Grande do Sul, Rondônia, São Paulo and Tocantins.

According to Scaff & Tupiassu (2004), the implementation of ICMS-e does not require complex amendments to the legislation and, more specifically, it does not require legal changes by the National Congress. It usually only requires state-level legislation, which is simpler to achieve.

ICMS-e is an example of how the existing fiscal system could be readily adapted to incorporate sustainability criteria and promote significant environmental benefits in Brazil. The case of the allocation of a small amount of revenue obtained through existing taxes according to environmental protection criteria has proven effective in the case of Brazil and can be reproduced in other countries.

The ICMS-e is not the only example of the successful implementation of GFP instruments at the subnational-level in Brazil. In a number of states a fiscal incentive[8] is available in the form of (ICMS) tax exemption 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, promoted job creation and social inclusion (as most of the used PET bottles are collected by cooperatives of waste pickers) and improved the competitiveness of the industry by reducing the cost of used PET bottles as input in the production process. Other examples of subnational green taxation include exemption of the state-level tax on automotive vehicles (IPVA) on less polluting vehicles, such as electrical vehicles (Maia, 2011; Domingues et al, 2013) and exemptions from the municipal-level tax on urban real estates (IPTU) for estates that maintain green areas (Lima, 2009).

These case studies of subnational implementation of GFP reveal that a significant number of initiatives are in place at the subnational-level (both in states and municipalities). Even though such initiatives have been uncoordinated and *ad hoc*, the available evidence indicates that their impact has been substantial, particularly in the case of the ICMS-e. The evidence of the effectiveness of these instruments suggests that fiscal policy can play an important role in green growth. It is suggested that further GFP instruments be implemented at the subnational-level, including the implementation of ICMS-e by other states and the use of fiscal incentives in the form of tax exemptions that promote less polluting activities. It is further suggested that subnational governments seek for a coordinated effort among federative entities at all levels not only in terms of GFP, but also with regard to other environmental protection policy instruments in order to maximize the impact on both environmental protection and economic growth opportunities.

2.2 Federal-level taxation: IR-e

The income tax (or IR to use its Portuguese acronym) is a federal-level levy. In 1966, before environmental protection reached global prominence, Brazil deployed environmental criteria as part of its IR, whereby individuals and legal entities could deduct up to 50% of their expenditure on afforestation and reforestation projects from IR[9]. This incentive was misused as native forest deforestation and subsequent substitution for homogeneous exotic forests was indirectly promoted by the incentive, and it was therefore discontinued (Lima, 2009).

In 2005, new legislation[10] was proposed in the National Congress to create the ecological IR (henceforth IR-e), which would provide IR deductions for individuals and legal entities in proportion (of up to 80% and 40%, respectively) to donations and sponsorships made to non-profit entities to support projects related to the sustainable use of natural resources and environmental protection. The IR-e is very similar in nature to other existing IR deductions in areas such as culture (known as Rouanet Law), sports and higher education (Maia, 2011). The IR-e is strongly advocated by environmental organizations, as it symbolises empowerment to non-profit organizations working towards the protection of the environment (Lima, 2009).

[8] Convenio ICMS 08/2003.
[9] Lei 5.106/1966.
[10] Projeto de Lei 5.974/2005.

Since the first version of the law proposal, amendments have been made and the proposed legislation has been adjoined to other similar legislations, which means that the legal proceeding has restarted multiple times (Brandão, 2013; Maia, 2011). The year 2015 marks 10 years of debate under the Federal Congress and there is no clear scenario for the approval of the IR-e.

The case of the IR-e is symbolic of how challenging it can be to approve new legislation in the Brazilian Congress. The challenges that may explain the difficulty in making progress with the IR-e are basically three. First, because the IR-e represents tax deductions, there is concern that it may lead to fiscal unbalance of government revenue and expenditure. This has been a concern mainly for subnational administrations, which depend on resources raised by IR[11]. According to Maia (2011), there is no potential fiscal unbalance from a legal viewpoint, because the deductions in the proposal conform with the Fiscal Responsibility Law[12] and therefore this should not become a legal impediment for IR-e. Second, there seems to be a dispute for the management and supervision of the donations and sponsorships, as the original text was amended so that these would be channelled through the National Environment Fund (FNMA) and other accredited public funds. These would allocate the resources to non-profit organizations, which would implement the projects. Third, IR-e involves the risk of diversion of resources, i.e. instead of supporting environmental protection the donations could serve other purposes. Maia (2011) argues that control mechanisms could be established, similar to those of the Rouanet Law, which would mitigate such risks. Following this line, the original text has been modified to impede support to non-profit organizations that are linked to the donor and to criminalize the misuse of the resources.

The IR-e is one of many proposals in the Brazilian National Congress that would contribute to a green fiscal reform (see Lima, 2009 for additional examples). The case of the IR-e illustrates some of the challenges of approving new legislation in the Congress. According to Blanchet & Oliveira (2013, p. 182) "*the greatest challenges to reforming the tax system in Brazil in order to incorporate environmental protection purposes (…) are not matters of legal and formal order but a matter of political will*". Although challenging, it is recommended that the efforts to approve the IR-e continue, as this could be an important instrument for green growth in the long term. In terms of direct taxation, the IR-e would not cause distortions in the production chain while supporting environmental protection. Therefore, its approval and implementation would be paramount in the context of a green growth strategy.

It is noteworthy that there have been cases of federal-level implementation of green taxation, mostly by incorporating environmental criteria into existing taxes. However, there have been difficulties in implementing these measures to their full extent as illustrated by three examples. The first example is CIDE Combustivel[13], a contribution in the economic domain due on oil and oil derived products, whose revenue is earmarked to finance, among others things, environmental protection projects and transportation infrastructure. In practice, however, the revenue from this tax has never reached its legally defined destination, as it has been used for contingency and primary surplus purposes (Juras & Araujo, 2008). Furthermore, the tax rate has been reduced to zero in recent years[14] as an attempt to control for inflation. A second example is the rural property tax (ITR)[15], a levy due on rural properties that provides exemptions for estates that contain preserved natural areas. This fiscal incentive, however, has proved ineffective, mainly because the tax rate of ITR is too small and therefore exemptions do not tend to modify behaviour (*idem*). The third and final example is the tax on manufactured products (IPI), which has adopted energy efficiency as a criterion for lower IPI rates in recent years[16]. The impact of these measures has not yet been analysed. However, the high frequency of the changes

[11] About 50% of the IR revenue is allocated to states and municipalities via their respective Participation Funds.
[12] Lei Complementar 101/2000.
[13] Lei 10.336/2001.
[14] Decreto 7.764/2012.
[15] Lei 9.393/1996.
[16] Decretos 7.660/2011, 7.705/2012, 7.770/2012, 7.796/2012.

to the rates leads to uncertainty as to whether such incentives will continue or not, which may hinder investments in energy efficient industries.

These examples illustrate that the Federal government has begun to adopt GFP instruments, but to a very limited extent and therefore with a limited potential to impact environmental protection. It is suggested that the Federal government expands the scale and scope of its initiatives, particularly by restoring CIDE Combustivel (and allocating its revenue according to its original mandate) and by developing a coordinated, explicit and foreseeable green industrial policy via IPI. These measures would help advance a green economy transition in the short term and would be strengthened by longer-term federal-level instruments such as the IR-e.

3. IMPACT OF FISCAL INSTRUMENTS ON GREEN GROWTH: ECONOMETRIC EVIDENCE

This section assesses the impacts of the existing fiscal policy on green growth, by econometrically testing the impact of selected fiscal instruments on the uptake of environmentally friendly technologies by businesses, i.e. green innovation. At the bottom line, if green growth is to address environmental issues, it requires a transition to sustainable ways of production through the adoption of greener technologies. Fiscal policy has a critical role in supporting businesses to invest in and adopt green technologies. This is an original contribution as no other studies relating fiscal policy to green innovation in Brazil were identified.

The analysis in this section becomes relevant, because there is growing evidence that the uptake of green technologies presents a positive effect on competitiveness in the country, which suggests that green growth can be a development alternative in Brazil. Studies show that some Brazilian firms are already investing in green technologies as part of their competitive strategies, particularly those with an international presence and large firms (Lustosa, 2002), which has led to improved competitive performance in terms of reduced costs and/or quality enhancement (Podcameni, 2007; Queiroz, 2011), increased added value (Lucchesi, 2013) and improved operational performance, which includes elements such as cost, quality and flexibility (Jabbour, Teixeira, Jabbour, & Freitas, 2012). In view of the evidence that green innovation enhances competitiveness, the relevance of assessing the impact of fiscal policy on green innovation as an instrument for green growth is highlighted.

3.1 HYPOTHESES AND MODEL DEVELOPMENT

In order to econometrically test the impact of the existing fiscal policy in Brazil on green innovation, two hypotheses were developed and modelled.

Firstly, it was expected that the fiscal system in general would not present a strong, consistent impact on the uptake of green technologies, because (as discussed in the previous sections) GFP is at a very incipient stage in Brazil. This first hypothesis was modelled so as to test the responsiveness of green innovation (or the uptake of environmentally friendly technologies by businesses) to fiscal policy in aggregate terms, including both aggregate taxes and aggregate government support for innovation, whereby both components of fiscal policy are considered: public sector revenue (through taxes) and public sector expenditure (through innovation support in the form of tax exemptions and subsidized public finance). The model also includes control variables for size, which were identified as relevant in the green innovation literature and are approximated by added value and number of employees. This first, general hypothesis was modelled as follows:

Model A:

$GI_i = \beta_0 + \beta_1 TT_i + \beta_2 GS_i + \beta_3 AV_i + \beta_4 OC_i + \varepsilon_i$, where:

i = industrial sector i

GI = green innovation (percentage of firms that implemented advanced environmental management techniques)

TT = total indirect tax burden net of subsidies (total tax burden net of subsidies as a proportion of added value in percentage terms)

GS = government support for innovation (percentage of firms that received government support in the form of tax exemptions and/or subsidized public finance for innovation)

AV = natural log of added value (expressed in Brazilian currency; Real)

OC = natural log of employment (number of employees)

ε = error term

Secondly, a detailed, disaggregated analysis of the impact of fiscal policy on green innovation should reveal to some extent the impact related to instruments that are already being used to promote environmental protection, particularly the ICMS. The second hypothesis was modelled similarly to the first hypothesis; the difference being that taxes and government support were tested in a disaggregated fashion in order to capture the particular effect of each fiscal instrument. It includes the same control variables for size and was modelled as follows:

Model B:

$GI_i = \beta_0 + \beta_1 II_i + \beta_2 IPI_i + \beta_3 ICMS_i + \beta_4 GFRD_i + \beta_5 GFIL_i + \beta_6 GFP_i + \beta_7 GFKG_i + \beta_8 AV_i + \beta_9 OC_i + \varepsilon_i$, where:

II = federal-level levy on imported products (expressed as a percentage of added value)

IPI = federal-level levy on manufactured products (expressed as a percentage of added value)

ICMS = state-level levy on purchase or circulation of merchandise (expressed as a percentage of added value)

GFRD = IR, IPI and other tax exemptions and deductions for businesses carrying out Research and Development (R&D) (percentage of firms that received this fiscal incentive)

GFIL = IPI exemptions for businesses carrying out R&D specifically in the hardware and automation industries (percentage of firms that received this fiscal incentive)

GFPU = public finance for businesses carrying out R&D projects in cooperation with universities and research institutes (percentage of firms that received this support)

GFKG = public finance for businesses carrying out R&D and acquisition of equipment and machinery (capital goods) (percentage of firms that received this support)

All other parameters are the same as above.

To conduct estimations for the models above, a multiple regression analysis was performed on a cross-sectional database at industry-level (24 industries in the manufacturing sector) relative to 2005 (latest available data). Several multicollinearity tests (variance inflation factor (VIF), tolerance, eigenvalue and condition index) were carried out in order to ensure the quality of the estimates. No meaningful

multicollinearity was identified within the independent variables. The presence of heteroskedasticity was detected in model A, as confirmed by the Breusch-Pagan test. The econometric method applied considered the specificities of the data structure and particularly the problem of heteroskedasticity; in model A the method of robust ordinary least squares was deployed, and the ordinary least squares method was deployed in Model B.

3.2 DATA

The data sources were the National Innovation Survey (hereinafter PINTEC) and the Input Output Matrix (IOM) relative to 2005 (latest available data), both provided by the Brazilian Institute of Geography and Statistics (or to use the Portuguese acronym IBGE). As the IOM and PINTEC are available under different classifications, a correspondence was established in order to make them comparable by using IBGE official correspondence tables.

PINTEC presents data on innovation in Brazil based on survey methodology in accordance with international standards, according to the Oslo Manual (OECD guidelines for innovation data collection and interpretation) and the Community Innovation Survey. The following variables were obtained from PINTEC: GI, AV, OC, GS, GFRD, GFIL, GFPU and GFKG.

The IOM presents the Leontief matrix of the Brazilian economy and is also based on internationally agreed standards, particularly the latest version of the United Nations Manual on System of National Accounts. The taxation variables were obtained from the IOM, namely: TT, II, IPI and ICMS. The IOM only presents indirect taxation data.

3.3 RESULTS AND DISCUSSION

The results for the two models are shown in table 2.

Model A tested the aggregate impact of selected fiscal policy instruments. The results show that, as a whole, taxes do not impact green innovation, as expected. Not only is the coefficient very close to zero, it is also insignificant from a statistical viewpoint. This result corroborates the hypothesis and the analysis of the previous sections, which found the GFP to be at a very incipient stage.

The results for Model A also indicate that aggregate government support for innovation in general (not only for green innovations) has a positive, statistically significant (at the 1% significance level) impact on green innovation. This result suggests that fiscal instruments that traditionally support innovation in general also have an important role in supporting green innovation. This implies that green innovation does not require entirely new government support measures, as the existing measures seem to be effective.

Therefore, the results from Model A indicate that government support for innovation has already been supportive of green growth to some extent. If a GFP is to be thoroughly implemented in Brazil, a stronger positive impact may be expected as government support is targeted at green innovation and taxes incorporate sustainability criteria, which implies that a GFP can perform a critical role for green growth in the country.

Table 2. Results.

Dependent variable: GI	Model A	Model B
Independent variables	Coefficient	Coefficient
Constant	-0.3603	0.0176
TT	0.0097	
GS	0.4276***	
II		0.0529
IPI		-0.0664**
ICMS		0.0918***
GFRD		0.6381***
GFIL		-0.2054
GFPU		-0.3204
GFKG		0.5421***
AV	0.0418***	0.0278***
OC	-0.0239*	-0.0366***
R^2	0.7640	0.9422
P > F	0.0001	0.0000

***Significant at 1%, **Significant at 5%, *Significant at 10%.

Model B tested the disaggregate impact of selected fiscal policy instruments. The disaggregated model allows the impact of each instrument to be assessed separately and reveals interesting findings. Subnational tax on the circulation of merchandise (ICMS) exhibited a positive, statistically significant (at the 1% significance level) impact on green innovation, which means that a higher ICMS tax burden (as a percentage of added value) is associated with a higher uptake of green technologies. This positive impact of ICMS may not be associated with the tax itself, but the use of its revenue, as seen for the aforementioned ICMS-e. Therefore, this result corroborates the hypothesis and is in line with the analysis of the previous sections.

Tax on manufactured products (IPI) exhibited a negative, statistically significant (at the 5% significance level) impact on green innovation, which implies that a smaller IPI tax burden (as a percentage of added value) leads to more green innovation. A smaller IPI tax burden may signify that businesses have more resources to invest in green technologies. It may also reduce the cost of green technologies for firms that wish to buy them in the market (instead of developing themselves). Indeed, the innovation strategy that most firms adopt in Brazil is based on the acquisition of equipment and machinery (or capital goods in general). According to PINTEC, more than 80% of firms reported that the acquisition of equipment and machinery was their dominating innovation strategy.

This result is corroborated by the positive, statistically significant (at the 1% significance level) impact of public finance for R&D and the purchase of capital goods (GFKG). This suggests that fiscal measures that reduce the cost of green technologies (via taxes, such as IPI; and via subsidized public finance) are paramount in promoting green innovation.

Tax exemptions and deductions for businesses carrying out R&D (GFRD) exhibited a positive, statistically significant (at the 1% significance level) impact on green innovation. This result corroborates the results of Model A in the sense that the traditional innovation incentives that are in place also seem to perform an

important role in supporting green innovation. The results from Model B indicate that GFKG and GFRD are the most important of these traditional incentives in promoting green innovation, as these variables presented the largest coefficients in the model.

Imports tax (II), fiscal incentives for informatics (GFIL) and public finance for R&D projects in cooperation with universities and research institutes (GFPU) exhibited no statistically significant impact on green innovation. The literature does not report the use of II for environmental purposes, which indicates that no impact would be expected from this tax on green innovation. GFIL would not be expected to present a direct impact on green innovation, because it is a fiscal incentive particularly targeted at hardware and automation development, which are not green innovations themselves – even though they may contribute as components of green technologies in other sectors. It is not clear why GFPU is not promoting green innovation. It is possible that GFPU simply does not incorporate green innovation criteria, but it is also possible that it is not an appropriate instrument for green innovation.

The control variables exhibited the same results in both models. Added value presented a positive, statistically significant (at the 1% significance level) coefficient, suggesting that larger businesses tend to innovate more in green technologies, in accordance with green innovation literature (Lustosa, 2002). Number of employees exhibited a negative, statistically significant (at different significance levels) coefficient, which suggests otherwise, but, in fact, the number of employees reflects the degree of labour intensity of the industry and labour-intensive firms tend to innovate less compared to capital-intensive firms, which might explain the negative coefficient (Podcameni, 2007).

Overall, the results presented in this section corroborate the hypotheses. They indicate that aggregate tax policy does not impact green innovation, while specific taxes that deploy environmental criteria (e.g. ICMS) seem to promote green innovation, in accordance with the analysis of the previous sections. The results also suggest that the existing incentive measures for innovation play an important role in promoting green innovation, particularly fiscal incentives for R&D and public finance for capital goods. As GFP is at an incipient stage in Brazil, it can be conjectured that the impact of fiscal instruments on green innovation would be maximized if a GFP were to be implemented. Overall, these findings indicate that fiscal policy has an important role as an instrument for green growth in Brazil.

CONCLUDING REMARKS

This paper discussed the role of fiscal policy as a potential catalyst for green growth in emerging economies, using Brazil as a case study. The paper assessed the potentials of and limitations to, deploying GFP instruments within the prevailing legislation (on both the revenue – taxes – and spending – government expenditure – sides) and found that there are a number of opportunities for green fiscal instruments that can advance the transition to a green economy. Furthermore, the paper assessed case studies on the implementation of green taxes, which present lessons learned for GFP. A key finding is that several cases of the successful deployment of green taxes can be found at the subnational-level, while initiatives at the federal-level seem to encounter challenges. This finding indicates that subnational taxes could be a more viable path for GFP in the short term, while federal-level fiscal measures should be sought as part of a longer-term GFP strategy. Finally, the paper provided econometric evidence that corroborates the findings of the previous sections and indicated that fiscal instruments have a critical role in the transition to green technologies.

The findings of this paper indicate that GFP is not unattainable; in fact, there are instruments that can be readily implemented to promote green growth – some of which are already in use. They also highlight the growing body evidence that indicates the effectiveness of fiscal instruments in promoting environmental protection, green innovation and competitiveness. Overall, these results suggest that fiscal policy has a critical

role in promoting green growth in Brazil. Although focused on Brazil, this paper presents lessons that could be valuable for other emerging economies facing similar challenges.

A future research agenda could explore these results in further detail, compare them with other emerging economies and assess the potential impacts of a shift towards green fiscal policy in Brazil.

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