Reforming Brazil's State Participation Fund:

Achieving Fiscal Equalization by Introducing Fiscal Transfers for Forest Conservation

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General background and motivation

The Fundo de Participação dos Estados (FPE), Brazil's main intergovernmental fiscal transfer of sharing Federal tax revenues with the States, is in need of fundamental and urgent reform, following decades of at best marginal changes to inequitable and outdated distribution formulas, and various rulings by the Brazilian Supreme Court demanding adjustments.[1] The reform of the FPE provides an opening for also promoting the introduction of an ecological fiscal transfer to incentivize (and recognize) states' role in the provision of ecosystem services, especially in the Amazon. This report highlights that one of the most critical policy challenges the Government of Brazil (GOB) faces, advancing the ecological agenda across subnational governments, could be an integral part of another critical task currently facing the GOB, the much needed and long waited for reform of the FPE. This opportunity for the coupling of these two policy issues arises because, as we will show, an equitable reform of the FPE that ignores the provision of ecosystem services by states would imply overall a significant withdrawal of funds from Amazonian States.

Yet states need to receive ecological fiscal transfers to ensure that the provision of ecosystem services is economically and fiscally viable. Given that the provision of such services is costly, and it includes both direct and indirect (opportunity) costs, the introduction of an ecological transfer would recognize states' efforts in preserving their biodiversity. Introducing the ecological fiscal transfer within the FPE reform is arguably the most efficient way to embed (and advance) the ecological agenda into Brazil's intergovernmental fiscal transfer system. A FPE reform that takes into account the costs associated with the provision of ecosystem services would reduce the fiscal impact that a "pure" fiscal equalization transfer reform would have on states, while also providing economic incentives for states to protect their ecosystem services. Since the main beneficiaries of the ecological fiscal transfer would be Amazonian States, bundling social and environmental reform provides a unique political window of opportunity to the Government of Brazil (GOB) to advance both its social and environmental agendas.

The report is organized as follows: This first section of the report is dedicated to reviewing the potential equitable reform of the FPE as fully discussed in World Bank (2022), including the motivation, contents, and potential effects of the FPE, and the potential funds that could be liberated to introduce the Green FPE. Section two reviews the international experience and conceptual approaches to the design of green transfers to extract useful lessons for Brazil, followed by a review of previous experiences with green transfers and antecedents with performance-based transfer design in Brazil. The core of this section two is dedicated to the conceptual design of the Green FPE, to structuring the formulas for the three components of the Green FPE, and last, to quantifying and simulating the different options for the implementation of the Green FPE system. In section three we explore the potential financing of the Green FPE system with funds from a reformed FPE, could leverage conservation finance options for states, including the potential role

[1] Ação Direta de Inconstitucionalidade (ADI) 5069/AL. Ação Direta de Inconstitucionalidade (ADI) 2727/DF.

of other funding sources, such as private market contributions, international donations, and so on. And the last section concludes with an analysis of the political economy of the reform.

The long-awaited reform of the FPE

Between 1964-66, Brazil implemented a series of tax reforms that shaped the national tax system for the next 60 years. The FPE, an intergovernmental fiscal transfer from federal to state governments was originally created in the midst of such reforms. FPE was established in 1965, in the same constitutional amendment that introduced the National Tax System (*Sistema Tributário Nacional*). The amendment later gave rise to another important reform: the introduction of the National Tax Code (*Código Tributário Nacional*) which took place in 1966. It would take almost 6 decades until another equally important tax reform were introduced in Brazil.[2]

The initial FPE allocation formula[3], designed in 1965, was intended to promote fiscal equalization across states. However, the transfer mechanism was plagued by various *ad hoc* factors that made it less transparent and limited its effectiveness from the beginning. The original FPE formula considered states' population share and the inverse of their GDP per capita. Once each of these values were calculated, they were mapped into an output value table. The calculation proceeded by the multiplication of these two output values for each state, generating an index for all states. The output value tables aimed at reducing the variation of results across states, and it did so by benefiting states with smaller population sizes and, to a lesser extent, also benefiting states with lower GDP. Given that the final distribution of transfers depended heavily on the *ad hoc* output values table, the methodology was not fully transparent and it became increasingly difficult for such it to remain relevant over the years.

Perhaps to correct for the limitations of the allocation formula, FPE apportionment rules went through various reformulations over the years. When it was initially established, 5% of FPE pool of funds were to be allocated according to state territorial size, and 95% according to the multiplicative formula (discussed above). In 1975, an amendment was implemented[4] such that in the next 2 years, the North and Northeast regions would receive 10% of FPE funds and from 1978 onwards, 20% of the pool of funds would be allocated to those regions. In 1989, a new legislation (LC 62/1989)[5] established that 15% of the FPE funds would be allocated to the North, Northeast and Midwest regions and 85% for the South and Southeast regions of Brazil. Importantly, the 1989 law also established new allocation coefficients for distributing FPE funds. These coefficients were defined in negotiations in Congress, in an *ad hoc* manner, where the previously used coefficients were adjusted to ensure the apportionment divide along the regional lines[6]. This was the first legislation, since the FPE was established, that defined FPE coefficients instead of a formula. These coefficients were supposed to be temporary and were expected to be updated with the 1990

[2] On December 2023, Congress approved a constitutional amendment (Emenda Constitucional 132) introducing a significant reform of the tax code. Perhaps most relevant was the introduction of the consumption base principle for tax collection which can introduce a significant shift in the tax base for some states but aligns Brazil's system with international best practices.

[3] Law n. 5172 from 1966

[4] Decreto-lei n. 1434 from December 1975

[5] Lei complementar n. 62 from 1989

[6] Ação Direta de Inconstitucionalidade (ADI) 5069/AL.

census data (as stated in the same law). However, the revision became increasingly difficult. The coefficients established in 1989 remained unchanged for decades.

Since early 2000's the discussions over the FPE distribution methodology has involved the judiciary, including appeals in the Supreme Court. In 2010, the Supreme Court declared law 62/1989 unconstitutional but it was only in 2013 that an FPE reform was passed in Congress. The new Complementary Law (143/2013) was passed in 2013, and it took effect in 2016. The 2013 measures included a hold harmless provision, guaranteeing the states the same transfers they had under Law 62 and with the new formula only applying to the FPE funding that exceeded the pool of funds in 2015 (adjusted for inflation). This new distribution formula applied to the marginal increment in the pool of funds and included a population output value table as well as an income per capita output value table, with both factors weighted equally.[7] These changes were, in essence, a return to the original FPE structure, and did little to change the status quo, especially given the overall low economic growth and therefore marginal increases in the total FPE pool of funds. Subsequently, several states appealed to the Supreme Court to assess the constitutionality of Law 143, claiming that the new law did not introduce any significant changes to the system, and thus did not comply with the Supreme Court ruling of 2010. Most recently, in 2023, the Supreme Court ruled against the constitutionality of the 2013 Complementary Law. The Supreme Court also mandated that new legislation defining FPE allocation formula should be issued by the end of 2025 (ADI 5069).

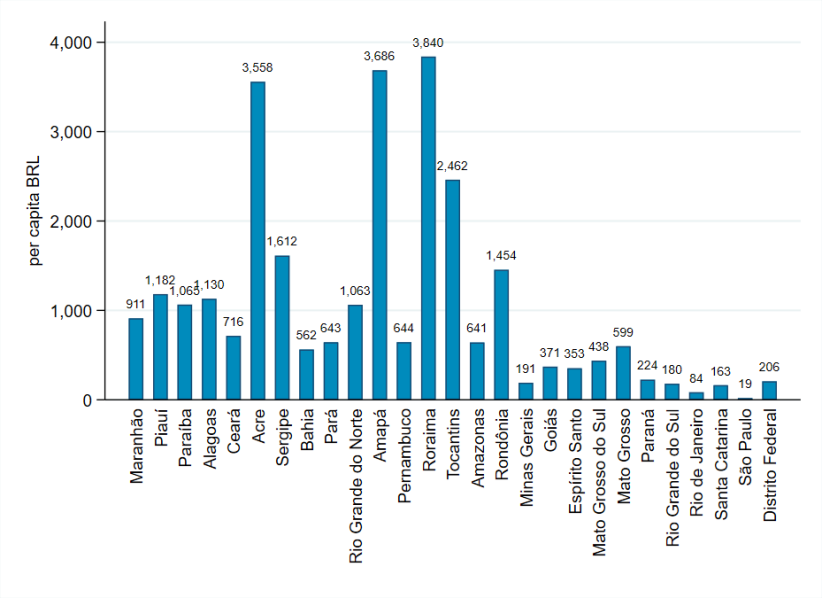
Considering options for the reform of the FPE based on Functional Expenditures

In its essence, the FPE transfer was designed as an equalization transfer, aiming at reducing fiscal disparities across state governments in Brazil. However, as documented in World Bank (2022), the current allocation formula has had, over the last decades, limited equalizing impact. Figure 1 shows that states in the middle of the income distribution benefit relatively more than poorer states. While some states have gone through significant economic changes since the fund was originally established, the allocation of FPE shares is essentially very similar to the one proposed in the 1960s, as discussed in the previous section.

In recent years the Brazilian government has been examining options for improving equity and cohesion of FPE transfers. To contribute to the public debate around FPE reform, the World Bank (2022) applied international best practices on the design of intergovernmental transfers to simulate the impact of a FPE reform. The most common objective of equalization transfer is to reduce horizontal fiscal disparities in terms of subnational governments' fiscal capacity to meet their standard expenditure needs. The most advanced model of equalization transfers found in international practice is the "fiscal gap" approach, which is defined as the difference between separate estimates of expenditure needs and fiscal capacity.

[7] In addition, if a state per capita income was more than 72 percent above the national average, that state's coefficient was reduced by the size of the "excess" identified; nevertheless, no state could have a coefficient smaller than 0.05 percent.

Figure 1: Per capita FPE transfer to the states from poorest (left) to richest (right)(2018)



Source: World Bank (2022)

The "fiscal gap" methodology succeeds in embedding into the system incentives for a more fiscally responsible provision of public services at the subnational level while encouraging own revenue mobilization and discouraging perverse strategic behavior from local governments. In particular, fiscal capacity is calculated as the sum of estimated own *potential* revenue, shared revenues and other qualified revenues. The use of potential revenues instead of actual revenues ensures that states do not engage in perverse behavior such as exercising less effort in tax collection in order to receive larger federal transfers. In addition, shared revenues (other federal transfers) are also considered for each state fiscal capacity. This ensures that transfers received outside of the FPE are also considered in the calculations of the fiscal gap, which brings more cohesion, equity and transparency to the system.

The calculation of expenditure needs uses a combination of top-down techniques and a regression based expenditure system approach. Even when there is similar level of economic development (and therefore fiscal capacity to raise own revenues), subnational governments differ in the level of expenditure needs arising from identical functional expenditure assignments due to differences, for example, in their sociodemographic composition, or the costs of standard service delivery. A list of government functions and the drivers selected to calculate expenditure needs is shown below. A more detailed explanation of the methodology can be found in World Bank (2022).

Table 1: Aggregate Expenditure of State Governments by Functional Categories

Functional category	Aggregate Expenditure (%)	Drivers
Previdência Social	25.20%	Population
Educação	17.47%	Population age 10-19
Saúde	15.27%	Population above 60; children 9 and below
Segurança pública	12.32%	Population; deaths related to violent causes
Judiciária	6.38%	Population
Administração	5.19%	Population
Transporte	3.79%	Hard surface road per 100km; population
Justiça	3.10%	Population
Legislativo	2.51%	Number of representatives in state legislature
Direitos da cidadania	2.01%	Population
Agricultura	1.21%	
Urbanismo	0.99%	
Assistência social	0.85%	
Gestão ambiental	0.75%	
Ciência e tecnologia	0.60%	
Saneamento	0.51%	
Cultura	0.39%	
Comércio e serviços	0.35%	
Habitação	0.22%	
Trabalho	0.17%	
Indústria	0.15%	
Desporte e lazer	0.15%	
Comunicação	0.10%	
Agricultura	0.04%	
Energia	0.03%	

Fonte: Declaração de Contas Anuais, STN, 2018. Cálculos próprios.

In addition to the general guidelines for the implementation of the fiscal gap approach, three underlying assumptions were included in the simulations: i) the reform should be budget neutral, and significantly increase the ii) equity and iii) efficiency in the allocation of FPE resources among the states. The application of the fiscal gap methodology to improve the fiscal equalization component of FPE is constrained by standing Brazilian Constitution mandates on expenditure policies by the states earmarking fixed percentages of the states' net revenues and transfers for specific uses: 25 percent for education and 12 percent for health. Taking those mandates into account, the World Bank (2022) report proposed creating three different equalization grants:

1) a conditional equalizing health grant;

2) a conditional equalizing education grant; and

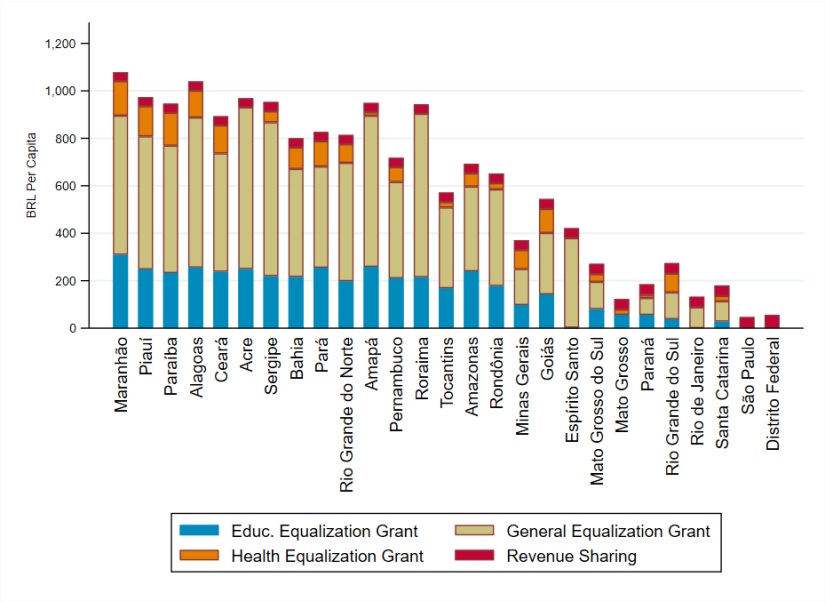
3) a general unconditional equalizing grant (involving all other expenditure needs excluding education and health).

The approach is also very flexible, having the potential to be fully adaptable even if constitutional earmarking for education and health services are changed. For example, the separate education and health equalization funds could be combined into a single conditional health & education equalization fund, or all transfers could be collapsed into a single general equalization fund. While it would be simpler to design only one unconditional equalizing transfer, the introduction of the health and education conditional grants make the system more coherent and transparent, given the constitutional mandates to earmark transfers for these sectors. In addition, the simulation also includes the introduction of a revenue sharing scheme, along with the equalization grants, emphasizing the "devolution" objective, or rewarding the states for their respective contributions to national wealth (in contrast to the purely redistribution objective pursued by the three equalization grants).[8]

The simulation results show various possibilities which yield more equitable results across the states, with relatively poorer states receiving more funds in per capita transfers than relatively richer ones, thus improving equity in comparison to the current allocation of FPE transfers. As an example, Figure 2 shows the final per capita value that each state would receive under a reformed FPE, here referred to as scenario 1, where states are ranked by income per capita from left to right. In contrast to the current distribution, as shown in Figure 1, the per capita funds received in broad terms decline with income per capita of the state. To verify the progressive pro-poor impact of the potential reform, Figure 3 shows the impact of the reform on states ranked by GDP per capita (panel "a"), the share of poor in each state (those living on under USD 5.5 a day, panel "b") and the Human Development Index (HDI) of each state (panel "c"). Overall, the new distribution of transfers would benefit the states with lower HDI more and also the states with larger shares of the poor. Since the FPE is the largest federal transfer to the states, the potential reforms would positively affect the distribution pattern of the whole system of intergovernmental transfers to states, which also include oil royalties (mostly received by states facing offshore oil production) and the Constitutional Fund for the Federal District (FCDF), as shown in Figure 4

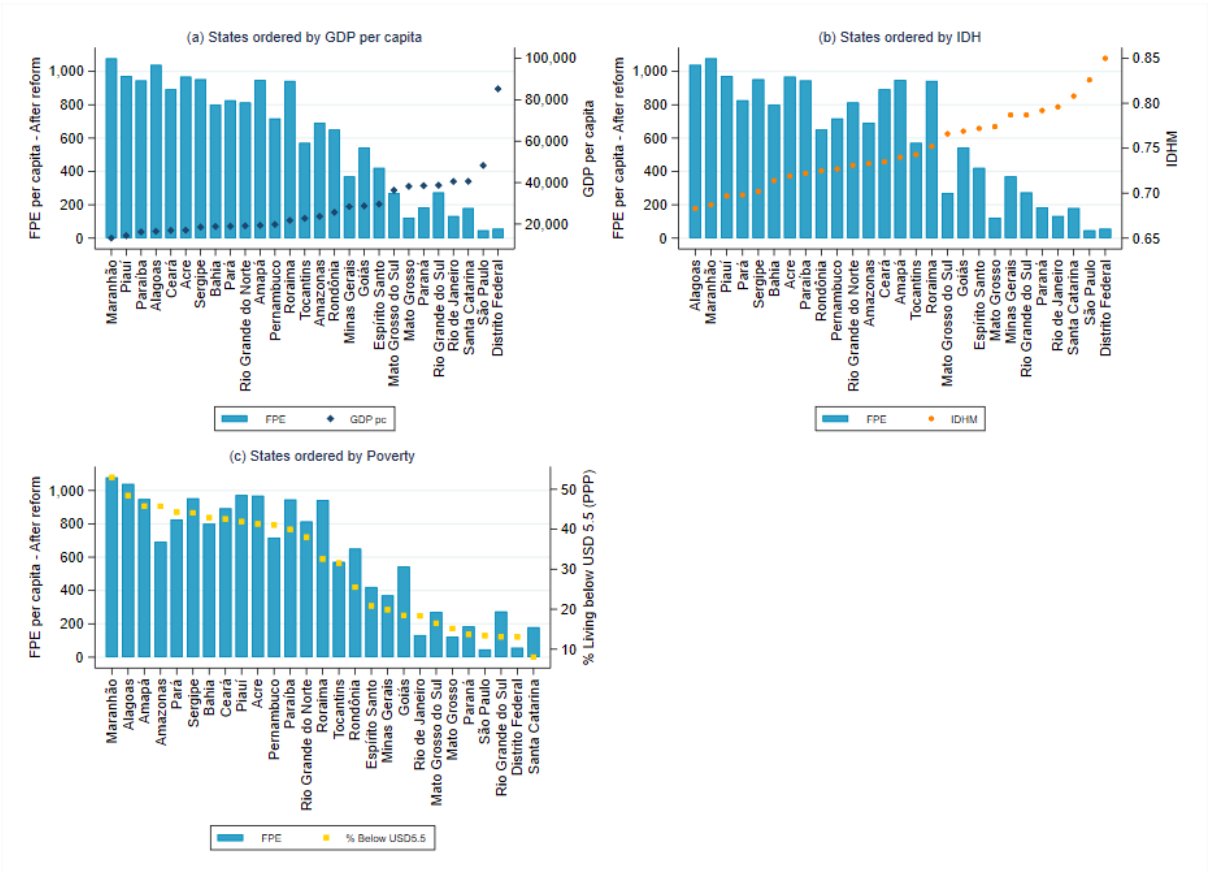
[8] The revenue sharing transfer was based on a simple formula based on population and state GDP. The GDP factor recognizes and incentivizes the contribution by the states to economic activity and growth, while the population factor tends to be more re-distributional. Revenue sharing is a common element of the transfer system in other federal or highly decentralized countries.

Figure 2: FPE funds per capita under Scenario 1 --with the states ordered from poorest (left) to richest (right)



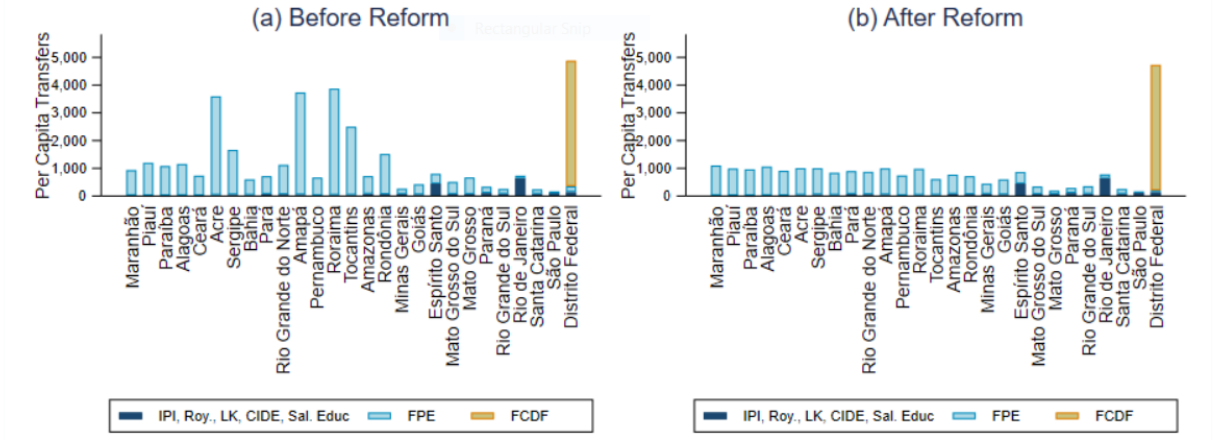
Source: World Bank (2022).

Figure 3: FPE distribution under scenario 1, according to GDP per capita, poverty, and HDI



Source: World Bank (2022).

Figure 4: Per capita total transfers Before vs After the FPE Reform (under Scenario 1) --with the states ordered from poorest (left) to richest (right)



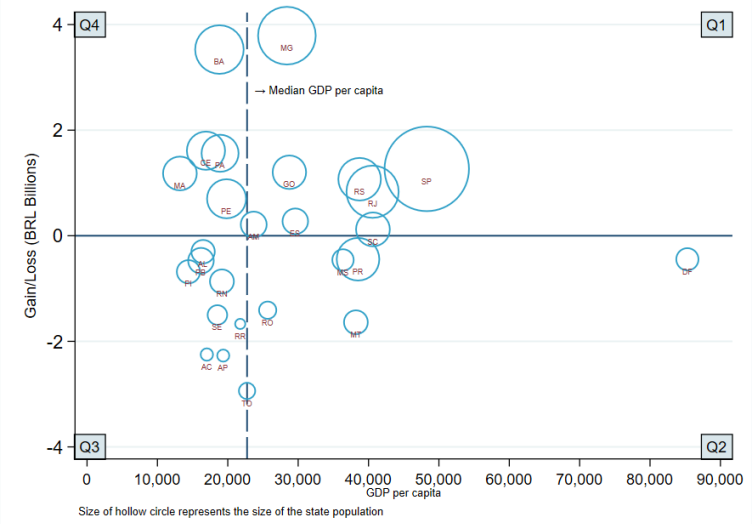
Source: World Bank (2022).

The impact of a budget neutral reform: winners and losers along population lines

Error! Reference source not found.**Since all reform scenario simulations were carried out under the basic assumption of budget neutrality, the implication is that the reforms would necessarily generate gains and losses**: some states would receive increased FPE allocations and other states reduced allocations, and the sum of the gains would equal the sum of the losses. A fiscal equalization reform that considers per capita expenditure needs corrects for the small population bias in the current distribution formula of FPE. Since the fiscal gap approach considers the relative difference in expenditures needs, which tend to be highly correlated with the client population base for the different public services, winners and losers from a budget neutral fiscal reform will be defined along population lines.

The potential reforms' winners and losers line up along population lines, shifting the regional distribution of FPE funds. A key driver behind the allocation of gains and losses is that the current allocation of FPE transfers benefit relatively more states with smaller populations, even if they are not the poorest among all, such as Acre, Amapá, Roraima, and Tocantins (all Amazonian states with a total population of about 3.5 million, or less than 2% of Brazil's total population). This effect is remnant of FPE's initial allocation formula, which tended to benefit small population states. The reform, as simulated under scenario 1, would increase the share of funds allocated to the South and Southeast regions of the country, which are more populous, and would reduce the funds allocated to smaller states in the North, Northeast or richer states in the Midwest regions, which includes the Legal Amazon states (Acre, Amapá, Amazonas, Maranhão, Mato Grosso, Pará, Rondônia, Roraima, and Tocantins).The impact of the reform (scenario 1) according to population and income level is shown more clearly in Figure 7.

Figure 7: Impact of the Reform, by GDP per capita and Population - Scenario 1



The vertical axis shows gains/losses, the horizontal axis shows the current GDP per capita, and the size of each circle represents the size of the state population (the larger the circle, the larger the state population). Source: World Bank (2022)

Implications for the reform of Green FPE – Going beyond functional expenditures

The rationalization of Brazil's fiscal transfer system and specifically the FPE may provide the opportunity to shift funds from some of the current transfers to finance the Green FPE. A FPE reform that allocates fiscal transfers taking into account only the currently assigned functions of state governments (see Table 1) would result in lower FPE allocations especially for the states in Brazil's North. However, such reform would not recognize the costly provision of ecosystem services that states already provide. A FPE reform that takes into account the costs associated with the provision of ecosystem services would reduce the fiscal impact that a "pure" fiscal equalization transfer reform would have on states, while also providing economic incentives for states to protect their ecosystem services.

Thus, there is an opportunity to restructure the FPE to not only include assigned state functions but also ecosystem services, broadening the objective of the FPE to ensure the provision of both social and environmental services. While not formally an assigned function of states, the provision of ecosystem services is costly - and they benefit the public at large. While states have been providing ecosystem services, no intergovernmental transfer has accounted for the provision of these services. This opens a clear window of political opportunity to both tackle the Amazon deforestation problem and the overdue and politically difficult reform of the FPE.

The important question is where the funds for the Green FPE could come from within the overall reform of the FPE. Over the years, FPE funds have been apportioned towards different regions of Brazil. For example, since 1989, the 15/85 rule has been followed in which 15 percent

of the pool of funds from FPE are allocated in three regions of Brazil (Northeast, North and Midwest) while the remaining 85% are allocated in two regions (South and Southeast). Thus, following previously established rules, it is conceivable to think that within the FPE reform scenario, a fixed share of pool of funds could be allocated towards the Green FPE. There are multiple reform scenarios that could generate funds within the comprehensive reform of the FPE. If the overall constraint continues to be overall budget neutrality, the funds could come, for example, from doing away with the revenue sharing component and using those funds (at 10 percent of the total FPE funding) for the Green FPE. Another possibility would be to reduce the funding for the three equalization grants (education, health, and general) to generate the necessary funds for the Green FPE.

I.2 Strengthening Forest Conservation: The Role of State Governments in preserving the Amazon Forest

The fate of the Brazilian Amazon Forest is of tremendous consequence for the global climate. Amazon deforestation comprises the largest share of Brazil's carbon emissions, making Brazil between the 4th and 6th largest carbon emitting nation on an annual basis (Climate Watch Data, 2023). Furthermore, continued deforestation of the Amazon combined with global warming risks a tipping point beyond which the Amazon rainforest ecosystem faces self-reinforcing drying, dieback, destabilization, and savannization (McKay et al. 2022). The carbon storage value of the Amazon is estimated to be US$210 billion per year. This is in addition to other public good values such as biodiversity (US$45 billion per year), existence value of forest cover (US$30 billion per year), ecosystem services value for agriculture (US$7.5 billion per year), and more, totaling a protection value of US$317 billion per year. This figure dwarfs the private values from crops, pasture, timber, and mining of US$43-98 billion per year (Hanusch, 2023).

The task of protecting such vast territory is immensely challenging and requires coordination and alignment of various actors, particularly states and the federal government. In Brazil, states have autonomy and authority that can be used to reduce deforestation. In a recent cross-country analysis across 30 tropical countries (Busch and Amarjargal 2020), Brazil's second tier governments (states) were second only to India in terms of authorities possessed to control and reduce deforestation. From the 14 indicators analyzed, (9 indicators to assess forest authority and 5 indicators to assess general authority of states), Brazilian states were found to possess 12. For example, Brazilian states have authority over taxation, budgets, police, courts, land ownership, agricultural permits, logging permits, protected areas, spatial planning, and development planning. This make states important actors in the fight against deforestation.

There is a strong economic case for the use of intergovernmental fiscal transfers for protecting the Amazon forest. Firstly, intergovernmental fiscal transfers from the federal government to states can be used efficiently to incentivize states to promote forest protection and therefore ensure the provision of ecosystem services. Environmental fiscal transfers (EFT) compensate governments for the revenues lost as a result of the restriction of economic activities on protected land. Thus EFT mitigate local budget constraints and provide incentives for increased

provision of local conservation by reducing opportunity costs at the local level. Secondly, Deforestation, and the overuse of natural resources in general, are cases of the tragedy of commons where individuals have access to a shared resource (public good) but don't fully internalize the costs associated with its use. The public at large bears the negative externalities that arise from the overuse of natural resources but is not able organize themselves to stop the depletion of natural resources because they face high transaction costs for doing so. In this case, the central government can play an essential role in coordinating the various actors and in aligning incentives (e.g. through transfers) to avoid the destruction of natural resources.

Deforestation in the Amazon is a complex phenomenon driven by economic forces. It is directly driven by the expansion of agriculture, especially cattle ranching (both for beef production and for land speculation) and soybean farming, as well as mining and hydroelectric dams —and the expectation of rising future economic demand for land, resulting in land speculation (land grabbing, or *grilagem* in Portuguese) (Hanusch 2023). These direct drivers are undergirded by the expansion of roads, in-migration, and weak governance and overall enforcement of the current legislation protecting the Amazon Forest. Thus, the key issue for finding a solution to deforestation is to understand why state authorities fail to enforce the law. One hypothesis is that state authorities ignore the illegal conversion of forest land because these activities are perceived as providing jobs, economic growth and various forms of incomes and revenues to the local (e.g., state) economy.[9] Furthermore, state governments may lack sufficient means to enforce the law, or see it as a lower priority.

BOX 1: The cyclical aspect of Amazon Deforestation

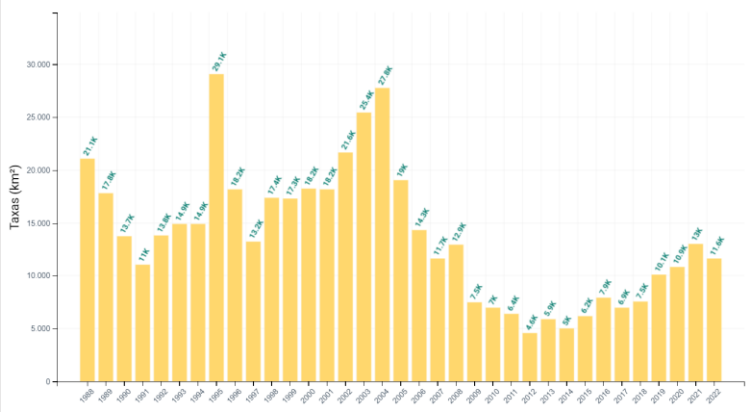
Deforestation in the Amazon has waxed and waned over recent decades. At times, policy has succeeded at substantially curtailing deforestation. The Action Plan for Prevention and Control of Amazon Deforestation (PPCDAm), a multi-faceted government program, succeeded in reducing deforestation by more than 70 percent from 2004-2012, even while Brazilian beef and soy production increased. The PPCDAm included expansion of the protected area system, recognizing Indigenous territories, credit moratoria for high-deforesting municipalities, and monitoring and enforcing deforestation restrictions on private lands. It was accompanied by private commitments not to source soy and beef from recently deforested lands (Nepstad 2014, Seymour and Busch 2016). Strong anti-deforestation policies were assisted by a concurrent dip in commodity prices (Assuncao et al. 2016) as well as other favorable macroeconomic conditions (Ferreira and Hanusch 2023). The total budgetary cost to national, state, and local governments of deforestation control

[9] The federal and municipal governments also play roles in in deforestation control but also may perceive receiving specific benefits from deforestation. For example, both may benefit from the expansion of rural land tax, which is regulated by the federal authorities and collected jointly with municipalities (Pereira et al, 2019). Although our focus will be on the role played by the states, land regularization (preventing land grabbing) and policing both are federal and state functions. From the violators' side, breaking the law to expand the production area can be rather easy; however, land grabbing may take years before it yields uncertain economic benefits. The expectation of private benefits can also lead to offering bribes to corrupt officials to ignore the deforestation. This last important issue is not addressed further in the report.

(excluding opportunity costs) has been measured at about US$1 billion per year (Fogliano et al. 2015).

The Brazilian government under President Lula, reelected in 2022, has again made control of Amazon deforestation a policy priority. In June 2023 the government announced new plans to stop deforestation in the Amazon by 2030. The revived PPCDAm once again presents a multi-pronged, whole-of-government approach to Amazon Forest protection. The plan is reported to include satellite monitoring, regularization of land titles, a registry of rural properties, economic incentives for reforestation and conservation, a crackdown on illegal logging and ranching, tracing of financial transactions and products, and the development of the green economy (MMA, 2023).

Figure 8. Rate of deforestation in the Brazilian Legal Amazon, 1988-2022.



Source: INPE. http://terrabrasilis.dpi.inpe.br/app/dashboard/deforestation/biomes/legal_amazon/rates

Existing programs to combat deforestation have up to now been fragmented and the jurisdictional approach has received relatively less attention. While funding at the project level has been made available either through donors (eg. Fundo Amazônia) or domestically (e.g. Fundo Clima), the role of states has not been fully accounted for. For example, both the original PPCDAm and its recently announced successor focus on anti-deforestation actions that can be taken by the federal government. Neither placed a strong emphasis on the role of state governments. While this is understandable for a national plan in a federal system, it is nevertheless a significant gap in the overall design and the potential effectiveness of the new PPCDAm. Brazil's states have a variety of authorities affecting land use that they can leverage to reduce deforestation if they choose to.

There has been tangible interest on the part of some Brazilian states in reducing deforestation and potentially accessing international finance for doing so but so far these initiatives have not taken off as expected. Nine Brazilian states have joined the Governors' Climate and Forest Taskforce, an international coalition of subnational governments dedicated to protecting forests, reducing emissions, and promoting rural development (Governors' Climate and Forest Taskforce, 2023). In 2010 the state of Acre signed a memorandum of understanding with the state of California in the United States to promote cooperation on REDD+, specifically related to linkage with California's cap and trade program, later formalized as the California Tropical Forest Standard. Both Acre and Mato Grosso have received results-based finance from Germany and Norway through the REDD Early Movers Program. In 2023 Tocantins signed an agreement with

the commodity trading firm Mercuria to sell up to 200 million tons of jurisdictional carbon credits, using either the ART TREES or Verra JNR standard (Reuters 2023).

The most important factor influencing states to establish legal frameworks for jurisdictional REDD+ was the credibility of market incentives, i.e., perceptions that finance for reducing deforestation will be available, according to research based on interviews with government officials and policy entrepreneurs in five Amazonian states (Gueiros 2023). Thus, the federal government can use credible financial incentivizes such as a performance-based transfer mechanism (Green FPE) to encourage the participation of Amazonian states in forest conservation. As already pointed out above, the main objective of this report is to help design such a performance-based transfer mechanism.

Even though states in the Amazon region are already receiving resources incentivizing their efforts for forest protection, the existing programs up to now have been fragmented, providing overall insufficient resources, and their allocation mechanisms have been generally inefficient. This is because conservation efforts have been focused on individual projects and specific areas, mainly because of donors' concerns about implementation complexities and lack of political commitment. The results have been slow in coming and often the disbursement of approved funds has been stopped because of lack of performance.

A jurisdictional approach, covering an entire administrative unit such as a state, is the most effective way to align incentives to stop deforestation. From an economic perspective, the jurisdictional approach addresses the collective action problem, where individuals would be better off cooperating but fail to do so because of conflicting interests between individuals that discourage joint action or because of high transaction costs for doing so. Similar to the experience of FUNDEB/F, Previne Brasil, ICMS-ecológico and ICMS-educação, the jurisdictional approach increases transparency and accountability while also provides financial incentives to induce desired policy outcomes.

The strongest justification for a jurisdictional approach is that a very high share of Amazonian deforestation, which has been estimated at 90 percent, is illegal. Over two-thirds of this illegal deforestation takes place in public lands (non-designated public lands, indigenous lands, conservation units, or land reform settlements). Close to one-third of the forest clearing on public lands has been linked to land grabbing, for the expansion of agricultural production and also for illegal timber extraction and gold mining. [10] As discussed above, states have various authorities in Brazil that position them well to combat deforestation. In particular, State Governments are the only legally responsible and capable entities for controlling state public lands and enforcing the legislation (Forest Code) in private lands.

The introduction of a Green FPE would help Brazil meet its NDCs under the Paris Agreement through improved federal-state coordination and by incentivizing Amazon states to stop deforestation via the federal performance-based transfer and other transfer

[10] Hanusch (2023).

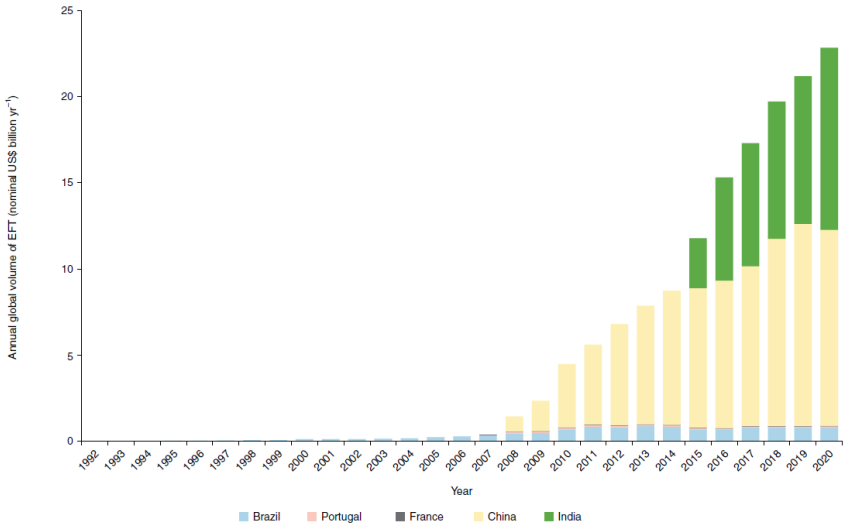
instruments to the states. The states will also benefit because of the increased availability of funds allowing them their most effective use to stop deforestation and at the same time pursue their broader development goals. All these are features should also help lower the risk of policy reversals by future administrations.

II. Designing and simulating the conditional ecological fiscal transfer

II.1 International experience and conceptual review in the design of green transfers

The design of a conditional ecological transfer ("Green FPE") in Brazil can learn lessons from international experiences with a class of public finance instruments called ecological fiscal transfers (EFT). EFTs are transfers of public revenue between governments within a country based on ecological indicators (Busch et al. 2021). The financial relevance of EFT has grown rapidly, from US$0.35 billion per year in 2007 to US$23 billion per year in 2020 (Figure 9). Here, we present selected international experiences with EFT, drawing out lessons for the design of a conditional performance-based transfer in Brazil.

Figure 9. Annual global volume of ecological fiscal transfers



Source: Busch et al. 2021

India: large finance alone does not lead to increased forest area in the absence of performance-based incentives

India's national (Union) government began transferring forest-related funds to state governments in 2005 and has continued to do so through four successive five-year Finance Commissions. In 2005 the 12th Finance Commissions granted a five-year, 10 billion rupee (approximately US$40 million) special-purpose grant for forestry. This special-purpose grant for forestry was enlarged in 2010 by the subsequent 13th Finance Commission to 50 billion rupee (approximately US$200 million) over five years.

In 2015, the 14th Finance Commission recommended that 7.5 percent of the centrally collected tax revenue devolved to states be allocated on the basis of states' area of high- or medium-density forest cover, as measured in the India State of Forests Report 2013. This amounted to more than US$37 billion over five years—a two-order-of-magnitude increase in funding relative to the previous special-purpose grants which they replaced. Unlike the previous grants, which were earmarked for forestry budgets, the new funds were lump-sum general purpose transfers to state budgets, i.e., they could be spent freely. This was concurrent with a major reform of India's fiscal transfer system that eliminated the Planning Commission and increased the share of centrally collected tax revenue devolved to states from 32 percent to 42 percent. In 2020 the 15th Finance Commission further enlarged the EFT, increasing the share of forest area-indexed transfers from 7.5 percent to 10 percent of the centrally collected tax revenue devolved to the states.

The 14th Finance Commission's stated rationales for enacting the forest-based transfers were twofold: i) to compensate states for the "fiscal disability" of forgone tax revenue arising from economic activities foreclosed by the presence of forest cover; and ii) to provide recognition for the forests' "huge" ecological benefits (14th Finance Commission).

While the annual volume of forest cover-indexed finance in India is large, it does not contain performance-based incentives (i.e., the share of funding states receive is not dependent on the extent to which they protect and restore forests). The large-scale financing has not yet been sufficient to bring about improved environmental outcomes. Retrospective analyses found that the size of the forest-based fiscal transfers as a share of state budgets were not correlated with state-level protection and expansion of forest cover nor increased forestry budgets (Busch, Kapur, Mukherjee 2020). This may have been because of the 5-10 year time lag between when the policy was enacted and when new trees would be visible to satellite monitors and reported in biennial reports. Furthermore, it was not until the 15th Finance Commission's 2020 reform that the measurement year for forest cover was updated, providing some confidence to state governments that future increases in forest cover would be rewarded with increases in future funding.

China: *transfer formulae can include bonuses and penalties, in addition to performance-based payments*

Since 2010, China has undertaken general-purpose fiscal transfer payments from the central government to provincial governments to compensate them for the presence of National Key Ecological Function Areas in which economic development is restricted or prohibited. These fiscal transfers comprise around 0.95 percent of the total transfer from central to local governments—around US$11.4 billion in 2020 (Busch et al. 2021).

The allocation formula for transfers is based on an environmental quality index. The formula includes bonuses for local governments that perform exceptionally well on the environmental quality index, as well as fines for local governments that perform exceptionally poorly.

In another Chinese EFT, neighboring provinces enter horizontal, bidirectional transfer agreements based on river water quality (ADB 2016; Cui et al. 2019). When upstream water quality improves relative to a benchmark, the downstream province pays the upstream province. When upstream water quality deteriorates, the upstream province pays the downstream province. The central government monitors, enforces, and subsidizes the arrangement. Again, the formula allows for

both rewards and penalties. Several empirical studies have found that China's NKEFA payments have had a positive effect on some aspects of environmental quality, including pollution reduction and water quality (Busch et al. 2021).

Portugal and France*: *fiscal transfer mechanisms can evolve over time

Both Portugal (Santos et al. 2012) and France (Borie et al. 2014) have enacted national-to-municipal EFT since 2007. In both cases the EFT were established to compensate municipal governments for forgone tax revenue from land restrictions associated with protected areas. These EFT represented 2.5-2.7 percent of total fiscal transfers in Portugal, but just 0.02 percent in France around 2011.

Both countries have made important changes to their EFT over time. In 2014 the Commission for the Reform of Green Taxation made the values that each municipality received from the EFT more visible to mayors. In 2019 France expanded the transfers to include areas within the European Union's Natura 2000 network of protected sites, increasing the number of municipalities eligible for the EFT more than seven-fold from 150 to 1,120.

Indonesia and Malaysia*: *fiscal transfers in high-carbon tropical forest nations

EFT have accelerated since 2019 in two large, federal, tropical forest nations—Indonesia and Malaysia.

In 2019 the Malaysia Ministry of Finance introduced federal-to-state transfers based on the area of terrestrial and marine conservation, to encourage designation of protected areas by state governments and to fund biodiversity conservation programs (Koh et al. 2023). The Government of Malaysia increased the budget allocation for EFT from US$31 million for 2019 and 2021, to US$22.5 million for 2022, and US$44.9 million for 2023. These EFT allocate grants to the Ministry of Natural Resources, Environment, and Climate Change (NRECC) to implement the mechanism in the states. The distribution formula involves a 70 percent allocation based on protected area, and a 30 percent allocation that is performance based (BIOFIN 2023).

Indonesia has enacted EFT across multiple levels of government. The Ecological Provincial Budget Transfer (*Transfer Anggaran Provinsi berbasis Ekologi*, TAPE) (Rahman et al. 2020) transfers budgets from provincial to district governments based on ecological indicators to be decided by each province. North Kalimantan includes reduction in forest fires as an indicator, alongside water quality, air quality, waste management, and open space (or natural area) (Governor of North Kalimantan (2019).

At the national level, the national-to-provincial Regional Incentive Fund (DID) was expanded to include environment and forestry issues by the Ministry of Finance decree No. 160/2021, applying to the 2022 national/state budget. The inclusion of forest cover in the considerably larger national-to-district General Allocation Fund was announced in November 2022 at the UNFCCC COP27 at Sharm El-Sheikh. EFT for district-to-village funds by including ecological indicators in the Village Fund Allocation have been established for prevention of forest fires in Siak Regency of Riau

Province (Kabullah 2022) and proposed for protection of forest areas in the Kutai Timur district of East Kalimantan (Nasim 2022).

Common themes of EFT: compensation, equalization, simplicity

In most, if not all, cases, EFT were put in place at least in part to compensate jurisdictions for forgone revenues due to environmental protection measures (e.g., protected areas in Brazil and Europe; land-use restrictions in China) or ecological land cover (e.g., dense forests in India). However, EFT were also motivated by a desire to improve environmental outcomes, including forest cover, forest fire control, and biodiversity. The creation of a Green FPE would be consistent with this storyline, compensating Brazilian states for the provision of ecosystem services, while also reducing the impact from a FPE reform that takes into account only functional expenditures (as illustrated above).

There is often a synergy between EFT and the "equalization" goal of intergovernmental transfer systems, i.e. the redistribution of public revenues to increase the public budgets of poorer states or municipalities, compensating for disparities in expenditure needs and revenue capacity. Regions that receive a larger share of EFT are often more remote, with greater fiscal needs; while regions that receive a smaller share of EFT are often more urban and well off. This pattern would be the case in Brazil as well.

Most EFT have relied on simple indicators such as protected area or forest area (a notable exception is China with an index of dozens of environmental quality measurements). Simpler indicators are easier to measure, easier to explain, and easier to coalesce to consensus across diverse stakeholders. However, simple indicators may be inferior to weighted indices, or more elaborate formulae, when it comes to capturing nuances for incentivizing changes in environmental performance. These issues and the tradeoffs involved are further discussed in the following sections.

Insights from fiscal transfer simulations

There do not yet exist any EFT that were designed primarily for the purpose of reducing deforestation and associated emissions. Thus, insights into the design of multi-tier incentive systems must come from simulations. Selected research on the design of effective, efficient, and equitable performance-based transfers to reduce deforestation is shown here, with insights for the Brazilian context.

Cattaneo (2009) proposed a "stock-flow with targets" multi-tier REDD+ incentive system in which revenues (e.g., between Brazilian states) are allocated based on three indicators: 1) Stocks of forest carbon; 2) reductions of flows of carbon dioxide emissions relative to a baseline; and 3) a bonus payment for achieving a target level of emission reductions. The weights placed on each indicator can be balanced to achieve desired levels of effectiveness, efficiency, and equity.

Busch et al. (2011) simulated a multi-tier incentive structure for REDD+ in Indonesia. A "mandatory" (i.e., cap-and-trade-like) structure of incentives performed best, reducing emissions 20-31 percent below reference at US$10/tCO2. However, four improvements to a "voluntary" (i.e. PES-like) structure could make it perform nearly as well, reducing emissions by 17-26 percent. These four improvements are: 1) Scale: incentivize performance at the scale of jurisdictions rather than site-by-site; 2) Reference levels: credit emission reductions relative to a modeled approximation of future business-as-usual emissions rather than historical emissions; 3) Revenue sharing: the national government should obtain a portion of revenues that districts receive from reducing emissions; 4) Responsibility sharing: district governments should bear a portion of the costs arising from their emission increases.

Irawan et al (2014) compared two approaches for paying for provincial emission reductions in a simulated Indonesia. In the "cost-reimbursement" approach, provinces are paid only for their opportunity costs. Here the producer surplus is "meagre," with the authors questioning whether the revenues would be sufficient to shift the interest of local governments toward forest conservation. Alternatively, in the "derivation" approach, the share of revenue received by provincial governments is fixed, and the overall amount fluctuates with a carbon price. Higher carbon prices make local governments more likely to participate in forest conservation and emission reductions.

II.2 Brazilian experience and antecedents: lessons from previous proposals on federal green transfers and experience with similar types of transfers.

FUNDEF/FUNDEB

In 1998, the federal government introduced an education equalization system, known as FUNDEF (later turned into FUNDEB), which comprises of 27 state education equalization funds with a federal top up for states that don't reach minimum spending. The emergence of the education equalization scheme was intricately connected with Brazil's rules for education funding at the subnational level. In fact, in Brazil funding for education is earmarked as a percentage of revenue collection. While the earmarking ensures investment in the education sector, it also creates distortions since richer governments are required to invest significantly more in education than poorer ones. Thus, with the goal of expanding access to education and reducing regional inequalities, the education equalization scheme was set up. It effectively redistributes revenues from richer governments to poorer ones within a state, thus creating a minimum state spending. The federal government provides a top up for state funds that don't reach (the endogenously defined) minimum per pupil spending.

FUNDEF, together with institutional reforms, has been widely credited for the expansion in enrollment for primary education. Prior to FUNDEF creation, the *Lei de Diretrizes e Base da Educação* was passed, which among other things, defined the assignment of responsibilities for the provision of education, assigning to local governments responsibility over primary education while state governments became responsible for upper secondary education. According to the

Ministry of Education (MEC, 2002), FUNDEF increased enrollment of students ages 7-14 by 6.7%. Importantly, student enrollment at local government schools increased from 33% in 1996 to 50.3% in 2002. According to most recent data, 86% of students in primary education in the public sector are enrolled in local government schools (INEP, 2022).

Despite success in increasing enrollment and incentivizing the assignment of responsibilities in education, FUNDEF has not been able to improve education quality significantly. In 2020, the legal framework of the now FUNDEB was revised by Congress and in addition to increasing the pool of funds available for the system of funds, a component on performance-based incentive was also introduced. This component will reward states based on school management practices and learning outcomes. Specifically, the performance-based component of the new FUNDEB is inspired in state experiences with similar schemes, most notably in the state of Ceará, which already uses performance-based incentives in the public school network of local governments.

PREVINE Brasil

In Brazil, primary health care (PHC) is an assigned responsibility of local governments. However, through the national fund for health, the federal government also provides monthly funding for local governments to support the implementation and improvement of service delivery. For many years, funding from the federal government was pulverized in a variety of programs which limited the effectiveness of the financing. To rationalize and make the PHC funding system more transparent and effective, the federal government introduced in 2019 the *Previne Brasil* Program, which became a new model to finance PHC in Brazil. The new financing model, inspired by international experience, introduced three criteria for the allocation of funds from federal government to municipalities: weighted capitation, payment for performance, and incentive for implementation of strategic programs.

The main objective of *Previne Brasil* was to structure a financing model focused on increasing people's access to Primary Care services and to strengthen the relationship between the population and the teams of health care providers. The introduction of transparent and objective measures aimed at increasing accountability for the provision of PHC. Payment for performance is now one of the components that make up the monthly transfer to municipalities. In this component, the amount to be transferred depends on the results achieved in a set of indicators monitored and evaluated, which are combined into a final synthetic indicator defining the financial incentive for payment for performance by municipality. The indicators are calculated every four months and the results are made available in the subsequent four-month period on the Ministry of Health's website.

The attributes of PHC are strengthened by the Payment for Performance of the *Previne Brasil* Program, which leads to the improvement of work processes and the qualification of health results, in addition to optimizing aspects such as periodicity and an explicit evaluation method. An example of this is that, by monitoring these indicators, access, quality and resolution of services provided by eSF/eAP can be evaluated, providing subsidies for measures implemented to improve actions, and giving more transparency to investments in the health sector to the society.

Previous Green FPE proposals

Several ideas of a Green FPE have been proposed and discussed in Brazil over the past several decades. In an important paper for this report, Cassola (2014) reviews in depth some these previous proposals that have attempted to add an environmental component to the FPE. The first of this line of proposal dates from 1999, when Complementary Bill No. 50/1999 was presented, proposing the so-called for the first time "Green FPE". Other bills followed, perhaps the most relevant being Complementary Bill No. 351/20027 proposed in 2000, and discussed in the Chamber of Deputies later as PLP nº 158/2015 (amending Complementary Law nº 62/1989). The proposal in substance was "to establish an FPE reserve for the Federation Units that house, in their territories, nature conservation units or demarcated indigenous lands."

This Green FPE would reserve 2 percent of the FPE resources to be shared among the States based on the relative forest coverage of protected areas of their territory (including indigenous peoples and federal conservation units in the public domain). In 2011 these 2 percent funds represented about R$ 960 million. More specifically, the proposal was to create seven discrete categories of coverage by type of protected area, and using a series of coefficients (ranging from 1 to 7) to arrive at how much should be transferred to the State under the Green FPE. An important consideration is that the proposal only included some categories of conservation units and excluded others in the computation of the Green FPE transfer.[11]

The proposal also had specific provisions for the sources of the funds and for the use of the funds received by the states. Concerning the sources of the funds for the 2% of the FPE, three-quarters would come from FPE resources that were allocated to the South and Southeast States and the remaining one quarter from the other regions.[12] Regarding the use of funds, the proposal mandated that the funds received from the Green FPE must be applied to "sustainable development projects," which would specified in future legislation.

ICMS-Ecologico as a forerunner of a Green FPE?

Brazil already has a system of ecological fiscal transfers from states to municipalities, the *Imposto sobre Circulação de Mercadorias* e *Serviços- Ecológico* (ICMS-E). In Brazil, states share revenues from ICMS (quase-VAT tax) with municipalities, but part of the resources can be distributed according to state specific rules. In 1991, the state of Paraná added protected areas for biodiversity conservation and watershed protection to its ICMS distribution formula—the first example of an ICMS-E. By 2020 the ICMS-E concept had been adopted by 18 of Brazil's 27 states

[11] In addition to indigenous lands, only certain categories of conservation units (National Parks, Federal Biological Reserves, Federal Ecological Stations, National Forests and Federal Extractive Reserves) were considered for the State to benefit from the Green FPE transfers. Thus, all state conservation units, as well as other federal conservation units were excluded from counting for the funds to be distributed.

[12] The distribution of the FPE continued to be based on fixed percentages, by which poorer States – Midwest, North and Northeast regions – received 85 percent of the FPE transfers and richer States – Southern regions and Southeast – received 15 percent. The Green FPE proposal would have changed those shares to 84.5% and 13.5%, respectively, which would have made up the required 2 percent.

(Busch et al. 2021).[13] The most common ecological indicators included by states are land area under protection (n=15), Indigenous lands (n=11), and water and sanitation (n=7). Indicators related to forest conservation include forest area (in Minas Gerais), forest management (in Pará), and fire control (in Tocantins). In the wake of thet ax reform approved in 2023, ICMS-E will be mandatory under the new tax system – 1.25% of state IBS revenues will be transferred to municipalities according to environmental performance based formulas.

Since 1999, proposals have been introduced in the Brazilian congress for a Brazil-wide national-to-state EFT, i.e. *an FPE-Verde*. However, none of these proposals have been approved into law (Cassola 2014).

II.3 Designing the Green FPE transfer system

In the Brazilian Amazon, the provision of ecosystem services is intricately dependent on the preservation of the Rainforest and on the reduction of deforestation. To the extent that states have autonomy and authority that can be used to reduce deforestation, they are key players in promoting forest preservation. In order to ensure the provision of ecosystem services, it is necessary to provide financial incentives for states to combat deforestation. Thus, there is a strong economic case for the use of intergovernmental fiscal transfers for incentivizing the provision of ecosystem services, and therefore forest protection, at the subnational level.

From an economic perspective, deforestation is the result of a cost-benefit analysis incurred by agents who seek to maximize their private welfare. More specifically, in the case of illegal deforestation, agents (including farmers, ranchers, and land-speculators) find it possible and profitable to illegally cut or burn forest land to use to produce various agricultural crops and cattle. Often, a key characteristic of this illegal process is that the agent does not own the land he deforests. Thus, unlike a farmer who behaves improperly on his own land, there is no private cost beyond the relatively small private cost associated with deforestation itself. Rather, there are mostly negative public externalities. As we have seen, these include carbon emissions, biodiversity loss, shifting precipitation patterns, loss of water reserves, or damage to indigenous populations.

A key feature of the deforestation cycle is that current laws are not being enforced. In a related manner, forest clearing may be happening on private properties in violation of statutory minimum area of forest cover ("legal reserves"). In this latter case, property rights are clear. However, again, even when property rights are clear, the law is not sufficiently enforced. The

[13] This includes all ICMS transfers to municipalities based on ecological criteria. In some states this is termed the ICMS Verde or ICMS Socioambiental or has no specific name.

value of social losses from climate change induced by deforestation far exceeds the benefits to states governments (as well as those of other actors like local governments and private farmers).

It is possible in principle to financially incentivize State Governments –as agents currently allowing deforestation—to enforce the current laws and stop deforestation. Assuming that the current Forest Code and "Command and Control" regulations will remain in place, cutting the forest will continue to generate criminal and monetary penalties. But, in addition the states will be incentivized to enforce those laws. Thus, a main part of the task will be to accurately estimate the threshold of payments that states would need to receive (i.e "willingness to accept") in order to seriously intervene through policing and other means to completely stop, or at least slow down, the deforestation of the Amazon Forest cover within their jurisdictions.

As discussed above, the main reason behind deforestation is that it produces economic gains for economic agents and ultimately also for the State Government. This reality is crucial for understanding what will and what will not work in effectively combating the deforestation of the Amazon. Thus, one main idea behind the performance-based transfer component is to compensate the States for the economic losses associated with stopping deforestation (including the losses of economic output, employment opportunities, and fiscal revenues), and in addition compensating them for their added law enforcement costs.[14] Thus, the main objective is to design a performance-based transfer program accompanied by other complementary transfers instruments with the main goal of incentivizing the Brazilian states, and particularly those in the Legal Amazon, to step up in their forest protection efforts enough to result in a complete halt to the Amazon deforestation process. How to do that most efficiently is one of the challenges. The other main challenge is how to do that equitably, and how to fit this new transfer scheme into a reformed FPE, the largest equalization transfer scheme of the federal government to the Brazilian states.

The jurisdictional approach: defining actors and territorial area

The Green FPE mechanism follows a jurisdiction-based approach. All the benefits and responsibilities associated with the scheme are designed at the state level. Although, in parallel, the federal government and local municipalities need to play significant roles for the overall scheme to function well,[15] the Green FPE does not address incentives for these two levels of government. Other stakeholders, including farmers and local businesses would also need to be involved. However, those agents are not directly addressed within the Green FPE mechanism. This is so to avoid institutional fragmentation and largely ineffectiveness as it happened with past policy programs, which had a focus on individual projects. The Green FPE concentrates on the level of

[14] The enforcement costs implied for the states (and for the federal government), effectively investing in land and forest governance can be quite significant. By enforcement costs we understand the full operationalization and monitoring of the Forest Code (especially the rural cadaster, CAR), the policing (Command and Control)–and land regularization. This latter is needed because a large portion of Amazonian land is still "undedicated," and this type of land is the most common target for illegal land grabbing activities (see World Bank, 2023).

[15] Those roles at the federal and municipal levels will be explained further below.

administration, the states, that are seen as the critical links in stopping the deforestation of the Amazon.

But what is a jurisdiction? In the development of the Green FPE mechanism, it is possible to consider two different perspectives on the jurisdictional approach at the state level. In the first, the relevant jurisdiction is each separate state. The first perspective is the state level, as represented by each state government making its own policies and decisions. The second perspective considers the entire Legal Amazon as one jurisdiction. In the latter, in addition to the payment to each state, as in the state jurisdictional approach, there will be a payment to each state if all the states select to not deforest, or if Legal Amazon-wide net deforestation is below a specified level.[16] While the first perspective is immediate and intuitive, the second calls for a little more explanation.

An important weakness of the jurisdictional approach based at the single state level is that it does not address the potential threat of deforestation leakages across different states. In theory, considering the entire legal Amazonas as one jurisdiction is more likely to ensure the effectiveness of climate change policy in Brazil. As we have seen, increases in the deforestation levels are very likely due to the presence of strong economic incentives. These economic incentives for any state are likely to become much stronger as other states are successful in cutting down or eliminating deforestation within their jurisdictions. Therefore, there is the risk that successful efforts to contain deforestation in one state can be undone by deforestation in another state, producing "deforestation leaks."[17] These leakages could compromise all other states eligibility for (some types of) conservation finance, and not just for the state(s) doing the deforestation. Adopting the entire Legal Amazon approach is a way to avoid those deforestation leaks. This means that the rewards to the states designed into the performance-based transfer are only implemented if deforestation falls across the entire Legal Amazon to the levels targeted so to completely stop deforestation. The major implication is that the compensation for each state in the performance-based transfer must include the benefits a state could get by choosing to deforest when all other states choose to preserve (not to deforest) (Kimbrough, 2023).[18]

Despite its theoretical appeal, the entire Legal Amazon jurisdictional approach implies complex design. The financing needs under this approach can potentially become much larger. In fact, the main design challenge is that the rewards for each state will depend not only on its own actions (as is the case in the state jurisdiction-based approach) but also on those actions of all other states (in the Legal Amazon). Since payments to any one state will depend on the joint performance of all Legal Amazon states in reducing deforestation, the risk of underperformance by any of the states would reduce the incentive for forest protection for all other states. Conversely, the returns to deforestation to any state increase as fewer states select to not deforest. Therefore, it would be important to have a design that avoids strategic or gaming behaviors across the states. To avoid

[16] See Kimbrough (2023).
[17] See Porcher and Hanusch (2022) for a full discussion of the issue of deforestation leakages.
[18] See Kimbrough (2023) for further discussion and insights.

this, the use of a "bonus payments" can be introduced to ensure that full forest protection is the dominant behavioral strategy for each state, thus ensuring the incentive compatibility of the system for all states. Thus, the key is to incentivize each and all states to do their part because they will be reassured that all other states will too.

Under the Legal Amazon one jurisdiction approach, the design of the appropriate bonus payments to ensure that compliance is a dominant strategy for each state is complex. The key idea here is that the opportunity cost of avoiding deforestation goes up for any single state as more states comply with zero deforestation policies (or more in general as they deforest less). In the limit, that opportunity cost will be the highest when all states but the one under consideration are compliant with zero deforestation. In that case the "bonus payment" for a state will be an increase in its performance-based transfer that allows for that highest opportunity cost (plus enforcement costs). This transfer with the "bonus" payment added will guarantee that compliance is the dominant strategy for that state (and each single state) no matter what other states do.[19] And this is the payments all state receive as they meet their targets for reducing deforestation. Compliance incentives can perhaps be further strengthened by introducing a second bonus for compliant states with the funds saved from (not going to) non-compliant states. That is, if a state fails to meet its target, then it receives nothing, while all states who successfully meet their targets receive an extra bonus payment (on top of its performance-based transfer) from sharing the funds of the non-compliant state(s). This strengthens meeting one's target as dominant strategy for each state. If any one state believes that one or other states will fail to meet their target, their incentive to control their own deforestation is now even larger. [20]

One potential way to lower the large financial requirements of adding the "bonus payments" under the Legal Amazon jurisdictional approach is to introduce penalties. For example, penalties can be introduced on any state that chooses to deforest high enough so that its gains from even being the only state deforesting are smaller than the gains it would receive if it joined all states in choosing joint preservation of the forest. In the case there is some deforestation the penalty receipts could be used to compensate the good performers.[21] On the downside, introducing a penalty within the performance-based transfer adds to the overall complexity of the design. In what follows, the simulations will consider the first perspective, that is, each state level, represented by each state government making its own policies and decisions.

The three components of the Green FPE transfer system

[19] This builds on the logic of "assurance games" from the branch of economics known as game theory (Kimbrough (2023).

[20] This additional bonus payment is suggested in World Bank (2023). It does not seem to be strictly needed to guarantee that compliance is the dominant strategy for each state, but it certainly strengthens it and help to solve the issue that all FPE funds must be distributed in any one year. Otherwise, the funds that are not paid to the non-compliant states would be retained and unspent. On the other hand, it would be still possible to spend any remaining FPE funds by transferring them to finance the other two windows of the Green FPE, as described above.

[21] See Kimbrough (2023).

Ecological fiscal transfers build on the existing system of intergovernmental fiscal transfers by distributing a portion of central revenues to regional governments based on selected environmental indicators. The spread of deforestation in the Amazon puts ecosystem services at risk, threatening the provision of water and climate regulation, erosion prevention, crop pollination among others. Thus, a key component of the system is to incentivize states to combat deforestation. The use of a performance-based transfer aims to ensure additionality and provide strong incentives for states to reduce significantly these activities in their territory. The proposed ecological transfer, to be introduced as part of a wider FPE reform, aims at ensuring the provision of ecosystem services through forest preservation, and is composed of three pillars, each pursuing complementary objectives.

- A performance-based transfer which rewards the states for eliminating (or reducing) deforestation in their jurisdictions.
- An equity transfer that rewards the states according to their whole stock of forested land.
- A disincentive or "penalty" for "excessive deforestation," beyond the baseline established in the first component, in any year.

The first component is a performance-based transfer which rewards the states for eliminating (or reducing) the forecasted annual flow of forest at risk (deforestation) in their jurisdictions. In essence, the states receive the full amount of the transfer if the forecasted vland area of forest at risk is conserved, or else they receive partial compensation proportional to the amount of land that has been preserved. The funds in the performance-based transfer are calculated to compensate the states for the opportunity cost and the enforcement costs associated with the non-deforested land (conservation). This performance-based transfer can be interpreted as an example of Payments for ecosystem services (PES), which is a name given to a variety of arrangements through which the beneficiaries of nature-based ecosystem interventions (from watershed protection and forest conservation to carbon sequestration and landscape beauty) reward those whose lands provide these services.[22]

The second component is an equity transfer that rewards the states according to their stock of designated forested land. The Amazonian states with their forest cover provide ecosystem services to Brazil (and the world). Yet, these larger public benefits may not be consistently realized as much smaller private local gains from deforestation will become the dominant strategy for local actors. Hence, clearly, there is a need for environmental equalization to those states, because it is simply equitable to reward them for those services being rendered, and also to rebalance incentives

[22] Or, alternatively, the performance-based transfer could be interpreted as a form of Payments for reducing emissions from deforestation and forest degradation plus conservation, sustainable management of forests, and enhancing forest carbon stocks (REDD+): ex post payments to governments for verified activities to reduce emissions (which is expected to motivate them to protect forests. REDD+ is an incentive-based scheme that aims to reduce greenhouse gas emissions by protecting tropical forests.22 Unlike other REDD+ designs an FPE-E would not entail the issuance of carbon credits or assigning a price on carbon.

so that the longer terms opportunity costs of forest loss are internalized via these payments to local actors. This is the general objective of this second component.

Although much of that Amazonian Forest stock may not be at risk of deforestation right now, this payment in the second component would be awarded to recognize states' expenditure needs related to maintaining that stock of forest.[23] This component is perhaps the best integrated within the basic nature and objectives of (the rest of) the FPE equalization scheme. Providing reliable funding to States with large forest cover, it would also contribute to the overall political attractiveness of the Green FPE scheme, as part of the reformed overall FPE. How much to compensate the states with this equity transfer and the financing tradeoffs, especially with the first instrument (the performance-based transfer) is a complex question, which is addressed further below. This second component is aligned with international practices. As discussed in the previous section on the international experience, in most cases, EFTs have been put in place at least in part to compensate jurisdictions for forgone revenues due to environmental protection measures or ecological land cover. Also in Brazil, the previous attempts to introduce a Green FPE were largely based on compensating states on the basis of the extent of the forest cover in their territories.

The third component is a disincentive or "penalty" for "excessive deforestation," beyond the baseline established in the first component, in any year. The penalty is effectively a loss of available funding under the first two components, rather than a payment that the infringing state would have to make. Although, the latter (an explicit payment) may have been desirable from an incentive perspective - there is likely to be a big difference in how states perceive losing money or being required to pay versus merely receiving a smaller transfer payment—such design was deemed politically inviable and hard to enforce if it were enacted. The overall logic of this third component is to reinforce the incentives against deforestation. Without it, states that overly deforest beyond their baseline allocations (e.g an annual forecasted level or alternatively a rolling average), would end up with a "negative" flow payment, which otherwise would go "unpunished" under the first mechanism (the performance-based transfer). The third component will also contribute to making explicit the discouragement or "penalty" for illegal deforestation. This is important because as we have seen the Brazilian government now has committed to zero illegal deforestation by 2030. Meeting that deadline means that states cannot go unpunished when illegal deforestation still occurs on their territory. Last but not least, the use of penalties cheapens the costs of the program to the governments by both inducing compliant behavior at a lower cost and by potentially resulting in additional funds in the overall program to incentivize compliant states.[24]

[23] The whole stock of forest is many times larger than the forest at risk estimates for a given year. We assume that all the opportunity costs associated with forest conservation have been captured in the first component and that there no opportunity costs related to the preservation of forest that is not at risk.

[24] There is limited relevant international experience with the penalization of deforestation activities across different levels of government. The most relevant here is that of the CAMPA (Compensatory Afforestation Fund Management and Planning Authority) scheme in India. This scheme penalizes states for their deforestation activities and compensates them for afforestation initiatives and gains in forest cover. In theory the CAMPA scheme imposes penalties representing net present values, which accrue earmarked into a "Compensatory Afforestation Fund" until

Measuring performance

One of the most critical elements in the design of the Green FPE transfer mechanism to the states is, naturally, the measurement of performance by the states. This will require some clear and transparent form of counterfactual, especially in the case of its first component, the performance-based transfer. Measurement of performance in the compensatory component and for the equity transfer component is a more straightforward matter. Yet in all cases, it is assumed that the instruments exist, such as modern satellite technology, to independently verify the changes in the Amazonian Forest cover in each state jurisdiction. The goal of the Green FPE is to progressively reduce the rate of deforestation so that it can be brought to zero in that medium term.[25] Thus, counterfactuals are needed to assess the states' performance each year and ensure additionality to the system.

A common approach to measure performance in reducing deforestation and conserving forest at risk has been to measure performance against historical averages. There are, however, significant limitations with the use of historical averages as a counterfactual for avoided deforestation. For example, Strand et al (2018) have estimated opportunity cost of the forest considering average historical values. But these were significantly different from observed deforestation. If a performance based transfer (PBC) had been implemented using this metric, states would have received payments for avoided deforestation even though they would have not made efforts to reduce it. A more credible methodology is thus needed to estimate deforestation counterfactual.

In the case of the first component of the Green FPE, the performance-based transfer, the counterfactual to measure performance could be constructed using variables that capture economic incentives that determine the area of forest at risk. A positive aspect of this form of counterfactual is that it recognizes that the economic opportunity for deforestation and the associated cost of the effort required to reach a given level of forest conservation are not fixed over time, but rather that they vary with broader economic forces within and outside Brazil over which state authorities generally have no control. The methodology followed to build this model is further explained in Box1. What is important for the design of the performance-based transfer of the Green FPE is that since the model is forward-looking, it can be used to assess ex-ante the deforestation targets for the next year and how realistic they are.

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the funds are drawn to reward reforestation activities. The main issue with the CAMPA scheme in India has been that it has lacked salience and therefore effectiveness because the penalties and rewards have been quantitatively too small; in addition, the institutional set up has been very slow to develop.

[24] Some governments have tried to impose penalties in private markets for deforestation. In Bolivia since 1996 the government has officially required landowners wishing to deforest to pay a permit fee of $15 per hectare to do so; however, enforcement of this law has been weak (Muller et al. 2013).

[25] The official Government of Brazil goal and commitment, as announced at COP 26, is to eliminate illegal deforestation by 2028, and to reach net zero deforestation over the longer term.

Figure 12: Actual and estimated deforestation using historical average

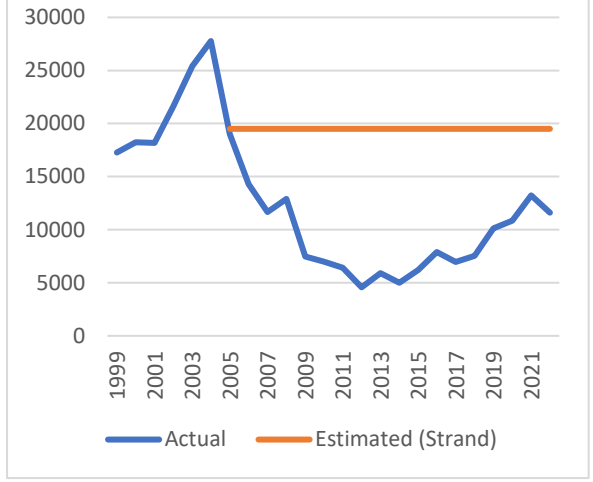
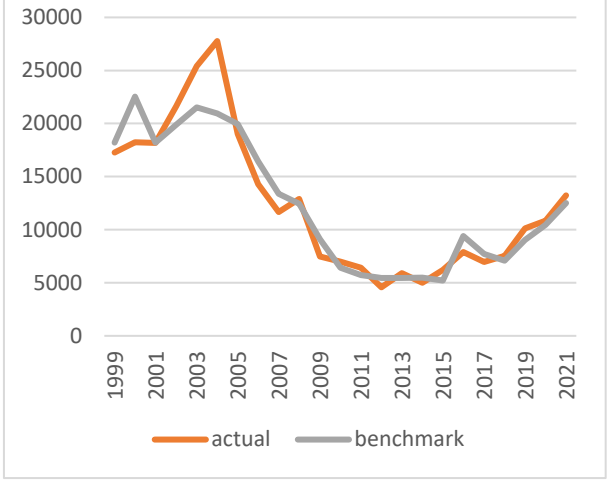


Figure 13: Actual and estimated deforestation using macroeconomic variables



Box 2. Calculating forest at risk: Model-based benchmarking for deforestation

The IPAM deforestation model (Silvestrini et al. 2023) uses Bayesian analysis to build a probability function at the municipal level predicting the likelihood that any tract of land in the Amazonian will be deforested in the next period. This is a simple model with a high rate of accuracy, and which only assumes that all independent variables are independent of each other. It is expected that different regions might have different deforestation drivers. After exploring the potential role of more than 30 variables, the model settled on six variables common to all regions and four variables as important for one or more regions. The common variables include: Distance to roads; distance to recently deforested areas (in the last 2 years of current step); suitability for farming; slope; land tenure (protected areas, indigenous lands, non-protected area, non-designated forests); and distance to urban areas. The selective drivers for just some regions are: elevation; carbon density; distance to rural settlements; and clay content. The model assigns different weights for each of the statistically significant drivers of deforestation.

In addition, a recent study by Wang et al. (2022) has proposed a model-based, forward-looking forest at risk estimations, which improves on the currently predominantly used historical moving averages.[26] The baseline was originally motivated for the introduction of Sustainability-linked Bonds (SLBs), but clearly it can be more broadly used to measure performance by the Amazonian states. The macroeconomic baseline is derived from an empirical model informed by economic theory and a robust machine-learning selection mechanism (Wang et al. 2022; Ferreira Filho and Hanusch 2022;). The model uses indices of commodity prices and Brazil's real effective exchange rate to predict forest at risk in the following year. The model has a high explanatory power (about 90 percent of the variation of deforestation) and forecast using annual or monthly data. Importantly the model allows for establishing confidence intervals for changes in forest at risk to distinguish

[26] Wang et al. (2022) Sustainability-Linked Bonds to Incentivize Lower Deforestation in Brazil's Legal Amazon?

between departures from structural trends from simple statistical noise. The baseline estimate in the model is for the entire Legal Amazon but spatial models are used to disaggregate the results to the state, municipal and even smaller levels. More recently, Hanusch et al. (2023) discuss how well this model has predicted the trend reversal of deforestation in 2022, with deforestation slightly declining for the first time after four years of consistent increases. By combining Brazil's real effective exchange rate (REER) and a commodities price index in the models it is possible to explain about 93.7% of the variance deforestation between 1998/99 and 2021.

Both models (IPAM and World Bank) have been combined so that the values generated by the empirical model informed by economic theory and a robust machine-learning selection mechanism can be spatially disaggregated using Bayesian analysis.

The yearly forest at risk baseline driven by economic variables is not the only counterfactual that could be used but it is arguably the one in which incentives are better structured, recognizing economic opportunity in the near future. Other methodologies to predict forest at risk can have been suggested, such as historical data have been used to construct other counterfactual measures such as "moving averages" from several years back, or a "downward trend" also based on data from past years. These measures clearly have the advantages of simplicity in their calculations, which makes them easier to communicate and be understood by public officials and the public. However, they have the important disadvantage of potentially offering perverse incentives, meaning that the worst performers would be rewarded with larger forest at risk counterfactuals ("baselines").[27] In contrast, using the forest at risk model based on economic variables, incentives are better structured, recognizing economic opportunity in the near future.[28] The economic driven model is the best approach to measure performance in a purely analytical sense. However, it may be too complex and perhaps allow for too much opportunity for technical and legal challenges to be practically feasible. In the third component, the penalty for excess deforestation will be benchmarked by how much actual deforestation during the year exceeds the forest at risk ("baseline") that was used as the benchmark in the first component.

Quantifying the level of payments required under the three components of the Green FPE

The case of the performance-based transfer

The underlying rational of the performance-based transfer is that state governments have to be incentivized to stop (or reduce) deforestation in their jurisdictions. To ensure additionality, the calculated payments will be disbursed against forest at risk that was actually conserved. This is achieved by offering them a payment that recognizes the opportunity cost of the otherwise

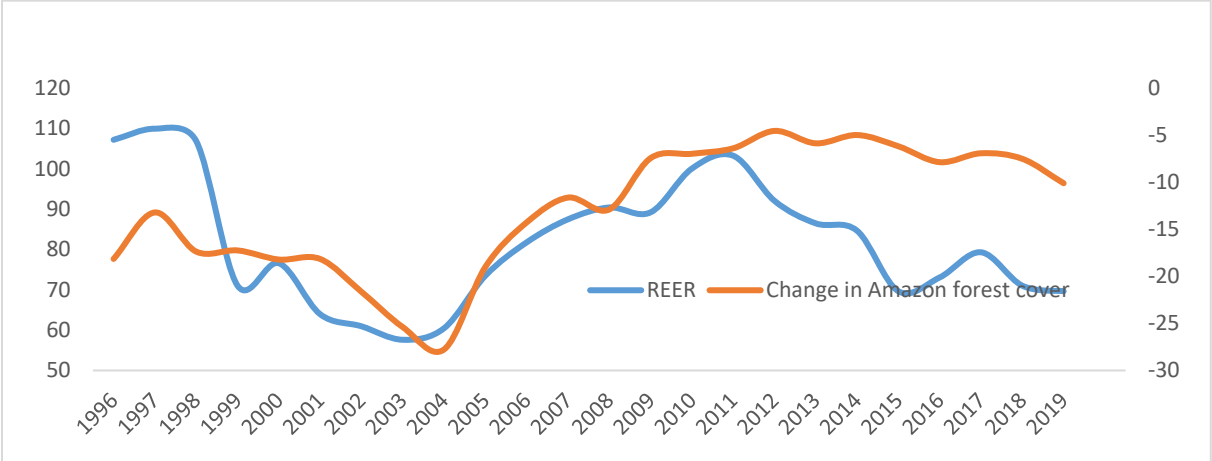
[27] For example, in the case of in the case of moving averages, the perverse incentives are not even based on historical deforestation, but deforestation in the performance period. More deforestation in the performance period leads to a higher allocation in the subsequent period, and vice versa.

[28] But note that to the extent that the model-based forward-looking deforestation benchmarking includes past levels of deforestation as one of the predictor variables, implicitly there is also here a reward for worse past performers.

deforested land and also the enforcement costs they will incur for effectively enforcing the law. While the measurement of enforcement costs can be quite straightforward, the computation of the right opportunity cost is more complex.

In the performance-based transfer, performance is measured against forest at risk forecasts, which are derived from macroeconomic variables for the whole of Brazil. There is a strong relationship between such variables and the actual rates of deforestation (Figure 10). This relationship arises because the real effective exchange rate, to a large extent, determines the profitability of mining, forest and agricultural sectors. Another important determinant of the deforestation rate is commodity prices, in particular the global prices (in R$) of beef, coffee, soy, corn sugar, soy oil, hardwood logs, and iron ore.[29] This means that as the macroeconomic environment changes so will the estimates of opportunity costs from year to year. These estimates are also expected to be different from state to state given the different impacts macroeconomic variable changes will have in those opportunity costs for each state. At present there are several estimates of the expected opportunity costs plus enforcement costs from reducing deforestation (see Box 2). Despite their greater complexity, forecasts of forest at risk based on economic variables are arguably are a superior form of establishing counterfactual scenario, informing the effort required to reach a given level of forest conservation by the states. These counterfactuals are not fixed over time, but rather they vary with broader economic forces which official authorities generally have little control.

Figure 10. ***Strong links between macroeconomic variables*****- Real effective exchange rate-** ***and deforestation***



Conceptually, the value of the transfer should be the minimum amount of funding that would induce the state government to effectively enforce the law against illegal deforestation. This reflects the opportunity ("marginal willingness to accept") that should be paid to states. The measurement of state opportunity costs have varying degrees of complexity. One lower bound estimate of the opportunity cost for the state could be the foregone additional tax revenues that

[29] See Arcand et al. (2008) and Richards et al. (2012).

otherwise would have been generated from the economic activity following a particular amount of land appropriation via deforestation. Alternatively, as an upper bound estimate, the state governments may see their opportunity costs as the forgone additional wealth that would be created in the state. That may be captured by the market value of the newly deforested land. That market value would reflect the discounted value of all the crops that would be produced with the land. An intermediate approach for figuring out the opportunity costs for one year may be the value of the production or change in state GDP from adding the additional land. That, in general terms, would be equivalent to the rental value of the newly deforested land.

Box 3. Forward model-based estimates of opportunity costs

There are several sets of estimates for the private opportunity cost of maintaining the Amazonian Forest. A few will be reviewed briefly below:

- The Busch et al. (2024) model combines data on gridded agricultural production value from IFPRI's Spatial Production Allocation Model (SPAM) with data on the share of this value that would be land rent (profit) from approximately 200,000 household surveys across LMICs from FAO's Rural Livelihoods Information System (RuLIS). The data are spatialized using a LMIC-wide machine learning model, and the key variable is "AgIncome," which yields an average annual land rent of approximately US$ 2,019 per ha, at 2020 prices. This estimate of the opportunity cost of forest land is likely to be an overestimate. This is so for several reasons. First, the average agricultural value within a municipality is not likely the same as the average agricultural value within *forests* within a municipality. We can expect that there is a persistent bias that places that have already been deforested would have higher (potential) agricultural value than places that have not been deforested. The values for municipalities would be persistently higher than the values for forests within municipalities. And therefore, the values are likely overestimates of the opportunity cost of forests. Thus, these estimates of the costs of preventing deforestation are likely on the high (conservative) side.

- The IPAM model covers the Legal Amazon and in addition Matopiba, predicting native vegetation loss (Prodes-forested areas and Mapbiomas-non-forested areas). It is a probabilistic model at the municipal level, with annual frequency and resolution of 500 meters. Different regions are assumed to have different deforestation drivers in the model and the final model identifies drivers for four regions, with six variables common to all regions and four variable important for one or more regions. The drivers for all regions are: distance to roads; distance to recently deforested area (in the last two years; suitability for farming; slope; land tenure (protected areas, indigenous lands, non-protected area, and non-designated forests); and distance to urban areas. The drivers to some regions include: elevation; carbon density; distance to rural settlements;

and clay content. Thus, the IPAM model is a spatiotemporal model with spatially disaggregated predictions and the location of deforestation.

- Araujo al. (2020) aim to estimate the Brazilian Amazon's carbon-efficient forestation, that is when farmers internalize the social cost of carbon, using a dynamic discrete choice land use model. These authors model the return of agriculture by combining potential yield for each crop with local prices data of agricultural products at the regional major trade hubs, and newly computed transportation costs, covering a period between 2008 and 2017. They find that the perceived carbon value that rationalizes observed land-use choices is $7.26 per ton of CO2.

- Souza-Rodrigues (2019) develops a model for comparing the cost effectiveness of alternative policies, including incentive-based to preserve the Brazilian Amazon. The model estimates the demand for deforestation on private properties. Exploiting regional variation in transportation costs and rescaling transportation costs using local yields, this study arrives at the different variations in farmers' valuations per hectare (in dollars). Farmers' average gross revenue per hectare in the Amazon in 2006 was estimated at US$120/ha. But this means that while the opportunity costs in some areas may be too high, those may be much lower in some more distant less well connected areas. For example, Souza-Rodrigues estimates that payment policy programs offering US$42.5/ha would also result in 80 percent of forest cover being saved. Better targeted programs, by paying farmers who are going to deforest and not paying those who are not going to deforest could reduce the costs of total subsidies by half; however, targeting is difficulted by asymmetric information. Regarding the additional costs of enforcement, the study simply adds the budgets of the two enforcement agencies, INPE and IBAMA, which in 2011 amounted to US$125 million and US$560 million, respectively.

As the Amazon gets developed, opportunity costs may go up but they may eventually fall if the level of urban development is strong enough to outweigh pressures from the rural sector

Initially, the development of the region, including the development of transportation infrastructure, may increase the opportunity costs of forested land in terms of alternative uses. Thus, it will be critical that the funds received by the states are used to promote alternate development models (in contraposition to model based on agricultural sector, such as soybean, and cattle raising). From an economic perspective, an urban led growth model will reduce pressures for deforestation. And if the Legal Amazon states develop a strong preference for urban sectors, deforestation pressures will ease, eventually reducing opportunity costs. That will strengthen the federal government position to carry out the Green FPE.

The institutional design of the Green FPE component is flexible enough to work well with different approximations to the opportunity cost that are available. Clearly, our knowledge on the proper measurement of the opportunity cost facing the states from enforcing the anti-deforestation laws still needs to be improved and this report is unlikely the right place to bring that debate to a close. Therefore, our quantitative analysis in the next section will simulate results and conduct sensitivity analysis based on different measurements of the opportunity costs. It is hoped that a future developed to go in parallel with the institutional development of the Green FPE is the advancement of more precise readings of the opportunity cost or the marginal willingness to accept by the states. For the time being there will be a trade-off between approaches for quantifying the amounts with which we need to incentivize the states, including those that are closer to accurately reflecting opportunity costs but require more complicated inputs and those that may be less accurate, but perhaps more politically appealing, less controversial to quantify, and that are likely to fit better in relatively simpler distribution formulas.

Calibration of payments for the two other components: the stock equity transfer and the penalty mechanism

One dimension of the equity transfer is clear; the funds should be proportional to the entire stock of forested land in each state. What is less clear is how much funding should be dedicated per aggregate measure of forest cover in the stock of each state. One approach could be to treat this second component of the Green FPE transfer as a residual objective, meaning the that the efficiency incentivizing objective pursued in the first component would trump the strict equity objective of the third component. The most likely viable way to calibrate the funding needed for this second component would be to use available cost estimates for the needed funds to "hold the states harmless." [30] Another dimension for the calibration of the funding for the equity component is the overall amount of funds that will be required to hold the Amazonian states harmless within the entire reform of the FPE, as was discussed in the first section of this report. What is affordable for the funding of the first component can only be answered after performing the quantitative simulations in the following section of this report.

The calibration of the third or penalty component is relatively simple. At the upper limit, if the penalties are made equal to the benefits received by the states from the excess deforestation, then all states would have very strong incentives to eliminate deforestation. But that is likely to be too hard to quantify. Complementarily, since the nature of the penalty is a reduction in the available funds under the first two components, the sum of those two funds also put a natural limit to the size of the overall penalty. Overall, there will be room to experiment with different size penalties. As we have seen, the third penalty component would add considerable incentives to control deforestation. And the other advantage is that the imposition of penalties to

[30] The basic idea is that this component is that states would get at least enough funding to be able to cover their forest direct protection costs. But note this relation could be questioned because some of these costs are already born directly by federal agencies (IBAMA, ICMBio, and others).

the non-performing states would contribute to lowering the funding requirements for the overall Green FPE.

II.4 Simulations for the three components of the Green FPE

In this section we will first develop separate individual formulas for each of the three components of the Green FPE,:

(i) The Performance-based Incentive component;

Let us start with the formula for the flow performance-based incentive component. Let us define observed deforestation outcome of state i in period t as:

d_i = the measured deforestation in (ha).

Also let the baseline for deforestation (ha) as b_i, where b_i could for example be the expected the deforestation outcome of state i in period t calculated on the basis of exogenous factors that affect deforestation (including the real effective exchange rate, global commodity prices, and so on.)[31]

We can measure the state i "Deforestation Performance Indicator in period t (DPI_{it}) as:

$$DPI_{it} = b_i - d_i$$

Let us now define the size of the "Performance-based Transfer " or the pool of funds that can be potentially transferred to the state based on opportunity cost of preserving forest at risk (or simply cost-based) for state i in period t as F_{it} . We can expect different values of F_{it} depending on the "jurisdictional approach" adopted (the state approach versus the whole Amazon approach as discussed in the previous sections). In addition, we will test lower bound estimates of the fund based on enforcement cost estimates for F_{it}

The value of the "Deforestation Performance Indicator" $DPI_{it} = b_i - d_i$ can now be expressed in relative terms as Relative Deforestation Performance Indicator of state i in period t

$$RDPI_{it} = (b_i - d_i)/ b_i$$

Now, finally there is a payment made under the performance-based component only when DPI_{it} >0. The actual amount of payment or disbursed funds (PBT_{it}) is:

$$PBT_{it} = [(b_i - d_i)/ b_i] F_{it}$$

[31] The baseline could be also represented by other measures such as a historical average, or could be set to maximize the use of resources, or to consider equity, opportunity cost, biological value, and so on.

Note that when d_i= 0 , then the state receives the entirety of the performance-based transfer. When d_i>0, then the state gets just a proportion of the transfer fund F_{it}, which eventually falls to zero when the actual deforestation is equal to the counterfactual ("baseline") amount ($b_i = d_i$). The case of "excess deforestation" for when ($d_i > b_i$) is addressed below under the third component or penalty component of the Green FPE.

(ii) The Stock Equity component

Let us now move to the stock equity component formula. Let f_i be the total designated forest area (ha) of state $i$and let $\sum_{i\epsilon I} f_i$ the total designated forest area of all the states. Let E be the total amount of funds (BRL) to be distributed through the Green FPE (e.g. a fixed percentage of the total FPE, and let γ be the weight placed on the incentive component relative to the stock compensation component, where 0<$\gamma < 1$.

Then the formula for the stock equity transfer component for state (EST_{it}) i is given by

$$EST_{it} = (1-\gamma) * \{ f_i / \sum_{i\epsilon I} f_i \} * \text{E}$$

(iii) The Penalty component for excessive (flow) deforestation.

And last, we discuss the penalty component formula. As discussed above, the penalty component only applies when there is excess deforestation, which we operationalize as the actual deforestation level d_i exceeding the counterfactual ("baseline") forest at risk b_i for the state in that year. The general notion with the penalty component is to reduce the funds available to the state, which otherwise would become available through the performance-based and stock equity components, or [PBT_{it}+EST_{it}].

There are different ways in which the penalty may be operationalized. And for clarity they need to be implemented separately into the performance-based and stock equity components.

In the case of the performance-based equity component, we note that when there is "excess deforestation," that is when ($d_i > b_i$), the penalty payment, $PPBT_{it}$ becomes a share of the F_{it}.

$$PPBT_{it} = [(b_i - d_i)/ b_i] * F_{it}$$

If the overall conception of the penalty component remains to be a reduction of the funds available form the Green FPE, then this penalty could only be applied to any of the existing funds for that year under the stock equity component. This is so because when $d_i > b_i$ there is no payment or funds under the performance-based component.

In the case of applying the penalty to the stock equity component, a salient formulation of the penalty would be to reduce the stock equity transfer payment EST_{it} in proportion to how much the actual deforestation exceeds the annual forest at risk estimates, applying the following coefficient to the stock equity transfer payment EST_{it}:

$(d_i - b_i)/ b_i$ and so the penalty for excess deforestation for state i, PE_i, would be:

$$PE_i = -\left[\frac{(d_i - b_i)}{b_i}\right] * EST_{it}$$

Finally, in this case, we would have that the cum-penalty equity stock transfer would be :

$$PEST_{it} = \left[1 - \frac{(d_i - b_i)}{b_i}\right] * EST_{it}$$

Note that with this formulation the stock equity transfer, when state i excess deforestation doubles the quantity of forest at risk estimated for the state in that year, payment would be drawn to zero, thus eliminated for the year.

We must note that an alternative approach to the overall formulation would be to have just two components—the performance-based and stock equity components- and integrating the third component, the equity component, into the performance -based component by letting the performance component be negative, when d>b. However, there are several potential reasons for leaving the penalty element as a third separately identifiable component in the overall approach. A main reason is salience, making it clear and transparent that there is a penalty for the case of over deforestation. In addition, having a separate components helps to identify that the penalized funds would have to come from the stock equity component. Last, the symmetry in rewards for positive and negative performance may not be the necessarily desirable approach.

To the effect of presentation and even legislation, it will be necessary to have a single comprehensive formula that combines all three components of the Green FPE. The most significant difficulty in coming up with a general formula lies in capturing the opportunity cost aspect of the incentives provided under the first component, the performance-based transfer. As we describe immediately below, some compromise approximations can be explored and may be feasible.

The expression that follows is one of the possible general formulas.

$$c_i = E\left[\frac{(1-\gamma)(f_i) + \gamma(w_i b_i - d_i)}{\sum_{i \epsilon I}(1-\gamma)(f_i) + \gamma(w_i b_i - d_i)}\right]$$

Where many of the parameters have been defined before but are repeated here for completeness :

- c_i is the amount of funds (BRL) received by state *i* for all three components of the Green FPE.
- E is the total amount of funds (BRL) to be distributed through the Green FPE (e.g. a fixed percentage of the total FPE)
- f_i is forest area (ha) of state *i*
    - γ is the weight placed on the incentive component relative to the stock compensation component
- b_i is the baseline for deforestation (ha) in state *i*
- d_i is the measured deforestation (ha) in state *i*
- I is the set of all eligible states

- the weighs $\boldsymbol{w_i}$ reflect the different weighting schemes that could be used in trying to reflect the different measures of opportunity cost or simply enforcement cost. [32] This approach obviates the need to calculate separate performance-based (opportunity costs) funds for each state.

Note that $(b_i - d_i)$ may be either positive or negative, depending on whether a state's deforestation is above or below its baseline, and therefore whether the penalty component would apply.

As already pointed out, the most questionable element in the general formula is the weighs $\boldsymbol{w_i}$ **.** For those weights to reflect the differences in opportunity costs across the states, we will have to assume that those differences in opportunity costs can be translated into ha of forest.

And last, a much more simplified formula would be

$$\boldsymbol{c_i = E\left[\frac{f_i + \gamma(b_i - d_i)}{\sum_{i \epsilon I}(f_i + \gamma(b_i - d_i))}\right]}$$

This formula still has the advantage of including the performance-based reward, the equity stock, and the penalty component all together, but it ignores the differences in opportunity costs or enforcement costs across the different states.[33] The formula is further simplified by using the parameter γ alone to signify the different weighting for the performance-based and equity stock components. The most relevant feature is that this case the formula only uses information on stocks and flows of (de)forestation. The question is whether this level of simplicity may be too costly in terms of accuracy and overall effectiveness of the allocation formula for the Green FPE. The basic premise of the Green FPE is that deforestation is an economic phenomenon, as it happens because of economic gains, legal and illegal, so that effective enforcement of the laws fails to occur. Thus, the questions sis whether an attractive simplified formula as the one above would be effective enough to incentivize the states to stop deforestation.

Would these formulas apply in the very long term where we would hope to see zero net deforestation?

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[32] Note that computing the weighs $\boldsymbol{w_i}$ would require to compute an index of opportunity cost across the states and then map that index into a normalized scale for example with $\boldsymbol{w_i = 1}$ for the mean value of the opportunity costs and with the rest of the weighs w_i within normalized values <1 and >1 for opportunity costs below and above the mean value.

[33] The incentive payment (reward) for reduced deforestation relative to baseline assumes the same value of the opportunity cost per ha. for each state. That would be an important limitation on how effective the incentives will be in this component. Thus, the payment-per-hectare wouldn't vary across states. The question is whether equity-wise it would be possible for the states to agree on one state being paid more than another per hectare. However, there may be some agreement that Amazon land values differ based on various biophysical and geographical factors, and the support this. However, this formula still has the nice feature that the payment-per-hectare will be likely higher in *years* when opportunity cost is higher. This may be so because in years when opportunity cost of protecting forest is very high, more states will increase their deforestation relative to the baseline and since those states receive zero from the incentive component(s) of the fund, the compliant states will have a bigger pie between them, balancing out the higher opportunity cost in that year.

The methodology could still be applied in the long term, where deforestation would have reached zero and reforestation had grown larger. By making the incentive component a payment for net-reforestation.[34] That is, the methodology would continue to provide an incentive for net reforestation after deforestation goes to zero; this would happen by allowing d_i to become negative through reforestation. The impact of reforestation on the forest stock component is relatively small and less salient – abeit not zero. State governments could use Green FPE funds to finance reforestation or pay private actors to reforest in form of a PES, as has been successfully done for example, in Costa Rica, or through some other form of private-public-partnerships (PPPs). While this would be more of a long-term issue in the Amazonian states, it could be a short-term reality for some coastal states which have low deforestation rates and could achieve net-reforestation.[35]

Alternative approaches to determining the overall financing of the Green FPE components

There are two approaches that can be followed to determine the envelope of funds allocated to Green FPE: a "bottom-up" approach and a "top-down" approach. The "bottom-up" approach requires calculating the amount of funds, or opportunity cost, required to sufficiently incentivize the states to enforce zero deforestation vis-à-vis the established base-line. This level of funding is expected to vary across states and over the years.[36] In contrast, there is no immediate "a priori" level of funds required to support the stock equity component. Perhaps, a reasonable approximation of the annual costs required for proper forest management.

The main advantage of the bottom-up approach is that it internalizes the main proposition that deforestation is an economic phenomenon and that therefore the incentives provided by the transfers need to be salient enough to effectively change the behavior of state institutions. The main disadvantages are that the estimates of the opportunity costs can be difficult to communicate to stakeholders and to calculate, with the potential inaccurate calculations causing the cost of the transfer to be higher (or much higher) than the minimum amounts necessary to change the behavior of the state entities. Note that it is also possible that the sum of the so calculated needed funds for the performance-based and stock equity components may add to total amounts that may not be affordable or feasible within the planned institutional design. But this

[34] Note that that most of the proposed formulas would do this, since if b =0, then (b – d) is positive for any negative d, that is for any net reforestation.

[35] The potential uses of Green FPE funds are more fully discussed in a section below.

[36] As was discussed in the sections above, there are different methodologies that have been developed to measure the opportunity cost of protecting the forest. Alternatively, we can use the direct valuation of the forest through, for example, the direct estimation of its public value. In the latter case, the valuation of the forest as a public good can be estimated through the CO2 equivalent emissions that are no longer emitted because of avoided deforestation (price associated with the CO2 value). The opportunity cost can also be indirectly measured through the impact on GDP that primary activities would have had if deforestation actually too place.

latter is more an inconvenient fact finding, requiring further institutional reform, than a true disadvantage of the approach.

The "top-down" approach, assumes from the start that there is a "fixed resource envelope" or overall financing constraint. For example, that could be the case if it is estimated that only a given percentage of the annual FPE funds can diverted to finance the Green FPE. What percentage of the original FPE funds can be allocated is an open political question but can be further pinned down by for example asking what level of funds will be necessary to close the financing gap for the state governments—mostly in the North—that would be net losers from reforming the FPE system.

One main advantage of the top-down approach is that it helps to bring certainty to the financing of the FPE, knowing that its implementation is feasible. The main disadvantage of this approach is that the amount of resources so determined may not be enough to offer the necessary incentives to the states and thus achieve an effective change in their behavior regarding deforestation.[37] Without doing the necessary calculations involving the opportunity costs of deforestation, a step completely bypassed in the top-down approach, the effectiveness of the Green FPE becomes a bit of a "shot in the dark."

How should the available funds be shared between the performance-based and stock equity components of the Green FPE?

In general terms, the balance in the distribution of funds among the two components is to make sure the incentives are set to achieve meaningful behavioral responses from the state entities. The inner logic and appeal of the Green FPE scheme is to effectively stop the deforestation of the Amazonian Forest. This means that the funding of the performance-based component is paramount, while making the funding of the stock equity component secondary or residual in the overall design. A different but complementary way to view the determination of funds for the stock equity component is as being sufficient to compensate the states for the management and protection of their forest stocks. However, there is no guarantee that the available "residual" funding—after taking care of the funding needs for the performance-based component-- would be enough to effectively compensate the states for those management and protection costs.

Selecting the data for the stock equity component of the Green FPE

In total, around 50% of deforestation in the Amazon takes place in public lands (federal or state) and most of the public land in Amazonia is federal (74% vs 26%) but there is still deforestation in state public lands (see below). Public forests are legally defined as forests, natural or planted, located in the various Brazilian biomes, in assets under the domain of the Union, the States, the Municipalities, the Federal District or indirect administration entities (Law

[37] Another factor to consider is that the overall FPE is pre-defined share of federal taxes, and if too much of it goes to the Green FPE, not enough resources would be left to achieve the fiscal gap equalization that is it's the primary objective.

11.284/2006). The public forests (public lands) are subdivided into: Indigenous lands, Conservation Units Settlements, Military Areas, and “Other”. However, not all public forests have been designated to one of these categories, and these are known as "undesignated public forests (UPF)". About 25 percent of the forest land in the Legal Amazon is “undesignated.” Deforestation tends to be significantly higher in these undesignated areas, precisely because those lands have no defined use, making them more prone to land speculation and private appropriation. And of course, most of the deforestation (around 90%) is illegal, whether in public or private lands.

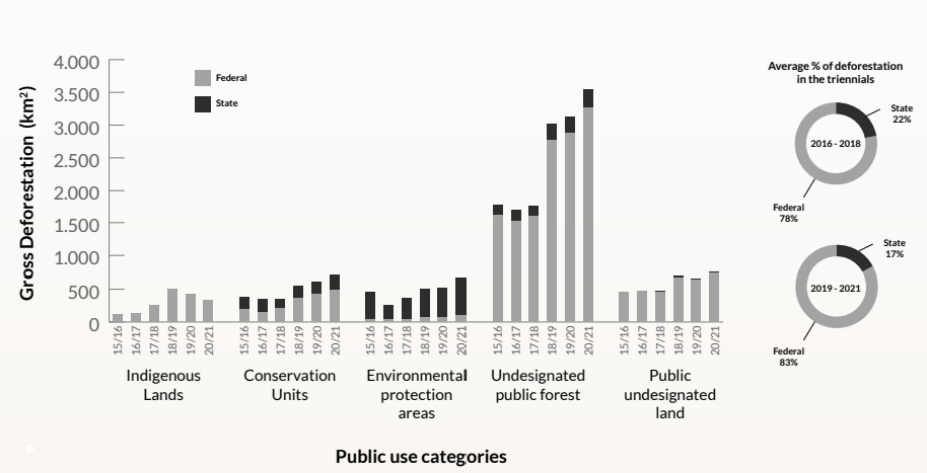


Figure 2. Annual deforestation in the main public use land categories by federal or state domain in the 2016-2018 and 2019-2021 trienniums. *Source: IPAM with PRODES data.*

An argument could be made for their exclusion of undesignated land in the stock component since, at least in theory, undesignated public forests have zero maintenance costs. In addition, by considering only designated forest lands, an incentive will be created for state entities to finalize the destination of their public forests and, at the same time, recognizes that the cost of maintaining these forests is not zero.

II.5 Quantifying and simulating the different options for the Green FPE design

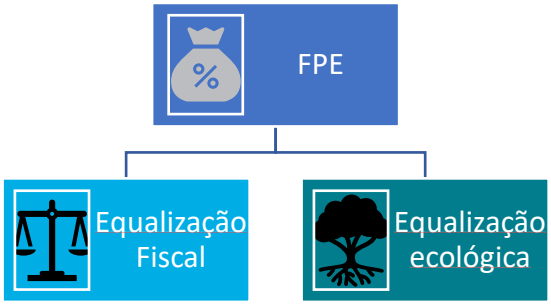
The Performance Based Component

As discussed above, the major challenge for the implementation of a performance-based approach to reduce deforestation is the establishment of a credible counterfactual since avoided deforestation is not observed. The relative deforestation performance indicator (RDPI) still ensure that the maximum transfer will only be achieved if deforestation is reduced to zero. The counterfactual values derived from the macroeconomic model and plugged into the RDPI define the maximum amount a state can receive if it achieves zero deforestation. If the macroeconomic context makes primary sector activities even more profitable, the total transfer the state can received for achieving zero deforestation is larger than in the scenario where macroeconomic context is less conducive to primary sector activities. In the simulations carried

out for this analysis, the FPE reform introduces two separate equalization transfers: a component for a fiscal equalization and another component for ecological equalization (Figure 14). As already discussed above, the amount allocated to the ecological equalization transfer can either follow a bottom-up or a top-down approach as discussed above.

To simulate the bottom-up approach, we will calculate the opportunity cost of deforestation and use the original FPE to finance all the needs estimated. The bottom-up approach can consider the impact of deforestation on weather patterns, and it can then calculate the losses of each individual farmer due to climate change to arrive at the total cost of deforestation considering its impact on farming. While theoretically compelling, limitation of data availability at the granular level makes this approach challenging to pursue. A more straightforward approach can consider the CO2 content stored in the forest to value the opportunity cost of deforestation. Information on CO2 content is widely available and is possible to retrieve at higher resolution. The market for CO2 emissions is still nascent in Brazil, but using international benchmarks, it is possible to arrive at range of credible estimations.

Figure 14: A reform of FPE that introduces Fiscal Equalization and Ecological Equalization



To estimate the the bottom-up approach, simulations were run using the latest year of data available for actual deforestation. The macroeconomic model can also be used retroactively. For 2022, estimated deforestation using macroeconomic variables amounts to around 12,000 square kilometers. This is also what is called “forest at risk”. Using a spatially disaggregated model, it is possible to distribute where deforestation will take place. Finally, we cross the spatially disaggregated deforestation data with data of CO2 above ground stock, a volume which varies across municipalities. Thus, it is possible to spatially disaggregate granular measures of CO2 avoided emissions at the municipal level which can be added up at the state level to arrive at the final estimations of the opportunity cost of avoided deforestation for a given state. In the scenario simulated, we assume zero deforestation, which means that the state would receive the whole amount of transfer available. While it is not trivial to achieve zero deforestation, the estimates are useful in providing an envelope of the maximum amount of resources that would be used to achieve such goal, considering the parameters described. According to calculations, the total amount of resources needed is close to R$32 billion – which represents about 20 percent of the overall FPE.

Figure 15: Bottom up approach estimates (CO_2 values = USD 20)

	Value (R$)
Acre	2,187,596,966.00
Amazonas	5,678,769,002.50
Amapá	201,329,503.31
Maranhão	665,509,309.64
Mato Grosso	4,559,093,441.19
Pará	13,253,159,718.13
Rondônia	4,306,368,330.13
Roraima	1,043,621,086.22
Tocantins	38,044,144.81
Total	**31,933,491,501.93**

In total, the Green FPE under a bottom-up approach could reach R$40 billion. In fact, In addition to the first component, the second component would consider the quantity of forests that the state possesses (equity component) so to enable funding for enforcement costs. While the component that considers forest coverage has an equity underpinning, the component can have an added effect of incentivizing states to designate undesignated public lands in Amazônia if the component considers only designated land. Previous simulations (see *Amazon Emergency Action Plan for Brazil*) have estimated the cost of land and forest management for the entire Legal Amazon at US$1.7 billion, or equivalent to R$8.5 billion. This funding could be made available in proportion to the amount of designated land only, so that the states would have an incentive for designate public forests that have not been designated. However, these estimates consider full compliance with zero deforestation.

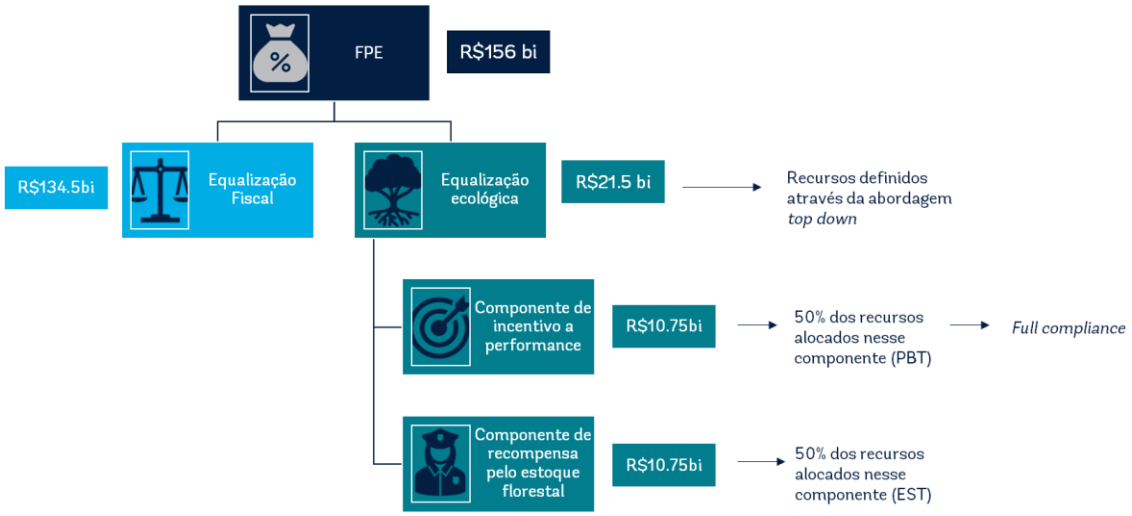
Figure 16: Public Lands in Legal Amazon: Designated vs Undesignated State Forests

	Designated	Undesignated	Total
Amazonas	17,624,615.00	31,300,829.00	48,925,444.00
Acre	1,150,915.00	3,581,223.00	4,732,138.00
Amapa	3,171,937.00	68,755.00	3,240,692.00
Mato Grosso	1,702,821.00	110,499.00	1,813,320.00
Rondonia	2,004,660.00	-	2,004,660.00
Roraima	2,333,768.00	-	2,333,768.00
Para	13,951,225.00	1,562,712.00	15,513,937.00
Maranhao	570,632.00	-	570,632.00
Tocantins	376,030.00	79,487.00	455,517.00
Total	**42,886,603.00**	**36,703,505.00**	**79,590,108.00**

Simulation with Top-Down Approach

In the top-down approach, we assume that the federal government will allocate towards the ecological transfers the same amount of resources that states in the Legal Amazon would lose in a scenario where a FPE reform would only consider a fiscal equalization component. In this case, the amount allocated to the ecological transfer is BRL 21.5 billion (Figure 17). In this simulation, the ecological transfer is split 50 percent for the performance-based incentive and 50 percent for the equity component. Again, we assume that states will comply with zero deforestation target and therefore will receive all the funding made available under the PBC; otherwise, the performance-based component formula would be applied and therefore the states would get only partial or no compensation.

Figure 17: FPE logic under top-down approach



With the introduction of the ecological equalization transfer under the top-down approach, the final allocation to states in the Legal Amazon remains similar to what it currently is, although states would be affected differently within the region. The introduction of the fiscal and ecological equalization transfers allows for 36 percent of the FPE pool of funds to be distributed to Legal Amazon in comparison to 35 percent that is distributed currently. The exercises carried out show that it is possible to mitigate the FPE reform impacts while also introducing more transparency and incentives to the system.[38]

[38] However, there would significant shifts between Amazonian States in the distribution of those funds.

Figure 18: FPE logic under top-down approach

	FPE	Fiscal Equalization	Fiscal Equalization + Ecological Equalization
Amazônia Legal	0.35	0.26	0.36
Brasil exceto Am. Legal	0.65	0.74	0.64
Nordeste	0.51	0.58	0.51

III. Leveraging resources for forest conservation

There are two separate important questions related to the financing of the Green FPE. The first, what will be the financing required, was already discussed in the section above focused on the application formulas for the Green FPE components. The second question, which is developed in this section, is what the main sources of financing are that Green FPE can leverage to support forest conservation. Without repeating in any detail that previous discussion, we saw there that the bottom-up approach adds the estimated opportunity costs required to incentivize the states to enforce zero deforestation and those funds deemed appropriate to offer support to the states for their stocks of forest, which may be approximated by the annual costs required for proper forest management. In the case of the top-down approach, feasibility, or what is deemed affordable is the rule to follow, although further guidance may be offered by the funding need to compensate the Amazonian states for their potential losses from reforming the FPE system. The primary source will have to be a share of FPE funds. The big unknown at this time is whether those funds from the FPE will be sufficient, and if they are not, whether the existence of this mechanism can be used to leverage additional resources to promote forest conservation.

III.1 Can the Green FPE be used to leverage more funding for forest conservation?

If there is the expectation that zero deforestation won't be achieved in the first few years, the government could budget for smaller pool of funds, but for the system to be credible it is important that the necessary funds are available. One of the main thrusts of this report has been to argue that it makes good technical and political sense to finance the Green FPE with a share of the FPE funds. However, what percentage of the original FPE funds can be allocated to the Green FPE is an open political question. And are there enough funds in the FPE in the short-medium term? What else may have to change in the reform of the FPE to make the financing of the ecological component possible? The simulations presented show scenarios with full compliance and therefore represent the maximum amount of resources employed.

The approach offered here is for the Green FPE to be contained with the overall reform of the FPE. But there may arise a need for more results-based financing, either because incentives are not strong enough or because States "deserve more" if they perform well – in any case, more financing would almost certainly be desirable. If the Green FPE is well designed, it will provide a credible, proven framework for allocating financing to the state governments based on jurisdictional (state-level) results in achieving reduced deforestation. This could then be an attractive instrument to use in raising and additional financing from other sources which would augment the impact of the Green FPE, without being part of it. They could also have all sorts of other features, such as use of funds rules, which green bonds or donors would require. So, the FPE fundamentally remains what it always has been - but the design, monitoring and verification that

happens under the Green FPE can be used for other financing flows that mimic the approach of the Green FPE.

III.2 *Role of other funding sources in supporting Green FPE objectives*

Clearly the Green FPE cannot be the sole mechanism through which Amazon Forest conservation is financed. Just as the PPCDAm takes a multi-pronged, whole-of-government approach to anti-deforestation policy, so too should the Green FPE be conceived as just one of several important, complementary forest-conservation finance mechanisms for Brazilian States. Here, we describe several finance mechanisms that could augment the level of finance available for state-level forest conservation, and the synergies and tradeoffs with a Green FPE. We focus here on *international* finance mechanisms that could plausibly provide financing to *state governments*. However, it is beyond the scope of this paper to discuss potential sources of finance for forest conservation by individual landholders, e.g. project-level generation of carbon credits for voluntary or nested jurisdictional markets; market premiums for agricultural commodities originating from low-deforestation landscapes; a "bioeconomy" of forest-compatible goods and services; and so forth.

The international finance sources discussed below fall into three categories: 1) direct financial support for a Green FPE; 2) indirect, performance-based international financial support through carbon finance; 3) derivative financial products.

Direct international support for a Green FPE: In principle, a Green FPE could attract official development assistance (ODA) directly from donor nations. However, ODA is a limited pool, subject to political winds, funding fads, and competition from many other competing priorities. ODA also often comes with more strings attached than performance-based funds. Donor countries for whom poverty alleviation is a primary motivation for ODA may face challenges in directing a large sum of ODA to Brazil, an upper-middle income country.

Box 4: The Amazon Fund

Since its establishment in 2008, the Amazon Fund has received results-based international contributions tied to Brazil's performance in reducing Amazon deforestation relative to a rolling historical average baseline rate. The largest contributions have come from Norway, which has provided more than US$1.2 billion. Germany and Petrobras have contributed as well. The Amazon Fund was frozen in 2019, but has recently been revived, with committed contributions of US$0.5 billion from the United States, and discussions of possible additional contributions from France, Japan, and other countries.

The Fund, administered by BNDES, has distributed about half of the proceeds it has received across more than 100 projects (Amazon Fund, 2023). Potentially, the Amazon Fund could distribute some share of its proceeds to the Green FPE, with the rationale that the FPE incentivizes states to contribute toward national-level deforestation reductions. Or, the contributors to the Amazon Fund could direct a portion of their funds straight to the Green FPE.

Climate finance from high-emitting nations or the multilateral Green Climate Fund (GCF) is another possibility. Here, if the motivation for donor countries is climate mitigation, the logic for Brazil as a recipient becomes clear, and for forest conservation within Brazil even clearer. However, in the case of the GCF, most funding is granted or loaned for large projects, meaning that direct international support of this type is probably more likely to defray establishment costs of setting up the Green FPE than providing an ongoing subsidy to its annual operation.

Indirect, international financial support through performance-based climate finance: The states of Acre and Mato Grosso have also received performance-based international funds for deforestation reduction from Germany, Norway, and the UK through Germany's REDD+ for Early Movers (REM) program. Here too, contributors to the REM might direct a portion of their funds to the Green FPE.

For a state that reduces deforestation, the domestic performance-based mechanism of a Green FPE and an international performance-based mechanism such as REM would offer complementary, cross-subsidizing sources of finance. Since neither are market mechanisms, there would be no issue of "double counting." That is, a state would not be selling the same verified emission reductions to multiple buyers. Instead, the domestic and international funders would combine to raise the reward for reducing deforestation above what either could achieve individually. This is similar to how the Amazon Fund receives funding from multiple international contributors, as well as a domestic contributor (Petrobras)

Non-market finance, whether to the national government of Brazil (e.g. the Amazon Fund), or to states (e.g. the REDD+ for Early Movers program) is fundamentally constrained in amount by what can be obtained from scarce public budgets. As mentioned above, public funds in donor countries are subject to shifting political winds and competition from many other competing priorities. Potentially, larger and more stable levels of finance may someday be obtainable through carbon market finance.

A hopeful conduit of public carbon market finance is Article 6 of the UNFCCC Paris Agreement. Article 6 has two relevant sections, both of which are still under negotiation as of the time of writing (Granziera et al. 2023). Article 6.2 would set the rules for *internationally traded mitigation outcomes* (ITMOs) between countries. A country, e.g., Brazil, that reduces emissions, would have the possibility to allow another country to claim a portion of these reductions toward its own Nationally Determined Contribution (NDC), and make a corresponding adjustment deducting these reductions from its own NDC. That is, effectively selling a portion of its emission reductions on an international market.

While Article 6.2 wouldn't on its own establish carbon markets between countries, it would set rules by which trading between countries could operate. A template for international trading of emission reductions from forest conservation can be found in the California Air Resources Board's California Tropical Forest Standard (CTFS), authorized in 2019, with rules on how verified emission reductions generated by a Brazilian state could be traded as an offset in the regulatory carbon market established under California's cap-and-trade program. In principle, emission reductions produced by Brazil, achieved in part due to the actions of states incentivized by a Green FPE, might someday be traded to another country to count toward the international

emission reduction claims of that country. The revenue resulting from such a transaction could be used to continually finance the Green FPE.

A second section of Article 6, Article 6.4, would establish an UN-sanctioned Sustainable Development Mechanism (SDM) as a successor to the Clean Development Mechanism (CDM). As with the CDM, verified emission reductions (VERs) generated under the rules of the SDM could be sold as offsets to public or private buyers. REDD+ is potentially eligible for SDM (Granziera et al. 2023), although rules remain to be finalized. Here too, it is possible in principle for Brazil to recycle the revenue from the sale of VERs under the SDM back into a Green FPE. Or, for Brazilian states to sell VERs to the SDM as a secondary source of finance to that obtained from the Green FPE. Again, there would be no double counting of emission reductions, as states would be selling VERs to a single buyer.

In addition, outside of the auspices of the UNFCCC, multiple independent standards bodies verify the production of forest emission reductions. The Lowering Emissions by Accelerating Forest finance (LEAF) coalition, backed by the governments of Norway, UK, and the USA, has mobilized more than US$1 billion in pledged finance from large companies to purchase jurisdictional or national emission reductions to use as offsets by applying the standard of The Architecture for REDD+ Transactions (ART)'s The REDD+ Environmental Excellence Standard (TREES). The private agency Verra also has a standard for jurisdictional and nested REDD+ (JNR). As with the SDM, it would be possible in principle for Brazil to sell VERs to these mechanisms with the proceeds topping up a Green FPE, or for Brazilian states to sell VERs to these mechanisms with the proceeds complementing funds transferred through a Green FPE.

The above-mentioned carbon finance mechanisms (e.g. Article 6.2; Article 6.4; ART TREES; etc.) deal in the trade of VERs. Because a Green FPE would not measure nor generate VERs, states' performance as measured for the purpose of receiving transfers (see section II.4 above) would not be directly eligible for finance under any of these systems. For Brazil or its states to be eligible for finance through those mechanisms, they would need to undertake or comply with additional systems as required by those mechanisms (Granziera et al. 2021), potentially including:

- measurement and monitoring of carbon dioxide emissions, beyond just measurement and monitoring of forest cover or forest-cover change for the Green FPE.
- a baseline or reference level for measuring performance in reducing CO2 emissions or increasing CO2 removals, beyond any baseline of forest-cover change in the Green FPE
- monitoring and reporting on social and environmental safeguards
- formulation of a national REDD+ strategy (in the case of the UNFCCC)
- adherence with modalities related to leakage, reversals, and uncertainty (e.g. in the case of ART TREES)
- development of a carbon registry for tracking VERs

***Derivative financial products*:** States could leverage the possibility of *future* carbon market finance through derivative financial instruments described by Golub et al. (cit). Forest jurisdictions or their agencies could sell in the present day the option to later provide emission reductions at a pre-specified price, if particular market conditions prevail by a certain future time.

Golub et al (2025) describes these potential financial instruments as follows:

> "Buyers may execute the call option on emission reductions if: a) the emission reductions are properly reported, verified, and recorded, and b) the strike price is below the spot price by the time of the contract expiration (European options) or any time before the expiration date (the so-called American option)."
>
> "A put option provides the right but not the obligation to sell ERs at a pre-agreed price, the strike price. The writer (seller) of a put option is obligated to buy the underlying ERs at the strike price if the put option holder (buyer) exercises the right to sell ERs to the put seller."

Or, according to Golub et al. (2025), the sovereign Brazil government on could issue carbon-linked bonds on behalf of states to fund emission reductions, taking on the risk that such reduction would eventually have market value.

III.3 Designing the use of funds by the states

Brazil already suffers from extreme budget rigidity due to the extensive use of earmaking and other mandatory spending, thus earmarking FPE resources would add even more rigidity and eventually become counterproductive. The main challenge is to create incentives for states to do the "right thing" without telling them how to do it, or how much to spend on it. Ideally the financial incentives in the mechanism would be large enough such that states will allocate the minimum amount of resources needed for forest protection.[39] Thus, the lion share of the funds in the first component (that representing compensation for opportunity costs) should be unconditional. This will provide the state governments with the flexibility to utilize the funds in the most effective way, including the incentivization of their municipalities, farmers, and other stakeholders to reduce deforestation in the state, and also facilitate other state policies pursuing different avenues for inclusive development. In the case of the second component of the Green FPE, the stock equity component, there would be no need to earmark those funds. Here, again, the states will be free to use the funds to incentivize other stakeholders and for investment in inclusive economic development programs within the state.

Fundamentally the principle is to leave states with the decision power to identify the right policy mix for incentivizing forest preservation and promoting inclusive economic development. Policies designed to promote sustainable development and improving living standards, and enabling alternative income sources, will be critical for taking pressure off the forest as additional economic resource for the states. The best protection of the forest would be a more developed Amazonian economy offering jobs and income for the local population, by among other things promoting a urban led growth model. Increasing basic living standards will require

[39] However, there may be a case to be made in favor of earmarking some of the first component, the performance-based transfer, for law enforcement efforts. These funds are most needed for the forest protection efforts provided by law enforcement agencies, and land and forest governance. Addressing deforestation and illegal activities (land grabbing, illegal mining, and logging) and territorial planning across the Amazon should be critical priorities and the earmarking of funds may help with that.

improved basic service delivery in education and health care services, and investments in basic infrastructure, especially for remote areas.

A last potential promising venue for the use of funds from the three components of the Green FPE would be for the states to introduce themselves performance-based transfers to their municipalities, thus reinforcing the forest conservation incentive further down to municipalities. Indeed, the *IBS verde* transfer from state to municipalities has been introduced in the wake of the tax reform. According to the new legislation, the State (via State law) has discretion to define how the *IBS Verde* will be implemented as long as the transfer is based on indicators of environmental preservation. The transfer size is 5 percent of the 25 percent of the new IBS, so 1.25 percent of the States IBS revenue – which can be expected to be greater than current ICMS revenue, given the broader base. Generally, this could be an opportunity for linking the states' reformed *ICMS Ecológico* more explicitly to deforestation reduction at the municipal level. The green FPE could be an opportunity for the Amazonian states to completely refund anew their ecological transfers to their municipalities and provide a boost to the forest conservation effort.

IV. The political economy of the reform

Gaining political support in the National Congress: The packaging of the reform

The adoption of the Green FPE, with the objective of conserving forest at risk in the whole Amazon in the most efficient and equitable ways possible, will require its approval by the National Congress, and this will not be an easy task. A priori we may anticipate general support of the Amazonian states for the Green FPE package, with the performance-based transfer and the stock equity transfers. The story should be expected to be quite different with the penalty component, because in this case the states will be penalized for any excess deforestation in their jurisdictions. A critical dimension for getting support from the states will be how to somehow match the magnitude of the Green FPE transfers with what the Amazonian states will lose under the proposed FPE reform. Here there will need for some creativity. Obviously, the closer the match, the more likely the reform will be to happen because the overall fiscal reallocation across states is minimized.

The support for the Green FPE in the National Congress by the rest of the states is even less clear. One the one hand, the Green FPE will contribute significantly to addressing the most pressing issue facing Brazil as a nation in climate change policy and this outcome would benefit all states (and the world). On the other hand, the Green FPE will demand, at least initially, considerable federal funding, which within a fixed federal budget constraint will mean the loss of potential funding for the non-Amazonian states. An additional difficult issue is whether the Green FPE arrangements can be limited to the Amazonian states, or whether it should be extended to other, or even all, states and not just the Amazonian ones. Of course, that potential extension would be only meaningful for other states that have forest in need of protection.

The potential difficulties for getting the reform approved are heightened by the well-known peculiarities of Brazilian politics, where voters' malapportionment gives the sparsely populated Northern states key decision power in the *Câmara dos Deputados* and the *Senate* for the approval of any reforms. How can support for the Green FPE be buttressed? As it was argued above and especially in the first section of this paper, there is a great political opportunity for doing so by pairing the Green FPE reform with the much needed and long waited reform of the Fundo de Participação dos Estados (FPE). The opportunity for the coupling of these two reforms arises because, as we have seen, the equitable reform of the FPE will imply a significant withdrawal of funds from some Amazonian states, while the Green FPE reform could return funds to Amazonian states in exchange for taking positive action to preserve the Amazonian Forest.

Packaging both reforms (the FPE and the Green FPE) together thus provides a unique political window of opportunity to the GOB to push ahead with both reform agendas. Additional reform synergies could exist by involving in the overall reform package the

Development Fund that is about to be created as part of the ongoing tax reform in Brazil.[40] This will represent a significant new infusion of federal funds aiming to contribute to the development of the less advanced Brazilian states. A smart design of the new Development Fund in the context of the FPE and Green FPE reforms could mean that the comprehensive reform package would yield all states as winners. Taking each reform piecemeal, there would be winners and losers among the states, which could mean that the separate reforms could fail to gain approval in the National Congress.

Incentive Compatibility for the Federal Government

For a successful reform, the federal government will have to do two main things. First support and implement the Green FPE system, providing the funds needed for the implementation of its components. Second, it will have to enforce the law on federal lands. This latter is important for the mechanisms to work well; otherwise, the states will bear the consequences of lower payments under the mechanism design that is being proposed.

There is nothing, of course, that will guarantee the federal government's full support and participation with the Green FPE. From a purely incentive compatibility perspective, as Kimbrough (2023) argues, the federal government may perceive that it only gets a share of the global benefit arising from the environmental externality of protecting the Amazon. And this may be less (or more) than the total federal outlays required from the implementation of the Green FPE, leading to the fundamental incentive incompatibility (or compatibility) of the program. One decisive factor may be the strong support for the Green FPE in the National Congress and the potential threat that voters in the supporting states may exercise by weakening their electoral support for the incumbent federal administration. But for this latter to be effective, a strong design of the Green FPE will be needed ensuring the incentive compatibility for a winning coalition of the states.

An added difficulty is that FPE revenues are procyclical while deforestation tends to be countercyclical.

[40] After long discussions, the Chamber of Deputies of the National Congress recently approved the first phase of the tax reform, which reformulates taxation on consumption in Brazil. The reform package eliminates five taxes (three of them at the federal level --: Social Integration Program (PIS), Contribution for Social Security Financing (Cofins) and Tax on Industrialized Products (IPI), and two at the subnational level --. the Tax on the Circulation of Goods and Services (ICMS) at the state level and the Tax on Services (ISS) at the municipal level. It their place a dual Value Added Tax (VAT) will be created, divided into two parts. One of them will be the Tax on Goods and Services (IBS) and the other the Contribution on Goods and Services (CBS), to be collected by the Union. In exchange for these changes which are expected to bring an end to the tax war between states, the government will create a Regional Development Fund to finance development projects in poorer states, initially budgeted at BRL 40 billion from 2033.

The procyclicality of the FPE revenues is easily understood given the sources of funds that stand behind the transfer. The countercyclicality of deforestation is best understood by referring back to our discussion in the sections above about the important role macroeconomic variables, such as the real effective exchange rate (REER), in creating powerful economic incentives for deforestation. This raises the desirability of having the Green FPE play more the role of a stabilization tool, at least in the Amazon states. The cyclicality mismatch would in theory require the FPE to accumulate and draw down savings from a stabilization fund. This would make the Green FPE more than an anti-deforestation and revenue distribution mechanism. However, despite this potential need for an actual fund attached to the Green FPE, this would imply substantial changes in the fundamental design, which makes it less politically viable. However, this is an important matter that should be further discussed and researched, including the options for financing and the role that private capital can play.

Transitioning the reform over time

The international experience offers several variations in transition periods, which could be considered since the proposed reforms will potentially lead to significant budget changes at the state level. Indeed, it would be desirable to phase in the reforms over a transition period to allow adaptation and avoid disruptions in public service delivery. At one end there is the practice of "hold harmless," which would mean that no state would receive less funding after the reform than in the previous period before the reform. Applying this approach is generally difficult because of the lack of the necessary funding. For the reforms being considered, packaging altogether the FPE, Green FPE and the Development Fund (from the ongoing tax reform) may make it possible to have enough new funding to allow for a change in the system without creating losers and being able to introduce much of the reformed system at the same time.

To promote transparency and decrease uncertainty, it is important that the transition period is defined upfront so that states know when the reform will be fully implemented. Without new additional funds, the "hold harmless" provision would imply a very low pace for the reforms, in parallel to any growth in the overall pool of funds over time. The more realistic alternative is to allow for net losses in overall funding, staggering those losses over a period. Indeed, this is the most commonly used mechanism in international practice. For example, a transition period of five years could be designed such that in the first year the new distribution coefficients would apply to only 20 percent of the stock to be distributed, then 40 percent, 60 percent, 80 percent and finally 100 percent in the fifth year. Of course, the transition period could be raised to a greater number of years.

Appendix 1: The CAMPA program in India

As reported by Gupta and Zahir (2023), the CAMPA interstate compensation program has had a hazardous evolution. After a Supreme Court of India judgment in 2002, a nationally uniform approach was adopted for compensatory afforestation payments and penalties based on Net Present Value calculations when deforestation occurs. These penalties and payments flow into a separate Compensatory Afforestation Fund (CAF) and managed by the Compensatory Afforestation Fund Management and Planning Authority (CAMPA). Importantly, the funds are not to accrue either into the Union (federal government) budget or directly into the state government budgets.

Even though CAMPA was created in 2004, it did not immediately become operational. For that reason, the Supreme Court ordered the creation of an ad hoc CAMPA in 2006 until CAMPA became fully operational and recommended all funds on behalf of CAMPA to be transferred to this temporary fund. However, lacking regulations for the management of the funds, these just accumulated in the ad hoc CAMPA. Again, the Supreme Court had to intervene in 2009 and allow the annual release to the states of about 10 percent of the funds accumulated.

Eventually, the Compensatory Afforestation Fund Act was signed in 2016 and the associated rules, approved in the Compensatory Afforestation Fund Rules in 2018. Only in August 2019, did the Union Government released the CAMPA funds to various states. The 2016 Act required state governments to establish a special Fund called the State Compensatory Afforestation Fund (SCAF) under its Public Account. All funds received from the National Fund, balances from the ad hoc CAMPA and all other related funds need to be credited in the SCAF. The SCAF funds have brought transparency in the monitoring of CAMPA funds.

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