

Analysis

Ecological Fiscal Transfers for Biodiversity Conservation Policy: A Transaction Costs Analysis of Minas Gerais, Brazil

Felipe Luiz Lima de Paulo^{a,*}, Pedro Jorge Sobral Camões^b^a Universidade Federal Rural de Pernambuco, Brazil^b University of Minho, Portugal

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ABSTRACT

This paper addresses the influence of ecological fiscal transfers (EFT) on the policy-making process of adopting local protected areas (PA) by municipal governments. Framed on the transaction-cost politics (TCP), it argues that an EFT schema designed at the state level may affect the expected payoff/costs of local level decisions and the time length to create PA. The mixed research design is composed of two parts: first, a descriptive analysis detailing the evolution of EFT in the state of Minas Gerais since the beginning until its current version; second, an event history analysis of municipal PA adoption from 1966 to 2013. The conclusion suggests that, while there is an overall increase in municipal PA after the introduction of EFT, some design aspects of the instrument such as uncertainty and monitoring costs slowed and flattened that increase.

1. Introduction

The primary aim of protected areas (PA) is biodiversity conservation, halting and reducing biodiversity loss. Ecological fiscal transfers (EFT) became an essential instrument to enhance municipal PA in Brazil (Ring and Barton, 2015; Droste et al., 2017c). Empirical evidence supports their importance to improve biodiversity conservation policies at local level. Fernandes et al. (2011) summarize the advantages of adopting this instrument in the state of Minas Gerais with respect to compensation of local governments, while Droste et al. (2017c) give an overview of Brazilian states regarding the effectiveness of EFT in encouraging municipalities to create new PAs. Conversely, Silva Júnior et al. (2012) argued for the non-effectiveness of the EFT scheme to promote PA and solid waste management in the state of Pernambuco, while attributing the increase of PA to local development and the level of environmental consciousness, measured as the number of city councilors with the party ideology more inclined to ecological issues.

Sauquet et al. (2014) studied the interactions among local governments and its consequences for setting up new PA. The research points out that in the state of Paraná “the utility gained from the creation of a PA decreased (or increased) if a neighbor created more (or less) protected areas” (Sauquet et al., 2014, p. 257). Grieg-Gran (2001, p. 7) finds a similar pattern in Minas Gerais state, noting that “changes in value added or the formation of new counties, can also affect the indices and obscure the effect of the ICMS ecológico”. However, there is a gap in the literature to

explain how the interaction of political actors at the state and municipal level impedes the specification, monitoring, or enforcement of an EFT scheme to encourage the creation of new local PA. This paper begins to fill this critical lacuna in theoretical and empirical analyses of EFT for biodiversity conservation policies, partly as a response to the call made by Moura (2015), who did not emphasize the conflicts among political actors in her institutional and legal analysis of EFT in Brazil. For practitioners, this paper provides relevant empirical evidence to improve the effectiveness of the incentive component of the policy instrument, that is, to choose an adequate governance structure and to reduce the transaction costs (Epstein and O'Halloran, 1999).

In spite of the amount of empirical evidence presented in literature, we join Sauquet et al. (2014, p. 250) to assert that the “ecological fiscal transfers are interesting in that they constitute a relatively new, innovative and poorly studied conservation instrument.” Most of the literature on EFT is based on the analysis of the policy outcome, but rarely on the policy process and its implication to the desired result of the policy instrument. This research is essential for other countries which intend to design and implement EFT to reach the goal 15 of the 2030 Agenda for Sustainable Development, mainly concerned to protect, restore and promote sustainable use of terrestrial ecosystems. EFT have been mentioned as an essential environmental fiscal reform measure to protect the biodiversity around the world (OECD, 2013).

This paper seeks to understand the influence of EFT in the policy-making process of adopting PA by municipal governments. Framed on

* Corresponding author.

E-mail addresses: felipe.paulo@ufrpe.br (F.L. Lima de Paulo), pedroc@eeg.uminho.pt (P.J.S. Camões).

the theory of transaction-cost politics (TCP) (Epstein and O'Halloran, 1999; Horn, 1995), it argues that an EFT schema designed at the state level may affect the expected payoff/costs of local level decisions and the time length to create PA. The research design is mixed and composed of two parts: first, a descriptive analysis detailing the evolution of the EFT design in the state of Minas Gerais, from the beginning until its current version; second, an event history analysis of municipal PA adoption from 1966 to 2013.

The paper unfolds in seven sections. The next section presents a literature review on EFT, including recent studies in Brazil and Europe. Section 3 describes the institutional framework of EFT and Protected Area in Brazil. Section 4 offers the theory of transaction costs, including a subsection on the EFT induced changes in agreements at the local level. Section 5 describes the empirical strategy. Section 6 offers and discusses the results concerning EFT design in the state of Minas Gerais. Section 7 concludes and offers some avenues for future research.

2. Literature Review

EFT redistributes revenues from upper to lower levels of government using ecological indicators (Ring and Barton, 2015). Typically, intergovernmental transfers use inhabitant or area-related indicators, being the use of ecological indicators the main novelty in EFT schemes. EFT can be adopted both in centrally organized countries, in which fiscal transfers are distributed from central to local levels and in federally organized countries, in which fiscal transfers are distributed by the states (Ring, 2008; Santos et al., 2012; Borie et al., 2014).

There are at least three different rationales for EFT adoption. First, most countries adopt the “principle of subsidiarity” to environmental policies, in which municipalities bear the costs of biodiversity conservation. In this case, the role of EFT is to compensate sub-national government expenditures (supply costs) on ecological public goods and services. Second, according to the “principle of equivalence” (Olson, 1969), some decentralized levels of government provide ecological public services that end up generating external benefits beyond their boundaries (spill-over effect). Thus, EFT may be used as payment for external benefits (Ring and Schröter-Schlaack, 2011). Third, an EFT scheme may be implemented to compensate the opportunity costs due to revenue loss generated by land use restrictions (Sauquet et al., 2014) imposed by national to sub-national governments, as well as to compensate tax revenue losses from private landowners. In practical terms, these rationales are “highly dependent on the country's legal and institutional framework - not least the financial constitution” (Ring and Barton, 2015, p. 439).

According to Schröter-Schlaack et al. (2014), each specific EFT scheme in place differs in the type of transfers applied, which can be either lump-sum (unconditional fiscal transfers) or earmarked (conditional fiscal transfers). Other features of EFT can be highlighted: the costs or benefits that are imposed; the type of indicators (quantitative or qualitative); the scale, that is, “the number of decentralized governments that can benefit from EFT” (Schröter-Schlaack et al., 2014, p. 108); the origin or type of financial funds allocated, and the overall amount of financial resources distributed.

So far, four countries have adopted an EFT scheme: Brazil (Ring, 2008), Portugal (Santos et al., 2012), India (Busch and Mukherjee, 2018) and, on a small scale, France (Borie et al., 2014; Schröter-Schlaack et al., 2014). Only Brazil and Portugal have implemented EFT to compensate municipalities for the costs of land-use restrictions related to PA (Santos et al., 2012). In India, EFT were created for forest cover (Busch and Mukherjee, 2018). In France, the EFT scheme is a lump-sum allocation to municipalities with part of their territory situated in national parks or natural marine parks (Borie et al., 2014; Schröter-Schlaack et al., 2014). Borie et al. (2014) presented a studied to expand the EFT scheme in France for other PA.

The pioneer in adopting an EFT scheme was Brazil at the beginning of the 1990s. Empirical evidence presents the effectiveness of EFT at the

local level. Droste et al. (2017c, p. 1) investigate “whether the introduction of this economic instrument in a state offers incentives to municipal responses in terms of further protected area (PA) designation”. The findings suggest that “there are clear indications for local responses to the implementation of EFT: after an ICMS-E introduction additional municipal PA are designated” (Droste et al., 2017c, p. 13). Loureiro (2002) offers an analysis of how the EFT contributed to biodiversity conservation policies in Paraná. The author concludes that ICMS Ecológico contributed to an increase in the number of PA and the quality of such enterprises. In addition, the adoption of EFT affected positively the quality of the management in the environmental agency in six municipalities. In Minas Gerais and Rondônia, Grieg-Gran (2001, p. 31) highlights that the “ICMS ecológico has the potential to create incentives for conservation but the effect appears to be highly variable”.

Conversely, Silva Júnior et al. (2012) conclude that the EFT are inefficient to improve PA at the local level in the state of Pernambuco. Moreover, Sauquet et al. (2014) describe and explain the sources and consequences of the incentive component of EFT in creating PA and promoting strategic interaction among local governments. The study concludes that the creation of local PA in the state of Paraná “reveals strategic substitutability in municipalities' conservation decisions”; that is, “the creation of [PA] by a municipality decreases the incentive of neighboring municipalities to create [PA]” (Sauquet et al., 2014, p. 249, 252).

In Europe, Portugal was the first country to adopt an EFT scheme with the approval of a revised Local Finances Law in January 2007 (Santos et al., 2012; Droste et al., 2017a). EFT are non-earmarked and the criteria adopted are the total area under protection and the percentage of local land designated as protected area. More recently, Droste et al. (2017b, p. 1) studied “whether introducing EFT in Portugal incentivized municipalities to designate PA and has led to a decentralization of conservation decisions”. The authors conclude that the EFT in Portugal contribute to “a significant increase in the ratio of municipal and national PA designations following Portugal's EFT introduction” (Droste et al., 2017b, p. 1). In France, the EFT scheme is based on the “ecological solidarity” idea, that is, “the municipalities are compensated for the opportunity costs of conservation imposed by the land-use restrictions associated with strictly protected areas” (Schröter-Schlaack et al., 2014, p. 104). In India, Busch and Mukherjee (2018, p. 2) “discuss the origin of India's EFTs and their potential effects”. The authors concluded that the EFT had not increased forest cover due to the short years of EFT operation.

In other countries, the issue of EFT entered the political arena in Poland (Schröter-Schlaack et al., 2014), while in Germany (Ring, 2002; Droste et al., 2017d), Switzerland (Köllner et al., 2002), and Indonesia (Mumbunan et al., 2012; Irawan et al., 2014) their effects were theoretically simulated. Using Indonesia as a case study, Irawan et al. (2014, p. 47) simulated “different approaches to the design of intergovernmental fiscal transfers (IFTs), a possible means to channel a REDD+ international payment to local governments which, in several countries, have a certain degree of authority over forest management”. The EFT mechanism in Poland was drafted by the Council of the Rural Boroughs Association, aiming to introduce compensation payments due to land-use restrictions related to Natura 2000 sites or PA. These transfers were prepared to be implemented as lump-sum transfers and based on algorithms proposed by the Ministry of Finance (Schröter-Schlaack et al., 2014). In Germany, proposals based on theoretical simulations to consider ecological indicators in the fiscal transfers have been presented for almost two decades, but the primary task nowadays is to put them for discussion in the policy arena (Ring, 2002; Schröter-Schlaack et al., 2014). Droste et al. (2017d) showed that “on average, sparsely populated states in Germany provide more PA per capita and would thus be eligible for increased fiscal transfers”. In Switzerland, the EFT were theoretically modeled through the integration of cantonal biodiversity benchmarking in the intergovernmental fiscal relations (Köllner et al., 2002). In European countries, Droste and Kettunen (2018, p.373) developed “a proposal for an EFT design within the supranational context of the EU and assess its potential effects with evidence-based estimates”. In sum, EFT

proposals across these countries focus on biodiversity conservation policies only, aiming to enhance PA.

3. Institutional Framework: EFT and Protected Area

3.1. Categories of Protected Area in Brazil and Their Transaction Costs

Several political and administrative procedures have to be followed to create a PA (Law number 9985/2000, 2000). In general, the Mayor enacts a municipal decree but it can also be adopted through a law from the municipal legislative assembly. A proposal to create a PA requires public hearings and technical studies, such as Environmental Impact Assessment (EIA) and Environmental Impact Report (RIMA). The public debate has to be understood by any person regardless of the school level. There are only two exceptions in which the municipal government can skip this stage: 1) to create the category of PA related to the ecological station; and 2) to create the biological reserve protected area. Legislation considers these categories as extremely important for biodiversity conservation in such a way that they have to be protected as soon as possible.

Although most of the categories of PAs are not mandatory for local governments, except the permanent preservation areas created by the Brazilian Forestry Code, most of the local governments have to deal with the lack of expertise and funding for developing and maintaining PAs. Nevertheless, in order to create new PA, some municipalities still apply efforts to financially compensate landowners after encouraging them to stop exploiting their lands economically.

Brazil follows a mix of policy instruments to achieve the goals related to biodiversity conservation (Flanagan et al., 2011; Ring and Schröter-Schlaack, 2011). According to Pádua (2011), the first governmental action to systematize a national plan for PA occurred in the beginning of the 1970s. At that time, only twenty-six PA areas existed in the whole Brazilian territory. The EIA and the RIMA were created under the National Environment Policy in 1981. In 1988, the Brazilian constitution assigned an essential role to protect the environment to the municipalities. Later on, the National System of Protected Areas (SNUC) shaped many aspects concerning PA at the local level.

According to Law number 9985/2000 (2000), there are two groups of PA (in Brazil also known as 'conservation units'): 1) integral protection; and 2) sustainable use. Integral protection PAs are more restrictive and allow only the indirect use of the natural resources, such as hiking, climbing, and bathing in waterfalls. This group comprises five categories: a) ecological station (ESEC); b) biological reserve (REBIO); c) municipal park (PM); d) natural monuments (MONA); and e) wildlife refuge (REVIS). PAs of sustainable use allow the direct use of natural resources, whether or not for economic exploitation. It comprises seven categories: a) environmental protection area (APA); b) area of relevant ecologic interest (ARIE); c) municipal forest (FLOMA); d) extractive reserve (RESEX); e) fauna reserve (REFAU); f) sustainable development reserve (SDR); and g) natural heritage private reserve (RPPN).

Concerning the integral group, the ESEC has two primary objectives: 1) to protect the environment, and 2) to support scientific studies if previously approved by the administrator of the PA. In this category, the expropriation process of any private property is inevitable because the land-holder of a ESEC is necessarily the public sector. This category of PA is not open for public visitation, except for environmental education. The REBIO has the primary role of protecting the biota and other natural assets without human interference. The PM is created to preserve natural ecosystems and their scenic beauty. In both cases, as in the ESEC, private property is not allowed. The public visitation is open in the case of PM, while in the case of REBIO it is restricted to environmental education. The MONA is created to protect rare nature sites and their scenic beauty, while the REVIS has the primary task of safeguarding flora and fauna. In both cases, private landowners can keep their land inside the protected area if consistent with these objective. Public visits and scientific studies are allowed when authorized

in advance by the administrator.

Concerning the sustainable use group, the APA allows human occupation and its primary role is to protect the biological diversity and to discipline the use of land in a sustainable way. APA category can have environmental-ecological zones in their area, which restricts human occupation. The ARIE comprises a small piece of land and has fewer human occupation when compared with APA. ARIE also allows private landowners and its primary role is to protect natural ecosystems. The FLOMA covers a forest area and its primary role is to promote the sustainable use of the forest resources, while enabling the permanence of traditional communities, public visits, and scientific studies. This category does not allow private use of the land, therefore landowners have their land expropriate. The RESEX are land-restrictions to ensure extractivist activities and subsistence farming by traditional communities and their primary role is to protect traditional communities with a sustainable use of natural resources. RESEX allows scientific studies and public visits when they are compatible with local interests. This category neither allows private land-use nor hunting activity, except by traditional communities. The SDR has similar characteristics, with the exception of private landowners who can keep their land if compatible with the PA. Private land is used in RPPN, but these areas are restricted to scientific studies and public visits for eco-tourism, environmental education, and recreational purposes. The public sector can provide technical support for landowners interested in turning their lands in RPPN. Other categories of PA can also arise in local governments' jurisdictions according to state policies, such as ecological private recovery reserves. Local governments can also deal with other types of land-use restrictions beyond PA, such as indigenous lands. In sum, the degree of land-use restrictions varies according to the category of PA.

The level of transaction costs is highly dependent on the type of PA, as well as on the stage of the policy process. As Bruner et al. (2004, p. 1120) has noted, "*the costs of establishing new protected areas may include both designation costs (e.g., stakeholder consultations, biological inventories, boundary demarcation land purchase, and compensation) and up-front purchases, construction, and planning*". In order to create a PA, local governments face four types of transaction costs faced by local governments: expropriation costs, rent-seeking-costs, commitment costs and collective costs. To enforce a PA, local governments face agency and monitoring costs as well as management costs.

To create a PA, local governments face barriers relating to expropriation costs for both sustainable and integral use PAs. This effect tends to be more robust for the ESEC, REBIO, PM, RESEX, FLOMA, and REFAU categories. Rocha et al. (2010) note that during the expropriation proceedings, the landowners usually claim for fair compensation for the land loss while the state tries to reach an initial agreement. If a contract has not been agreed upon after that moment, the landowner may try to file a suit against the state.

Companies lobbying and lobby groups can also facilitate or complicate the policy process of creating new municipal PAs. Lobbying by non-governmental environmental organizations, such as environmental groups, organizations, networks, and associations, can facilitate the creation of new PAs. In contrast, agribusiness lobby, hydroelectric lobby, and the mining lobby can complicate the process of creating new PAs (Loyola, 2014). In Brazil, for example, "*owing to pressures of the agricultural sector, national administration has recently revised the Brazilian Forest Act*" (Loyola, 2014, p. 1365). Rent-seeking costs can be substantial for integral PAs because their uses are highly limited due to biodiversity conservation purposes. Private entrepreneurs in the agribusiness sector anticipate future gains and losses before creating a new PA. This cost and benefit analysis has to be discussed with all political actors involved in the policy process before creating a new PA. Also, after adopting a PA, entrepreneurs interested in exploring the land for agribusiness are able to pressure local government to change the category and the extension of the PA.

A municipal PA also faces barriers related to collective costs. As a natural resource, a PA leads to new institutional arrangements that are

evaluated by the local communities (Ostrom, 1990). They tend to compare previous agreements with the new ones, leading to a kind of cost and benefit analysis. Extractive reserve and fauna reserve are examples in which traditional communities and surrounding communities have to deal with new institutional arrangements, mainly for hunting and agriculture exploitation. The municipal government tends to spend money and efforts to maximize cooperation among communities to enforce a new institutional arrangement, such as a PA. In Brazil, landholding regularization to traditional communities in extractive reserves may take years due to administrative proceedings and the financial costs associated with the process.

Local governments also face the consequences of the over time lack of commitment from the state government with respect to financial and technical support. Most of the municipalities face financial stress and a lack of technical expertise to create and maintain a municipal PA. For instance, they have to develop technical studies to create a new PA, including EIA and RIMA. These studies raise spending in hiring external experts.

During the implementation stage, after creating a municipal PA, the primary barrier to local governments is related to agency costs. Internal conflicts may arise to manage the PA. Pressure from companies lobbying and lobby groups may lead the manager of municipal PA (agent), which acts on behalf of the municipal government, to act in order to maximize their power and wealth which can be not aligned with the environmental conservation target predicted to the PA category. It can increase political and financial costs related to the Municipal Council on the Environment (CMMA) (Decree number 4340/2002, 2002) which is usually designed to oversight the PA, that is, it may increase monitoring costs.

Also after creating a municipal PA, municipal governments face an increase in management costs, that is, the recurrent management costs for existing PA. It includes operation costs “(e.g., staff salaries and training, fuel, maintenance, community engagement, and monitoring and evaluation), site-level administration, and development projects or recurrent compensation costs that are a direct responsibility Systemwide of the protected area” (Bruner et al., 2004, p. 1120). Some local governments face lack of funding to maintain these costs which is normally required in the implementation stage.

The political and financial costs to maintain the Municipal Council on the Environment (CMMA) to monitor the PAs and the spending to manage all categories of PA is sometimes an enduring task to local government's budget. Creating a municipal PA requires a relatively short-term political and financial commitment, but maintaining them is necessarily a long-term commitment to political and financial resources (Bruner et al., 2004). The spending may also decrease or increase according to the size of the PA because of economies of scale in monitoring/management, that is, a large PA that has greater inaccessibility area may have “fewer impacts from edge effects, and a greater likelihood to be ecologically self-sustaining” (Bruner et al., 2004, p. 1120).

In sum, the sustainable use and integral protection groups of PA tend to impose different levels of transaction costs, and hence facilitate or complicate the policy-making process of creating a PA. Also, “different management objectives [for managing protected areas] require widely different activities and expenditures” (Bruner et al., 2004, p. 1120).

3.2. EFT in Brazil and Minas Gerais

In Brazil, the EFT constitute part of the “Imposto sobre Operações relativas à Circulação de Mercadorias e sobre Prestações de Serviços de Transporte Interestadual e Intermunicipal e de Comunicação” (ICMS) collected by the state governments and transferred to municipalities. To be precise, three-quarters of the ICMS is transferred to municipalities using the criterion of fiscal added value (VAF). Only a quarter can be redistributed to municipalities using other criteria, such as ecological indicators (see Fig. 1).

The states are free to decide upon the criteria used in these transfers,

which means that local governments can use the money as they want (Moura, 2015). Some states include environmental criteria to transfer the ICMS, mainly those related to promote the creation and maintenance of PA, landfills, recycling centers, and composting plants. EFT in Brazil are known under several names, such as “ICMS Ecológico”, “ICMS Verde” and “ICMS Socioambiental”.

At the beginning of the 1990s, the state of Paraná created the first fiscal transfers using ecological indicators to municipalities for creating and maintaining PAs. The EFT scheme in Brazil has spread over the years; so far, sixteen states are using PA as indicators related to biodiversity conservation to transfer revenue from the ICMS, that is, the primary EFT objective is to reduce the “biodiversity loss by stimulating the creation and management of protected areas” (Sauquet et al., 2014, p. 250). The extensive literature describes two ways for EFT to reach that goal: first, local governments create new PA; second, compensate municipalities for bearing the cost of building and maintaining PA, which produces environmental services that go beyond their borders (Ring and Barton, 2015; Sauquet et al., 2014; Droste et al., 2017c; Ring, 2008). Ring (2008, p. 485) states that EFT are used to provide a “compensation for land-use restrictions and an incentive to value and engage in more conservation activities at the local level.” Sauquet et al. (2014, p. 250) summarize these two EFT ways in the sense of “(i) [...] rewarding municipalities for hosting state and federal PAs”, and “(ii) [...] encouraging municipalities to create new PAs.”

As Grieg-Gran (2001, p. 06) notes, the compensation dimension of EFT is justified when municipalities host state and federal PAs, because “local governments have little scope for influencing decisions made on the designation and maintenance of a large proportion of the area set aside for protection”. In addition, EFT may include an incentive component to local governments by the creation of municipal PAs (Droste et al., 2017c; Ring and Barton, 2015). A potential incentive is expected from EFT because the ICMS “constitutes an important source of revenue for local governments” (Grieg-Gran, 2001, p. 01). However, as protected areas are created the incentive and compensation from EFT tends to reduce because the money to be transferred reduces due to more municipalities sharing the same financial source.

Minas Gerais was the fourth Brazilian State to enact the first EFT law (Paulo and Camões, 2017). With regard to its practical implementation, “the states of Minas Gerais and São Paulo started operating the ICMS ecológico in 1996, followed in 1997 by the state of Rondônia” (Grieg-Gran, 2001, p. 1). After EFT implementation, it is expected the creation of more protected areas by local governments due to the additional money transferred by the state governments from the ICMS. The EFT scheme in Minas Gerais is known as the Robin Hood law, because its aim is “to reduce the allocation to the richer counties and give more to the poorer ones” (Grieg-Gran, 2001, p. 12).

The EFT constitutes a small part of the ICMS which is collected by the State and transferred to municipalities. As Grieg-Gran (2001, p. 2) has noted “(...) the introduction of the ecological criterion was accommodated by a reduction in the weight assigned to the value-added criterion”. The percentage dedicated to the environment is 1% to be split between water sanitation and PA. The first is related to sewage treatment, composting plants, and landfills, “which attend to the needs of a certain proportion of the population” (Grieg-Gran, 2001, p. 4). The second includes PA from the federal, state and municipal governments, as well as those from private landowners, “although any ICMS revenue associated with them accrues to the county and not to the owner of the land” (Grieg-Gran, 2001, p. 4). From the beginning of EFT until 2008, 0.5% was devoted to water sanitation, while 0.5% to the PA (Law number 12040/1995, 1995; Law number 13803/2000, 2000). From 2009 up to now, 0.45% is dedicated to water sanitation, 0.45% to the PA, and 0.091% to fire control (Law number 18030/2009, 2009). The environmental rates for fiscal transfers (conservation factor) increased gradually over the first years (see Table 7 in appendix). From 1996 to 1998 the percentage dedicated to environmental issues increased from 0.333 to 1 (one) (Law number 13803/2000, 2000; Law number 18030/2009, 2009),

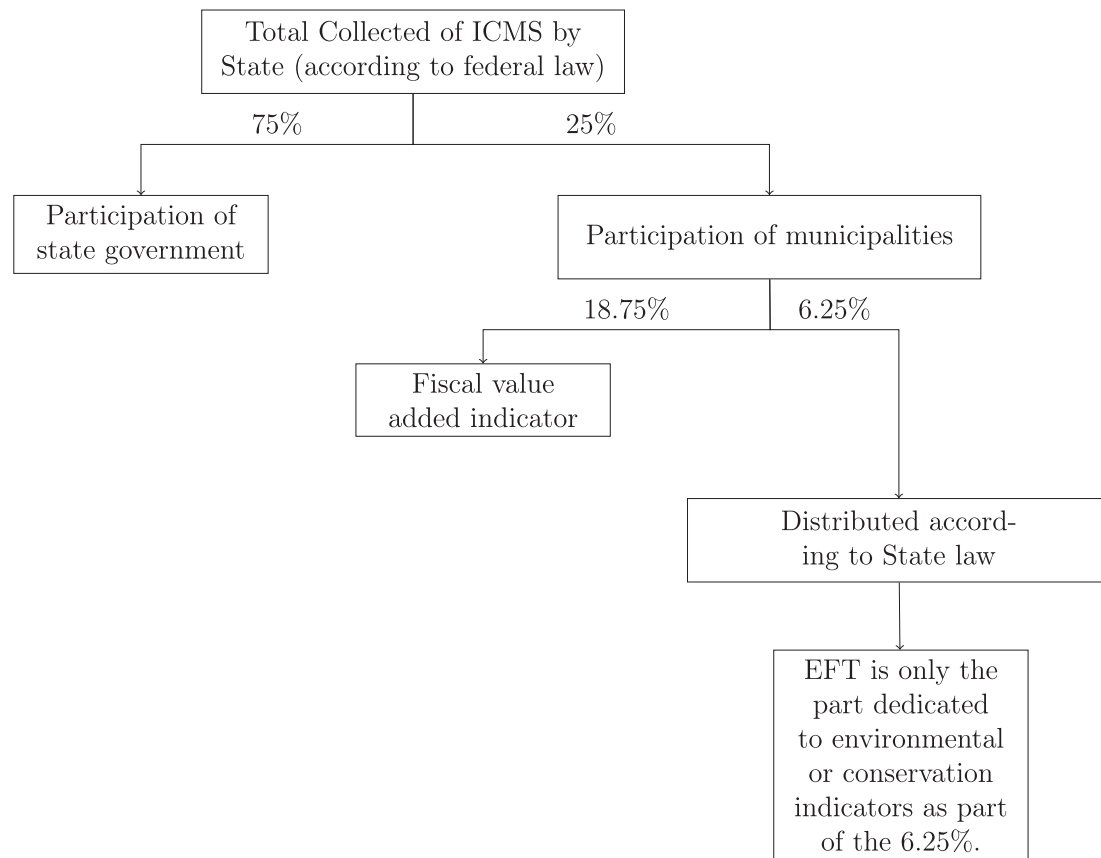


Fig. 1. EFT scheme in Brazil.

Source: Source: Paulo and Camões (2017).

indicating that EFT legislators were uncertain about how to design this policy instrument. The gradual increases in environmental rates observed over the years where what Douglass North designated as a “stable structure of exchange” (North, 1990, p. 50). But a simple change in the rule of fiscal transfers have the potential of imposing substantial changes in municipal budgets (Paulo and Camões, 2017, 2018). This is important because it may reduce the political resistance of political actors.

The Index of Biodiversity Conservation of Municipality measures the PA that are included in the EFT in Minas Gerais state (“ICI” - see formula (4) in the appendix). Concerning the operation procedures, the municipalities have to register their PA in the state environmental agency to receive money from the EFT. Currently, the state environmental agency publishes the ICI for all municipalities each trimester. There are three components in the method to determine the ICI index to be used in the EFT formula: i) the area of the PA in hectares; ii) the conservation factor of the PA (FC); and iii) the quality of the PA. The quality index varies from zero point one to one and was introduced only in 2005 by the regulatory deliberation 86/2005, that is, there is a delay in the implementation of the quality index in Minas Gerais from 1996 to 2005. The quality index imposes more costs to local governments in monitoring and management of the protected area. The FC assigns different weights to each type of PA (see Table 1). As Grieg-Gran (2001, p. 5) has noted, “the more restrictions imposed on the use of the land, the higher the conservation weighting.”

Fig. 2 represent the cumulative number of adoptions of protected areas per category. The two vertical lines indicate two critical moments in this evolution: i) the implementation of EFT in 1996; and ii) the adoption of the Quality Index (FQ) of the Protected Area in 2005. The line present clearly distinct paths between sustainable (APA) and integral (PM and REBIO) PAs. After EFT adoption, there is an increasing

Table 1

Conservation factor of the protected area.

Source: Source: compiled by authors from the law 12040/1995, law 13803/2000, and law 18030/2009.

Group	Management category	1995	2000	2009
Integral protection	ESEC	1	1	1
	REBIO	1	1	1
	MONA	1	1	1
	REVIS	1	1	1
	PM	0.9	0.9	1
Sustainable use	RPPN	0.9	0.9	1
	RESEX	0.5	0.5	0.5
	SDR	0.7	0.7	0.5
	FLOMA	0.7	0.7	0.3
	REFAU	0.3	0.3	0.3
	ARIE	0.3	0.3	0.3
	APA (with env. eco. zoning maps)	0.1 to 1	0.1 to 1	0.1 to 0.5
	APA (without env. eco. zoning maps)	0.025	0.025	0.025
	Eco. recovery private reserve	0	0.9	0.1
	Indigenous land	0.5	0.5	0.5
	Specially protected areas	0.1	0.1	0

inflection of the evolution of APA. However, such evolution was flattened after the FQ implementation. In the case of the integral categories the evolution mostly steady over the years. The legislation considers the integral category as extremely important for biodiversity conservation, which may be one possible explanation for the pattern of integral PAs over the years.

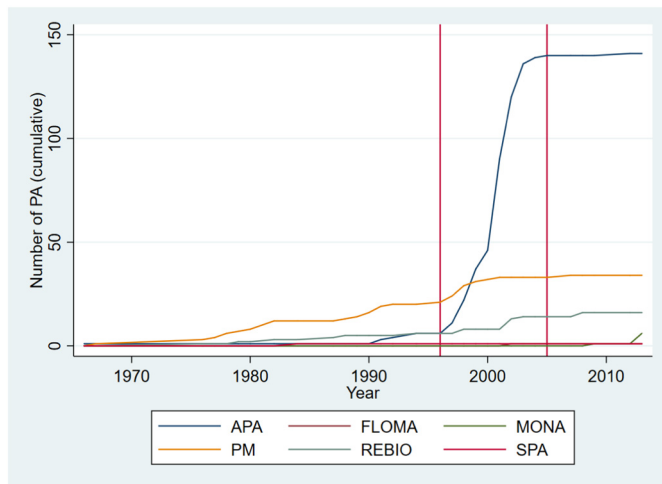


Fig. 2. Cumulative PA (category).

4. The Transaction Costs and the EFT

Local governments can adopt more or less PA according to EFT criteria implemented at a given moment in time. The EFT policy instrument may alter the net balance between costs and benefits in implementing a local PA, which leads to different choices to adopt municipal PA with different transaction costs.

The information costs is the main point to understand the concept of transaction costs, "(...) which consist of the costs of measuring the valuable attributes of what is being exchanged and the costs of protecting rights and policing and enforcing agreements" (North, 1990, p. 27). As Williamson (1989, p. 142) noted, "transaction cost analysis entails an examination of the comparative costs of planning, adapting, and monitoring task completion under alternative governance structures". Simply put, our theoretical argument is that the EFT scheme modifies the net balance between costs of planning, adapting, and monitoring in the adoption of PA at the local level and benefits in implementing a local PA, and their expected benefits. The EFT scheme reduces the resistance of political actors to accept the costs of protecting rights and policing and enforcing agreements in adopting municipal PA.

The EFT are a policy tool that encompasses two types of delegation, both related with standard principal-agent problems of moral hazard and adverse selection. First, following the background of intergovernmental institutions in federalist systems, delegation happens through devolution of competencies from the state government to lower more decentralized government levels. Following Epstein and O'Halloran (1999), the decision to delegate competencies from state government to more decentralized governments is analogous to the make-or-buy decision which is faced by firms in the economic market, that is, "the legislative body faces a trade-off between internal costs of policy production and external costs of delegation" (Tavares, 2003, p. 12). The external costs are related to the information costs of gathering all preferences at the local level and monitoring costs. One way to minimize the external costs of delegation is by offering grants to local government, such as the EFT, as a commitment signal of the state government to more decentralized governments.

Second, delegation in federalist systems also occur from state legislators to state agencies. The formulation and implementation process of a state policy instrument may encompass areas in which the state Legislative branches do not open their policy-making discretion to state agencies, because bureaucrats may be not aligned with objectives of the legislators and can jeopardize their chances of reelection. Tax policies are an example of how legislators try to fill all loopholes in the law and, as a result, end up not assigning any discretion to modify it (Epstein and O'Halloran, 1999). Concerning environmental policies, Oliveira (2002,

p. 1716) states that "protected areas are rarely perceived as an urgent need, and thus do not attract much political support". The transaction cost politics predicts that in these cases the state legislative branches tend to enact vaguer laws and delegate to the state agencies the role to regulate the details because the delegation process ends up minimizing the policy-making costs to the legislative branch transfer (Horn, 1995; Epstein and O'Halloran, 1999). EFT encompass tax policies and environmental policies; then this delegation process appears during the EFT formulation stage at the state level. When delegation increases, it is easier "for the incumbent legislature to intervene in administration without changing legislation and, therefore, increases the commitment problem" (Horn, 1995, p. 50). Therefore, the commitment costs tend to increase when the design of EFT predicts change in the rules of the policy instrument over time. When the commitment problem arises, the municipalities tend to adopt different policies from those related to the state-policies objective. The costs to the municipalities in maintaining a policy aligned with the state-policies objective tend to increase when commitment problems arise. Usually, the municipalities face some costs to create and maintain a PA: expropriation costs, rent-seeking costs, commitment costs, collective costs, agency costs, monitoring costs, and management costs.

Based on these theoretical explanations, we discuss two arguments in this paper. The first is that the municipalities face a menu of transaction costs to create a PA in the period pre-EFT: expropriation costs, rent-seeking costs, commitment costs, collective costs, agency/monitoring costs, management costs. The EFT may alter the net balance between costs and benefits in implementing a local PA. What is more, the EFT provides a financial incentive of fiscal transfers, which functioning as a support for local governments to maintain a PA (post-EFT). The effects of the financial incentive to minimize the resistance to accept and maintain a new institutional arrangement are stronger during the first years of EFT operation.

The expropriation costs are the costs of expropriating private lands to transform in PA, that is, the amount of money the local government has to pay to private landowners. The rent-seeking costs are related to political costs in adopting a municipal PA due to the pressure from companies and lobbying groups, such as the agricultural sector and tourism companies that pressures local governments. The commitment costs are the costs associated with securing the rules agreed upon and the financial support from EFT to local governments over time. The costs to maintain financial aid and the rules agreed upon over time affect the policy choices at the local level, that is, affect the creation and maintenance of municipal PA. The collective costs are faced by local communities to accept a new institutional arrangement in their land, that is, the costs bore by these communities to create and maintain a municipal PA. The agency costs are internal costs which arise from the manager of municipal PA (agent) which acts on behalf of the municipal government. The municipal government wants the manager of municipal PA to follow EFT requirements, while the manager of municipal PA may act to maximize its power and wealth which can be aligned with the interests of some companies lobbying and lobby groups. This may increase monitoring costs. The management costs are the costs related to the management of the municipal PA, such as spending on staff salaries and training, fuel, maintenance, and so on.

The second argument is that the EFT policy instrument is a mix of tax and environmental policies. Then, the municipalities predict a certain level of uncertainty concerning changes in the EFT legislation by the state agencies over the years. The uncertainty may change the expected payoff/costs due to the change in the probability of the outcome. Also, when the quality index was implemented after the EFT implementation, without any additional support from the state government, the local governments were faced with additional costs related to the improvement of environmental agency technical capacity and the increase in monitoring efforts, which made it more difficult the creation of new PA. Next section presents an assessment between the EFT and the transaction costs that affect the PA adoption.

4.1. The Change in Net Benefits From the Pre-EFT to the Post-EFT Period

An EFT scheme may follow requirements from local, regional, national, and international levels to implement ecological indicators, such those related to protected areas. Also, public and private actors with different interests are involved in the policy process, including mayors, members of Congress, governors, and municipal associations (Ring and Barton, 2015). At the local level, there are groups with a keen interest in the creation of new PAs, such as landowners that will face land-use restrictions, entrepreneurs who will suffer a reduction in their economic activities, and so on.

Our approach regards EFT as a contract between the state government (principal) and the municipal governments (agents), although the state government has the power to impose an EFT scheme and holds the residual powers to modify the schema over time. Sometimes an agreement between principal and agents is an enduring task. The EFT literature points that EFT introduce a redistributive effects (Grieg-Gran, 2001; Jatobá, 2005). In Minas Gerais, for instance, the introduction of the EFT (known as Robin Hood Law) affected negatively the budget of the largest municipalities, leading “the Association of Local Governments in the state, [to protest] about the reduction in their income (...)” (Grieg-Gran, 2001, p. 20). Jatobá (2005) describes the same redistributive effect in the state of Pernambuco.

With the implementation of EFT, the net balance between costs and benefits faced by municipal government with the creation of a new PA tend to change. The financial resources transferred from the state government to municipal governments constitutes additional income (benefits) in terms of available budget. EFT helps municipal governments to deal with expropriation costs, rent-seeking costs, collective costs, and commitment costs at the local level, particularly in the case of poor municipalities (Grieg-Gran, 2001; Loureiro, 2002). To be more precise, with EFT they have more money to pay compensations for expropriating a land, to increase spending in stakeholder consultations, biological inventories, and demarcation of lands which reduce the collective costs. In addition, they have more political incentives to create more restrictive areas and to deal with lobbying companies and groups because the money they receive from EFT is not earmarked, that is, the mayor is able to expand its budget and spend more money in other policies in order to increase its chances of reelection.

From the perspective of the principal (state government), EFT may be considered as an additional source of income which helps local governments (agents) to deal with different types of transaction costs in order to guarantee specific environmental policies, mainly in the short run, an argument that was introduced by Tavares (2003). In the long run, the EFT may also impose commitment costs to state government due to political costs in keeping the criteria agreed upon initially.

The extant literature have ignored the changes in EFT rules made by the state environmental agencies over time and their consequences for municipal budgets and, consequently, to local decisions. In Brazil, state legislative branches delegate to state agencies the role to refine the details in the EFT legislation. As Horn (1995, p. 21) notes, “*uncertainty exists at enactment when it is difficult to predict the private benefits associated with a given legislative refinement or standard, or the private costs of compliance with this standard*”. These changes in the EFT, such as the weight of the conservation factor for a specific category of a PA to use in fiscal transfers, tend to increase the uncertainty for local governments. The design of EFT schema assigns different weights to transfers according to the type of PA: for integral protection or for sustainable use. Natural monuments, included in the integral protection group, can be used for eco-tourism, while environmental protection areas, extractive reserves, sustainable development reserves, and natural heritage private reserves included in the sustainable use group are also indicated for this purpose (Zaú, 2014).

As a redistributive game, another effect of the EFT is that the adoption of a new PA, that is, the inclusion of one more municipality in the share, reduces the revenue to be transferred to the others. Since the

overall “*slice of cake*” decreases, creating the group *winners* and the group of *losers*, the redistributive effects of EFT tend to reduce the incentive to local governments for creating more PA as time evolves (Grieg-Gran, 2001). The expected payoff/costs of local level decisions tend to change over time accordingly.

The quality index adopted by each EFT scheme, comprising a set of qualitative requirements, such as monitoring the level of physical quality of the PA, its management plan, and its infrastructure, imposes an additional increase in transaction costs to local governments. Despite the importance of this index for biodiversity conservation (Grieg-Gran, 2001; Loureiro, 2002; Veiga Neto, 2000), monitoring all categories of PA is sometimes an enduring task for municipalities and some local governments are short in technical expertise to maintain a PA according to this quality requirements. Moreover, some municipal environmental agencies have to manage internal conflicts because they also bear the responsibility for agricultural, tourism, and environmental purposes (Oliveira, 2002; Pedrosa et al., 2013). Metaphorically, this is like a “*fox guarding the henhouse*”. Delegation increases administrative discretion and, therefore, the ability of administrators to act in their interests (Horn, 1995). To minimize this potential problem, some Brazilian municipalities rely on a Municipal Council on the Environment (CMMA) with leaders of local communities, experts, and entrepreneurs (Decree number 4340/2002, 2002), with either consultative, and/or deliberative assignments in monitoring and enforcing new PA. In this institutional setting, the EFT design may facilitate or impede PA creation and enforcement, because the indicators related to local PA used in fiscal transfers may or may not compensate the additional efforts with qualitative requirements. Also, with the implementation of the quality index, municipal government face an increase in management costs such as staff salaries and training, fuel, maintenance, and community engagement.

The uncertainty about the regularity of money transfers, the lack of stability of the EFT rules over time, and the qualitative measurement that may be imposed by EFT, which “*imply additional transaction costs related to monitoring*” (Ring and Barton, 2015, p. 442), tend to change the net balance between costs and benefits in creating a protected area at the local level. To be precise, municipalities expect that the policy instrument will remain in effect without major revisions or changes by future coalitions.

The uncertainty and agency/monitoring/management costs which may change the incentive effect of EFT among local governments have not been theoretically and empirically explored by the literature so far. This paper argues that the EFT scheme designed at the state level alters the net balance between costs and benefits in implementing a PA by local governments, which leads to different choices to adopt municipal PA with different transaction costs. At the beginning of EFT implementation, EFT function as a commitment sign of the state government to municipalities in order to adopt environmental policies aligned with the state objectives. However, as time evolves, the net benefits between payoff/costs tend to change over time, and the incentive effect may reduce. Also, the agency/monitoring costs and management costs tend to increase after adopting qualitative criteria in EFT scheme. Both transaction costs tend to retard or inhibit the adoption of the PA at the local level. Feiock and Stream (2001) assert that “*institutional reform provides the promise of overcoming trade-offs between economic and environmental policy goals*”, but such reform have to take into account the structure of costs involved in political transactions.

Table 2 summarizes the change in the net balance between costs and benefits in implementing a PA by local governments after EFT implementation.

We derive three hypotheses from the theoretical arguments. The **first hypothesis** is related with the difference in transaction costs between the integral protection and sustainable use groups of PA. We expect higher transaction costs in integral categories of PA than in the sustainable use (Parente, and Bursztnyn, 2012). Empirically, the implication is to observe higher survival rates, that is, **less adoption of**

Table 2
Change in the net benefits with the implementation of EFT.

Group	PA category	Transaction cost	Direction of change in the net balance between costs and benefits after EFT implementation
Integral protection	ESEC	Expropriation costs	Net benefits in expropriating a land: increases
		Agency/monitoring/management costs	Net benefits in agency/monitoring/management costs: decreases with a qualitative assessment
	REBIO	Rent-seeking costs	Net benefits to deal with pressure from companies and lobbying groups: increases
		Expropriation costs	Net benefits in expropriating a land: increases
	MONA	Rent-seeking costs	Net benefits to deal with pressure from companies and lobbying groups: increases
		Agency/monitoring/management costs	Net benefits in agency/monitoring/management costs: decreases with a qualitative assessment
	REVIS	Rent-seeking costs	Net benefits to deal with pressure from companies and lobbying groups: increases
		Agency/monitoring/management costs	Net benefits in agency/monitoring/management costs: decreases with a qualitative assessment
	PM	Expropriation costs	Net benefits in expropriating a land: increases
		Rent-seeking costs	Net benefits to deal with pressure from companies and lobbying groups: increases
Sustainable use	RPPN	Agency/monitoring/management costs	Net benefits in agency/monitoring/management costs: decreases with a qualitative assessment
		Agency/monitoring/management costs	Net benefits in agency/monitoring/management costs: decreases with a qualitative assessment
	RESEX	Expropriation costs	Net benefits in expropriating a land: increases
		Collective costs (more intensively)	Net benefits to deal with local communities to accept a new PA in their lands: increases
	SDR	Agency/monitoring/management costs	Net benefits in agency/monitoring/management costs: decreases with a qualitative assessment
		Expropriation costs	Net benefits in expropriating a land: increases
	FLOMA	Agency/monitoring/management costs	Net benefits in agency/monitoring/management costs: decreases with a qualitative assessment
		Expropriation costs	Net benefits in expropriating a land: increases
	REFAU	Agency/monitoring/management costs	Net benefits in agency/monitoring/management costs: decreases with a qualitative assessment
		Expropriation costs	Net benefits in expropriating a land: increases
	ARIE	Collective costs (more intensively)	Net benefits to deal with local communities to accept a new PA in their lands: increases
		Agency/monitoring/management costs	Net benefits in agency/monitoring/management costs: decreases with a qualitative assessment
	APA	Agency/monitoring/management costs	Net benefits in agency/monitoring/management costs: decreases with a qualitative assessment

integral categories. The **second hypothesis** addresses the uncertainty that leads to changes in the net benefits of payoff/costs (Epstein and O'Halloran, 1999; Tavares, 2003) and it is related with the implementation of EFT. Since EFT increases the net benefits between costs and benefits at least in a short-term, the municipalities will be attracted to adopt more PA from the sustainable group. The empirical implication is an **increase in adoption of PA after EFT**. The **third hypothesis** is related to the agency costs and management costs at the local level (Horn, 1995). Empirically, we expect to find a **decrease in the creation of new PA after the imposition of the quality index** to local governments when the state government does not increase the support to municipal governments.

5. Empirical Strategy

In order to assess the three hypotheses, the empirical analysis begins by presenting descriptive data and follows to the statistical analysis that tackles the adoption of 199 PA by the 853 municipalities of the State of Minas Gerais, located in the southeast region of Brazil. The fortunate access to reliable information gathered from the environmental agency (*Instituto Estadual de Florestas*) justifies our choice. In addition, since this specific state introduced a delay in the implementation of the quality index (from 1996 to 2005), this presents a richer opportunity to study its effect on the EFT scheme.

5.1. Methods

The first part of the analysis presents the design of EFT at the state level, detailing the evolution from its beginning until its current version. The analysis will describe the time length to adopt the quality index, as well as the changes of the biodiversity conservation factor over the years. These two indexes imposed important modifications in transactions costs faced by municipal governments because they lead to changes in their budgets due to the increases or decreases in the money transferred through EFT. Therefore, observed over the years, can be explained by these changes

In the second part we perform an event history analysis (EHA) which is specially suited to account for the dynamics in the pattern of

PA adoption. The analysis focuses on the municipal category because it allows investigating the stimulus of the local governments in creating new protected areas (Grieg-Gran, 2001). We begin by estimating Kaplan-Meier survival curves. With this analysis, we statistically test the difference in the survival rates between the sustainable and integral groups of PA. We expect to find higher survival rates in integral PA groups (first hypothesis). After the enactment of the EFT, we expect to see a decrease in the time length to adopt new PA in categories related to sustainable groups vis a vis the integral group (second hypothesis). Then we proceed to the regression-based EHA in order to enquire about the factors explaining the duration of PA adoption by municipal governments. As in these types of methods, the unit of analysis is the PA created in a given year and the dependent variable is the duration time for creating a municipal PA (Box-Steffensmeier and Jones, 2004).

Two methodological notes are in place at this point. The first is about the particular type of sample available, one in which an observation is considered only when it is recognized. In fact, we only recognize a PA when it is created and recorded as data. This type of data is characterized by right truncation, the case when only those units that have experienced the exit event by some particular date are included in the sample (literature refers as an outflow sample). The second note is about estimation. Based on Akaike Information Criterion and BIC statistical tests, we estimate the model using the Gompertz distribution¹. The implication of this choice is that the proportional hazard ratio is adopted rather than the AFT metric.

With regard to independent variables, we included four main parameters to capture the effect of the EFT design in PA adoption. The first is related with the fluctuations in EFT money for PA. As Grieg-Gran (2001) has noted, "It is not straightforward to estimate the effect on a county's ICMS revenue [by] creating a protected area." We measure the change in EFT money for PA with two variables. One is with a dummy for the years after EFT adoption and the other is by the conservation factor (FC) incorporated in EFT rules after its implementation. This factor observed some variations in the EFT regulations over the years (see the formula in the appendix). The second parameter is the quality index (QI) imposed in the EFT design to municipalities. We expect to

¹ We also run Weibull, being the results virtually the same.

Table 3
Variables and sources.

Variable	Source	Measurement
Duration	Instituto Estadual de Florestas (MG)	Duration until the PA adoption
Event	Instituto Estadual de Florestas (MG)	1 in case of PA adoption, 0 otherwise
EFT	Law 12040/1995	1 for the years after EFT adoption in 1996, 0 otherwise
Conservation factor	Law 18030/2009	Conservation factor for each PA category
Share of area	Instituto Estadual de Florestas (MG)	Area of the PAs over the total area of the territory of the municipality (ha)
Quality index	Regulatory deliberation 86/2005	1 after the implementation of the quality index in 2005, 0 otherwise
APA	Instituto Estadual de Florestas (MG)	1 for the years after APA category adopted, 0 otherwise
PM	Instituto Estadual de Florestas (MG)	1 for the years after PM category adopted, 0 otherwise
REBIO	Instituto Estadual de Florestas (MG)	1 for the years after REBIO category adopted, 0 otherwise
MONA	Instituto Estadual de Florestas (MG)	1 for the years after MONA category adopted, 0 otherwise
FLOMA	Instituto Estadual de Florestas (MG)	1 for the years after FLOMA category adopted, 0 otherwise
SNUC	Instituto Estadual de Florestas (MG)	1 for the years after SNUC adopted, 0 otherwise

find an increase in time (in years) for adopting a new local PA after the implementation of this index. The third is share of the PA area in the overall municipal area. The inclusion of this ratio is justified because the area of the PA constitutes one component to compute the EFT to be transferred (see formula (2) in the appendix). The last, which functions mostly as a control variable, is a dummy for the adoption of the National System of Protected Areas (SNUC). In sum, the following equation is estimated within the EHA framework.

$$Duration_i = \beta_1 EFT_i + \beta_2 QI_i + \beta_3 FC_i + \beta_4 Share_i + \beta_5 SNUC_i + \epsilon_i \quad (1)$$

5.2. Data

Under the law on access to public information (law 12527/2011), we collected data concerning all municipal PA created from 1966 to 2013, including the group (sustainable or integral) and categories adopted in the State (APA, FLOMA, MONA, REBIO, PM, and SPA). As previously referred, the dependent variable (duration until the adoption of a PA) is measured in years.

Table 3 summarizes the variables used in the analysis, how they are measured, and how they were collected. We collected FC from the environmental agency in Minas Gerais. EFT, the quality index, and the National System of Protected Areas (SNUC) are all computed as a dummy variables (1 for the years after their implementation, 0 otherwise). The categories of PA are also dummy variables (1 when a municipality adopts that type of PA, 0 otherwise). The share of PA a ratio area of the PA in the total area of the municipality. In the cases where the same municipality adopts more than one PA, we measure the cumulative share of area over the years. Table 4 presents descriptive statistics for all these variables.

Table 4
Summary statistics.

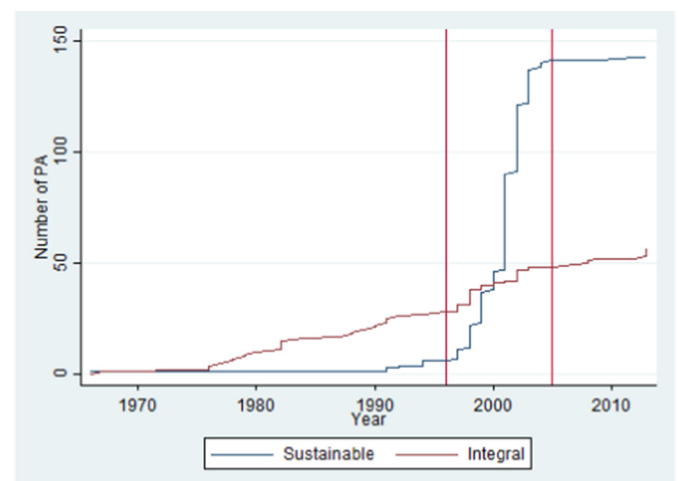
Variable	Mean	Std. dev.	Min.	Max.	N
Duration (years) of PA adoption	32.452	7.591	0	47	199
Conservation factor	0.485	0.271	0	1	199
Share of area (cumulative)	0.253	0.215	0	0.806	199
Quality index adopted	0.055	0.229	0	1	199
Group of PA	1.714	0.453	1	2	199
APA	0.709	0.456	0	1	199
PM	0.171	0.377	0	1	199
REBIO	0.08	0.273	0	1	199
MONA	0.03	0.171	0	1	199
FLOMA	0.005	0.071	0	1	199
SNUC	0.613	0.488	0	1	199
EFT	0.834	0.373	0	1	199

6. Results and Discussion

6.1. The Design of EFT at the State Level

The conservation factors have changed over time although only slightly (see in Table 1 with the categories of PA in bold). As explained in Section 4, over time the legislative branch delegates to the environmental state agencies the role of refining the details in legislated in the EFT scheme, imposing its preference over local governments. Considering the conservation factors assigned to PA in the integral groups, municipalities significantly choose to increase the adoption of APA, which belong to the sustainable group. This effect is clearly observed after the adoption of EFT, as the visual inspection of Fig. 3 clearly shows.

The vertical lines shown in Fig. 3 indicate the EFT implementation in 1996 and the adoption of the Quality Index of the Protected Area in 2005. Although predicted in the first law enacted in 1995, Minas Gerais adopted FQ only in 2005 (regulatory deliberations 86/2005 passed by COPAM, the Environmental state agency). The figure suggests that before the EFT, while few in number, the integral categories of PA were preferred. The introduction of EFT led to a pick in the number of PAs adopted, with an inflection to the choice of the sustainable group (mostly APAs). A second inflection was observed with the introduction of the Quality Index flattened the evolution of PA across municipalities. Overall, the period between the two lines registered a transformations that is clearly observed. This result goes in line with our hypotheses of the opposite effects of EFT and Quality Index, particularly the argument that the introduction of the quality index decreases the net balance in costs/benefits for local environmental agencies. We turn now to assess the statistical significance of these visual impressions.

**Fig. 3.** Cumulative PA (groups).

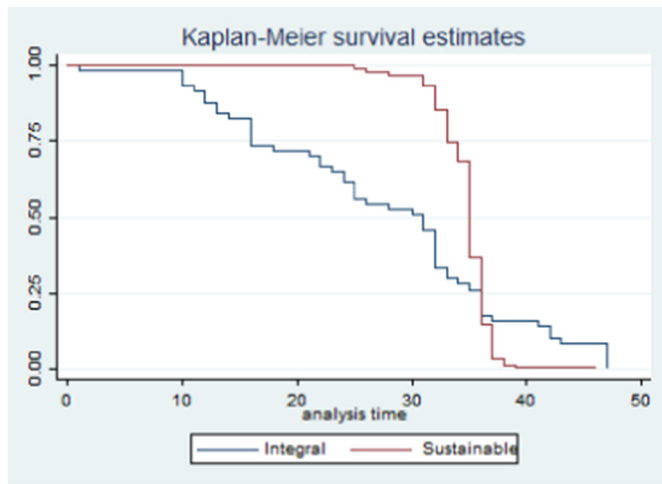


Fig. 4. Groups.

6.2. Event History Analysis

Fig. 4 plots Kaplan and Meier survival rates for the integral and sustainable groups of PA. These two curves, measuring the probability of staying in the sample as time evolves, significantly differ (Log-Rank test: $\Pr > \chi^2 = 0.0457$ for null hypothesis of non-difference). This means that the probability of surviving is different for the sustainable and integral groups of PA at any point in time. This happens because the evolution of the survival rates in the integral group of PA is mostly stable over time. In the case of sustainable group, there is a structural change after about 35 years, with significant decrease in the survival rates, meaning the adoption of more PA of this group, particularly of the APA category. This turning point is shortly after the adoption of the EFT. Our first hypothesis of a higher level of transaction costs in integral categories of PA is corroborated but only for the period after the EFT.

This result persists when we control for other factors when we run survival regressions as in Table 5. Both the conservation factor (FC) and the dummy for EFT are statistically significant, which clearly shows that the implementation of the EFT contributed to increase timing of adopting local PA, robustly corroborating the conclusions of Fernandes et al. (2011) and Grieg-Gran (2001). On the other hand, the dummy for the adoption of the quality index is not statistically significant, which that it does not capture its flattening effect on the adoption of PAs. The

Table 6
Logistic regression.

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
Ecological fiscal transfers			1.196 (1.72)		1.243 (1.85)
Quality index				−2.396* (−2.33)	−2.444* (−2.42)
Conservation factor of PA		−2.781** (−2.97)			
Share of area (cumulative)	14.35*** (5.83)	14.78*** (5.67)	13.62*** (5.57)	12.66*** (5.26)	11.77*** (4.88)
National system of PA	0.761 (1.58)	1.953* (2.94)	0.249 (0.44)	1.374* (2.52)	0.862 (1.41)
Constant	−1.655*** (−4.56)	−0.976* (−2.50)	−2.250*** (−4.11)	−1.540*** (−4.31)	−2.147*** (−4.04)
Observations	199	199	199	199	199

t statistics in parentheses.

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

other variables are all statistically significant as expected.

The survival regression results, controlling for other factors, provide significant evidence for the effect of EFT but it is not conclusive with regard to the opposite effect of the quality index. In order to shed some additional light to this question, we perform a logistic regression analysis of the choice between integral and sustainable group of PAs. Here the dependent variable assumes two values (1 in the case of a sustainable group and 0 otherwise) with the coefficients to be interpreted as marginal effects on the probability of adopting one group of PA rather than the other. Table 6 present the results that strongly support the negative effect of the quality index on the adoption of the sustainable group of PAs. The effect of the EFT is near the border of the conventional statistical significance and, more importantly, with the sign as expected by the hypothesis and visual analysis.

7. Conclusion

This paper contributes to EFT literature to fill a critical gap to address the influence of EFT on the policy-making process of adopting local PA by municipal governments. The findings derived from our

Table 5
Gompertz regression.

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
Ecological fiscal transfers			−1.422***** (−3.78)		−1.521*** (−3.80)
Quality index adopted				0.0757 (0.23)	−0.267 (−0.76)
Conservation factor of PA		−3.479*** (−15.15)	−1.718*** (−3.51)	−3.487*** (−15.03)	−1.558** (−2.91)
Share of area (cumulative)	−4.654*** (−14.92)	−3.615*** (−9.62)	−2.798*** (−6.61)	−3.599*** (−9.44)	−2.819*** (−6.64)
National system of PA	−1.520*** (−14.28)	−0.269 (−1.74)	−0.0150 (−0.08)	−0.275 (−1.75)	0.0238 (0.13)
Gamma	−0.0673*** (−18.82)	−0.0246*** (−6.41)	−0.0243*** (−6.36)	−0.0246*** (−6.41)	−0.0242*** (−6.32)
Observations	198	198	198	198	198

t statistics in parentheses.

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

analyses partly complement the Moura (2015) analyses.

First, we provided empirical evidence that the uncertainty of the EFT revenue changes the incentive of EFT to local governments. It leads to changes in local decisions in the sense of choosing the best institutional arrangement through the policy-making at the local level, that is, local governments tend not to lose their discretion so much. Second, we provided empirical evidence that the rate of designation slows down after the introduction of the quality criterion, which may be explained by costs associated with it.

Finally, we recommend to test this set of hypotheses in other Brazilian states. For practitioners, we suggest the involvement of the local governments in state governments decisions, hearing their needs

and supporting them before an institutional change, such as the implementation of the quality index for PA.

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Appendix A

$$FCM_{il} = \frac{AreaUC_{il} \times FC \times FQ}{AreaMI} \quad (2)$$

Index of biodiversity conservation factor of the protected area “j” in municipality “l” (Eq. (2)) where:

FCM_{il} is index biodiversity conservation factor of the protected area “j” in municipality “l”

Area UC_{il} is area of the protected area “j” in municipality “l”

FC is conservation index of the protected area

FQ is quality index of the protected area

Area MI is area of the municipality “l”

$$FCE = (EFCM_i) \quad (3)$$

Index of biodiversity conservation factor of the state (Eq. (3)) where:

FCE is index of biodiversity conservation factor of the state

E FCM_i is biodiversity conservation factor of the protected area “j” in municipality “l”

$$ICI = \left(\frac{FCM_i}{FCE} \right) \quad (4)$$

Index of biodiversity conservation of municipality (Eq. (4)) where:

ICI is index of biodiversity conservation of municipality

FCM_i is Biodiversity Conservation Factor of the Municipality

FCE is biodiversity conservation factor of the state

Appendix B. ICMS Distribution in Minas Gerais State

Table 7

ICMS distribution in Minas Gerais state.

Source: Source: compiled by authors from the law 12040/1995, law 12428/1996 law 13803/2000, and law 18030/2009.

Criteria	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2009	2010	2011
Value fiscal added	88,05	83,46	79,49	79,55	79,61	79,63	79,64	79,66	79,668	79,68	79,68	79,68	75
Geographic area	0.333	0.666	1	1	1	1	1	1	1	1	1	1	1
Population	0.666	2.0420	2.71	2.71	2.71	2.71	2.71	2.71	2.71	2.71	2.71	2.71	2.7
Munic. (largest population)	0.666	1.3320	2	2	2	2	2	2	2	2	2	2	2
Education	0.666	1.332	2	2	2	2	2	2	2	2	2	2	2
Food production	0.333	0.666	1	1	1	1	1	1	1	1	1	1	1
Cultural heritage	0.333	0.666	1	1	1	1	1	1	1	1	1	1	1
Environment	0.333	0.666	1	1	1	1	1	1	1	1	1	1	1,1
Health	0.666	1.332	2	2	2	2	2	2	2	2	2	2	2
Municipality tax revenue	0.666	1.332	2	2	2	2	2	2	2	2	2	2	1.9
Minimum quota	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Mining town	1.5	0.75	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.01
Water resources	0	0	0	0	0	0	0	0	0	0	0	0	0.25
Number of prisons	0	0	0	0	0	0	0	0	0	0	0	0	0.10
Sports	0	0	0	0	0	0	0	0	0	0	0	0	0.10
Tourism	0	0	0	0	0	0	0	0	0	0	0	0	0.10
ICMS Solidario	0	0	0	0	0	0	0	0	0	0	0	0	4.14
Minimum per capita	0	0	0	0	0	0	0	0	0	0	0	0	0.10
Mateus Leme	0.20383	0.1807	0.13555	0.09037	0.04518	0.032	0.024	0.016	0.008	0	0	0	0
Mesquita	0.08755	0.0778	0.05837	0.03891	0.01946	0.016	0.012	0.008	0.004	0	0	0	0
Total	100	100	100	100	100	100	100	100	100	100	100	100	100

Appendix C. Supplementary Data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ecolecon.2019.106425>.

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