TASK FORCE ON CLIMATE, DEVELOPMENT AND THE INTERNATIONAL MONETARY FUND

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THE INTERNATIONAL MONETARY FUND AND DEFORESTATION

ANALYZING THE ENVIRONMENTAL CONSEQUENCES OF CONDITIONAL LENDING

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ABSTRACT

International financial institutions (IFIs) face ever more calls to support national and global policy challenges, including environmental issues seemingly outside the remit of their mandate. In response to these demands, IFIs are increasing the volume of their financing—yet surprisingly little is known about the environmental impacts of their work. This paper investigates the environmental implications of the International Monetary Fund's (IMF) lending toolkit by documenting its advice on forest management and examining the association between IMF programs and deforestation. Deforestation is a key driver of biodiversity loss and is also the third largest source of carbon dioxide emissions in the world economy, while also deteriorating biodiversity. We expect IMF programs to accelerate deforestation because the policy reforms

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attached to lending arrangements require borrowers to consolidate fiscal spending, potentially on environmental protections, and create incentives to extract economic value from natural resources. Empirically, we first show that the IMF rarely targets forest management; in a quantitative text analysis of 35,915 conditions administered to low- and middle-income countries in the last four decades, we find only 34 pertain explicitly to forest management. Second, we investigate annual tree cover loss between 2000 and 2020. Estimates from two-way fixed effects models show that IMF programs are, on average, associated with an increase in the level of annual deforestation by 9.2 percent. Assuming an average three-year duration of an IMF program, our estimates imply that each IMF loan is, on average, associated with a decrease in forest area of 258km^2, almost the size of the Maldives. Our study thus indicates that understanding national-level environment-related outcomes will require greater attention to international-level determinants. In terms of policy, the results suggest that IFIs need to explicitly model their environmental impact in their program design to ensure that they are aligned with the Paris Agreement.

Keywords: Deforestation; Forest transition; International Monetary Fund; Climate change

INTRODUCTION

International financial institutions (IFIs) play an important role in shaping financial flows to emerging market and developing economies (EMDEs). Recent estimates show that EMDEs excluding China need to mobilize $3 trillion on an annual basis between now and 2030 (G20-IEG 2023), and these institutions have been upgrading their toolkits to better support national and global policy challenges. For example, the World Bank embarked upon an 'evolution roadmap' process through which it upgraded its vision and mission, operations and financing model (World Bank 2023). As a part of this transformation, the World Bank's corporate score card includes indicators such as hectares of key ecosystems globally and global greenhouse gas emissions (World Bank 2024). Multilateral development banks (MDBs) have also been working collaboratively to harmonize their work on nature. In 2023, they announced common principles to track nature-related finance (IADB 2023). While this engagement by MDBs is welcome and much needed, the role of the International Monetary Fund (IMF) in forest conservation, and nature more generally, has received considerably less attention.

The IMF—an international lender of last resort—is yet to articulate a strategy for halting forest loss. In fact, the IMF has adopted a Climate Change Strategy that delves into the distinct challenges posed by mitigation, adaptation and transition management; yet, it does not single out the forestry sector (IMF 2021a, 2021b)—despite deforestation's major contribution to carbon dioxide emissions. For surveillance and advice, the IMF has an important

role in supporting the mobilization of resources towards forest conservation, underscoring the vital role that tropical forests play in ecosystem services and highlighting the importance of global efforts to stem forest loss. In terms of the IMF's lending function, ensuring that short-term balance of payments needs do not encourage deforestation will be important, alongside the need to enable countries to lay the groundwork for rapid economy recovery in a manner that supports their development and environmental goals.

Since the 1980s, low- and middle-income countries around the world have comprehensively restructured their economies under the auspices of the IMF—often as part of mandated policy reforms during lending programs (known as 'conditionality') (Kentikelenis and Stubbs 2023; Woods 2006). For example, the Vulnerable 20 Group (V20)—a group of 58 climate-vulnerable countries—have had an active IMF lending arrangement in almost 1-in-3 years since 1980; they have collectively spent 838 years under an IMF program. The macroeconomic framework in which countries now craft their environmental policies has therefore largely been shaped by the IMF. Yet despite calls for the Fund to include sustainability assessments in its lending programs dating to at least the mid-1990s (Abaza 1996), we know relatively little about how, precisely, the IMF considers environmental issues in its advice and how this affects forest-related outcomes (for exceptions, see Shandra, Shircliff, and London 2011; Soener 2024). This prompts our central research questions: How does the IMF consider environmental impact in its lending programs? What environmental consequences are associated with IMF programs in borrowing countries?

To understand how IMF programs shape environment-related variables, we examine the impact of IMF programs on forest management and land use change in developing countries. In 2022, tropical primary forests shrunk by 41,000 km^2, equivalent to losing approximately 11 soccer fields of forest each minute (Weisse, Goldman, and Carter 2023). If deforestation was a country, it would be the third-largest emitter of greenhouse gases in the world, only after China and the United States (Seymour and Busch 2016). In addition to the carbon-intensive process of clearing forests, deforestation has long-lasting and difficult-to-reverse consequences for climate change because it reduces the earth's capacity to absorb greenhouse gases (Xu et al. 2022)—estimates suggest that in the last two decades, global forests annually absorbed net emissions of 7.6 $GtCO_2e\ yr^{-1}$ (Harris et al. 2021). Further, these figures are likely to underestimate the true effect on the climate because they neglect the impact of degradation on greenhouse gas emissions (Pearson et al. 2017).

Beyond climate change, deforestation is important since reduced forest cover contributes to desertification and decreased biodiversity (Busch and Ferretti-Gallon 2023; FAO 2022; Seymour and Busch 2016). Correspondingly, reducing deforestation is central to conservation strategies (Barlow et al. 2016; Panfil and Harvey 2016). For example, in Montreal in 2022, the parties of the UN Convention on Biological Diversity at COP-15 adopted a landmark framework which targets that "all areas under agriculture, aquaculture and forestry are managed sustainably" (Convention on Biological Diversity 2022). More ambitious still, more than 50 governments have endorsed the New York Declaration on Forests that commits signatories to halt the loss and degradation of primary forests by 2030 (NYDF 2024). Finally, deforestation can infringe on human rights of affected communities in manifold ways (Ray, Gallagher, and Sanborn 2019). For instance, people rely on forests for subsistence: the UN

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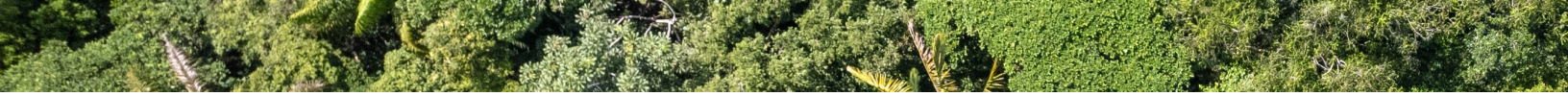
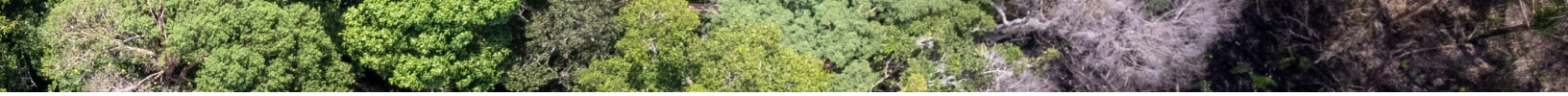


Food and Agriculture Organization (FAO) reports that forest-related activities contribute about 20-25 percent of household income for forest-adjacent communities (FAO 2022). All of this makes the analysis of deforestation a compelling case to evaluate the IMF's role in climate governance.

Theoretically, we build on scholarship on the political economy of land use change and the literature on program evaluations of IFIs. From the former, the forest transition curve stipulates that changes in land use and forest cover are closely linked to a country's development (Barbier, Delacote, and Wolfersberger 2017; Mather 1990, 1992). Simply put: a country clears forests as it experiences economic and population growth and expands activity in the primary sector and manufacturing; once growth slows and the country moves towards a service-based economy, agricultural land is less useful and areas are reforested. We pair insight with an empirical finding from the program evaluation literature of IFIs and posit that IMF programs are likely to delay this forest transition, chiefly because lending arrangements tend to reduce economic growth (e.g., Dreher 2006; see also review in Steinwand and Stone 2008) and governments faced with such prospects may seek to exploit forests to raise financial resources. In addition, deforestation may increase if governments decrease spending on forest protection programs amidst fiscal consolidation measures—a cornerstone of IMF programs. As a result, we hypothesize that IMF programs are associated with higher rates of deforestation.

Before examining this empirically, we conduct a quantitative text analysis on the full text of 35,915 conditions attached to IMF lending arrangements in low- and middle-income countries since 1980 (Kentikelenis and Stubbs 2023). Of those, merely 34 include explicit targets for forest management. These conditions were administered as part of lending programs in 14 distinct countries, as early as 1990 (in Guyana) and as recent as 2019 (in the Republic of Congo). These results demonstrate that forest management has been, as per the Fund's mandate, far from a priority for the IMF—but it does not preclude the possibility that countries respond to and implement IMF programs in ways that affect deforestation. To test this, we subsequently regress the area of annual forest loss unrelated to fires (Tyukavina et al. 2022) on a binary indicator of an IMF program. We employ two-way fixed effects models that absorb variation in a country's annual forest loss due to time-invariant country characteristics (such as whether or not a country is located in the tropics) and events common to all countries (such as global price shocks). Controlling for a borrowing country's economic fundamentals and determinants of forest transitions, we find—consistent with our argument—that IMF programs are associated with greater deforestation. In our baseline models, an IMF program is associated with an increase in annual tree cover loss by 9.2 percent. In additional analyses, we show that these effects are not driven by reforms targeting forest management explicitly; rather, the environmental impact we draw attention to is likely to stem from borrowing countries shifting their priorities amidst an IMF program.

Taken together, our research has important implications for distinct scholarly and policy debates. There is considerable work on how non-states actors, such as transnational advocacy networks, international non-governmental organizations (NGOs) or civil society, seek to influence international organizations to become environmentally friendly (e.g., Dörfler and Heinzel 2023; Greenstein 2022; Gutner 2005; Park 2005). We shift the focus to the



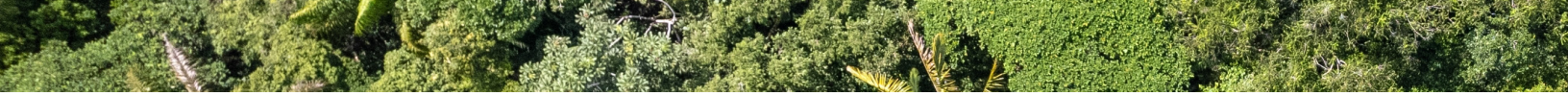
environmental consequences of their policy advice (e.g., Buntaine and Parks 2013; Goes 2023; Goes and Chapman 2024; Soener 2024). This extends research on the IMF's efforts to establish natural resource funds in borrowing countries (Goes 2023; Goes and Chapman 2024) or the institution's economization of climate finance and energy subsidies (Skovgaard 2021). Our analysis indicates—consistent with earlier studies (Shandra, Shircliff, and London 2011; Vreeland, Sturm, and Durbin 2001)—that IMF programs have also contributed to increased rates of deforestation.

In terms of policy, our results inform debates about the Fund's emerging climate advice (Task Force on Climate, Development and the IMF 2023). To be clear, we do not argue that the IMF deliberately designs its lending programs such that they increase deforestation—indeed, we document that explicit targets of forest policy in lending programs are extremely rare. Instead, we show that IMF programs are associated with borrowing countries extracting economic value from deforestation. Put differently, over the last two decades, *some* deforestation in developing countries has taken place that may not have occurred if the country did not have an IMF program. The relatively limited year-to-year variation in deforestation rates indicates that the IMF's impact on forest management is not major, but it also suggests that the Fund needs to considerably step up its climate action going forward if it is to make a difference—and we call for the IMF to reckon with this reality. The institution is, of course, largely dominated by Western shareholders (for a review, see Forster, Stubbs, and Kentikelenis 2022) and climate-vulnerable countries are severely underrepresented in IMF governance (Merling and Forster 2024). Yet in the realm of international forest policy, NGOs from the Global North and South share many concerns, including the 'urgent need to halt and reverse deforestation in all forested regions' (Humphreys 2004, 52). We believe our findings provide theoretically based and empirically driven justification for these efforts.

THEORIZING IMF PROGRAMS AND DEFORESTATION

Two strands of literature help understand how IMF programs affect deforestation: scholarship on the political economy of deforestation and studies on the determinants and consequences of IMF lending programs.

Countries may deforest to extract wood fuel, they may convert forests into agricultural land to sell crops, or clear area for mining purposes or urbanization (for a recent review, see Busch and Ferretti-Gallon 2023). Regardless of the specific motivation, deforestation can be viewed as a question of land use change. The *forest transition curve* conceptualizes a country's land use change as a transition from shrinking to expanding forest area following a u-shaped trajectory (Barbier, Delacote, and Wolfersberger 2017; Barbier and Tesfaw 2015; Mather 1990, 1992). First, from a point of large forest cover and low social and economic development, deforestation is attractive to extract resources and convert into agricultural land to meet the rising food demands of a growing population. The marginal returns of deforestation are positive, but decreasing. At later stages of development, once a country increasingly derives value from manufacturing rather than the primary sector, the benefits of deforestation diminish to the extent that the costs outweigh the benefits. This culminates in the forest transition—"a sustained shift from net deforestation to net reforestation"

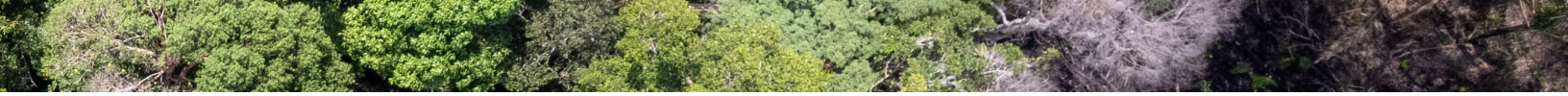


(Barbier and Tesfaw 2015, 256)—which initiates the third phase where forest recovery becomes technically and economically feasible (Barbier, Delacote, and Wolfersberger 2017; Barbier and Tesfaw 2015).

Although the common underlying cause of the forest transition are population and income growth, the specific drivers are debated (for a review, see Barbier, Delacote, and Wolfersberger 2017). Economic factors, such as prices and demand for forest and/or agriculture products, incentivize certain land uses more than others. To a certain extent, these conditions are subject to government intervention and policies influencing forest and agricultural rents therefore help us understand land use change (Barbier, Burgess, and Grainger 2010; Foster and Rosenzweig 2003). For instance, the forest transition in South Korea, roughly starting in the 1950s and stabilizing in the 1980s, is seen as an example of a state-led transition (Bae, Joo, and Kim 2012). This view also invites scrutiny of countries' governance and political institutions. Corruption and political instability, for example, lead to inefficiencies by reducing returns from forest and agriculture, thereby delaying the transition (Barbier and Tesfaw 2015). In short, states may be able to nurture (or hinder) the forest transition by employing policies that advance development and strengthen the institutional framework (see also Wuepper, Crowther, et al. 2024).

How do IMF programs come into play? Financial support by the IMF is conditional on the implementation of policy reforms. Such conditionality typically encompasses market-oriented reforms that range from fiscal consolidation and monetary tightening (known as austerity) to financial liberalization, from privatization of state owned-enterprises to deregulation (Kentikelenis and Stubbs 2023). While the IMF designs these programs to bolster investor confidence and spur economic growth, the academic evidence to date shows that IMF efforts are mixed at best. In a review of the relationship between IMF programs and economic growth (Steinwand and Stone 2008), seven out of eight studies that control for selection consistently find that IMF programs lower economic growth.[2] These findings have continued to hold. Countries that are most interested in participating in IMF programs are the least likely to have favorable growth outcomes (Bas and Stone 2014) and IMF programs contribute to widening inequality and higher poverty headcounts and poverty gaps (Forster et al. 2019; Lang 2020; Stubbs et al. 2021), thereby undermining development. The Fund's own Independent Evaluation Office also noted that "in cases of prolonged use of general resources, IMF-supported programs tend to be associated with a negative impact on growth" (IEO 2002, 11). This was confirmed by the Fund itself in 2023, showing that IMF programs centered on fiscal consolidation are not associated with economic growth and thus fall short of addressing debt sustainability (IMF 2023). If the economic growth promised by IMF conditionality does not materialize, governments may seek to raise additional funds by increasing their production and export of agricultural products, including trade in forest products (Antonarakis, Pacca, and Antoniades 2022). For instance, during the 1997-98 East Asian financial crisis (with heavy involvement of the Fund), countries expanded agricultural

[2] Countries that approach the IMF for financial support are different than non-borrowing countries with regard to economic growth. It is typically a crisis, i.e., a negative shock to growth, that prompts a government to approach the IMF. Evaluations interested in the causal effect of IMF programs on economic growth therefore need to account for this non-random selection, and we only consider such studies here. For a methodological discussion of this issue, see Stubbs et al. (2020).



activities to compensate for income loss (Dauvergne 1999). Further, fiscal consolidation measures are a cornerstone of IMF programs and governments frequently cut expenditure on non-core activities (e.g., on health spending, see Stubbs et al. 2017). Such decreases in government expenditure could increase deforestation by weakening forest management and conservation initiatives (Antonarakis, Pacca, and Antoniades 2022), as was the case in Brazil (Kasa and Næss 2005). Our central hypothesis is therefore as follows:

> **H1.** Countries with IMF programs experience greater forest cover loss than non-borrowing countries.

Beyond the impact on economic growth, other elements of IMF programs also tend to narrow borrowing countries' fiscal policy space (Kentikelenis, Stubbs, and King 2016) with potential consequences for forest policies (see also Shandra, Shircliff, and London 2011; Vreeland, Sturm, and Durbin 2001). For example, IMF conditionality with agricultural content tend to promote the extension of private property and competitive markets and discourage government interventions (Daoud et al. 2019). In addition, IMF lending tends to increase corruption in borrowing countries because influential social groups, such as business and civil servants, seek to maintain their privilege amidst losses due to structural reforms (Reinsberg, Kentikelenis, and Stubbs 2021).

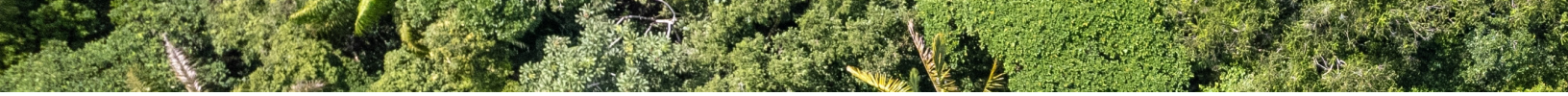
We do not attempt to model or test the forest transition of low- and middle-income countries. Yet the forest transition curve offers us a conceptual perspective from which to evaluate the impact of IMF programs on deforestation. Since multiple components of IMF policy advice are likely to undermine economic growth and maintain incentives to exploit natural resources, we argue that IMF programs are associated with a shrinking forest cover in borrowing countries.

RESEARCH DESIGN

Text Analysis

We first examine the IMF's policy advice on forest management. To this end, we leverage a new dataset that includes the full text of all conditions administered in lending programs for low- and middle-income countries since 1980 (Kentikelenis and Stubbs 2023). These texts are succinct descriptions of the policy reforms to be conducted as part of an IMF program, e.g., they include targets for 'medium/long-term debt', specify that a government needs to 'establish a securities trading regulatory framework', or that the borrowing country 'carry out 3,400 tax audits of corporations and independent professionals.' Given the brevity and the official character of these policy reforms as part of the lending agreement, the full text is meaningful to understand whether the IMF explicitly targets forest policy.

To classify which of these policy reforms pertain to forest management, we use a dictionary approach (e.g., Kaya and Reay 2019; Ramos, Gallagher, Kring, et al. 2022; Ramos, Gallagher, Stephenson, et al. 2022). Dictionary methods use a list of words that approximate a given topic and use the absolute or relative frequency of texts mentioning these terms as measures of intensity. For example, the Washington Consensus would be captured by



terms such as 'deregulation; privatization; fiscal discipline; trade liberalization; or structural adjustment' (Kaya and Reay 2019) or the IMF's attention to climate in surveillance can be captured by references to 'subsidy; carbon tax; or renewable energy' (Ramos, Gallagher, Stephenson, et al. 2022). The more often a text mentions these terms, the more the text is about the Washington Consensus or climate surveillance, respectively. We classify any condition as relating to forest management if the text of the policy reform in the official loan documents mentions at least one of the following terms: forest(s); rainforest(s); wood(s); tree(s); forestry; logging; felling; deforest; desertify; deforestation; desertification. After implementing the dictionary, we manually checked for, and removed, false positives (e.g., any references to Bretton Woods). This analysis provides a first glance as to whether the IMF explicitly targets forestry policy in borrowing countries.

Regression Analysis

Second, to examine the impact of IMF programs on deforestation, we use novel data on annual tree cover loss based on global ground and Earth observation data (Harris et al. 2021), which advances on yearly estimates of forest area by the FAO. Ideally, we would only consider forest loss due to policy interventions. For lack of such data, we consider changes in tree cover that are unrelated to fires (Tyukavina et al. 2022)—e.g., Bolivia recorded a tree cover loss of circa 5,600km^2 in 2021, but 44 percent of this was due to fires (Tyukavina et al. 2022). Our sample includes up to 125 low- and middle-income countries between 2000 and 2020 (see Appendix A for a list of countries). In robustness checks, we show that our results are not sensitive to alternative definitions of the sample.

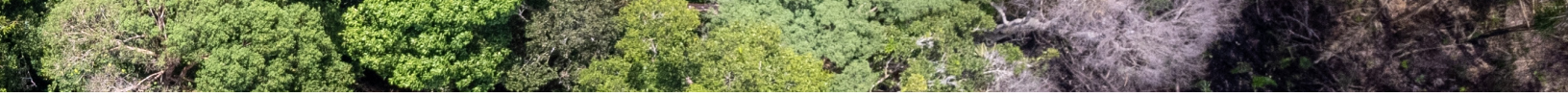
Our main treatment variable of interest is a binary indicator equal to 1 if an IMF program has been active for at least five months per calendar year (Kentikelenis and Stubbs 2023). In robustness checks, we also consider a binary indicator for whether an IMF program included environmental reforms—conditions pertaining to land registries, granting of property rights, environmental regulations and access to commons—and a binary variable equal to 1 if an IMF program had binding conditions.

To model the relationship between an IMF program and loss of tree cover, we estimate the following equation using Ordinary Least Squares:

$$\begin{aligned} \textit{Tree cover loss (ha)}_{i,t+1} = \alpha + \beta_1 \, \textit{IMF}_{i,t} + \beta_2 \, \textit{EconFundamentals}_{i,t} + \\ \beta_3 \, \textit{ForestTransition}_{i,t} + \textit{FixedEffects} + \varepsilon_{i,t} \end{aligned} \tag{1}$$

where the dependent variable is the log of annual (non-fire related) tree cover loss (in ha) in country *i* measured at *t+1*. Our quantity of interest is the point estimate of the coefficient β_1 on the IMF program dummy.

We are not interested in modeling forest transitions, nor do we want to test for all possible determinants of deforestation. Rather, we are interested in the relationship between IMF programs and rates of tree cover less. The control variables are therefore based on the many well-established determinants of selection into IMF programs (e.g., Dreher, Sturm, and



Vreeland 2015; Steinwand and Stone 2008; Thacker 1999). We want to include in our models those factors that plausibly also correlate with forest policies; the absence to account for such variables would confound the relationship between IMF programs and deforestation. First, as per the Fund's mandate, economic fundamentals of borrowing countries matter for the selection into IMF programs. We therefore control for GDP (log) (IMF 2019), economic growth (%) (WDI 2020), current account balance (% of GDP) (IMF 2019), and debt service (% of exports) (WDI 2020). In robustness checks, we also include annual inflation (%) (WDI 2020). The idea behind all these variables is that they determine whether a country faces a balance-of-payment crisis and needs financial support from the IMF; at the same time, the precarity of the situation may force the country to exploit its natural resources, including forests. Further, we approximate for political institutions by including a variable for the level of democracy (Coppedge et al. 2020) because democracies tend to receive fewer conditions from the IMF (Stone 2008); at the same time, they exhibit stronger international environmental commitment than non-democracies (Neumayer 2002).

Second, we include in our baseline model five variables that approximate the underlying variables of the forest transition curve (e.g., Barbier, Delacote, and Wolfersberger 2017; Barbier and Tesfaw 2015) and deforestation more generally (e.g., Busch and Ferretti-Gallon 2017, 2023): We control for population growth (%), forest rents (% of GDP) and the value added of agriculture (% of GDP) (all from WDI 2020) because these set the material incentives to deforest and reflect countries' position on the forest transition curve (Barbier, Delacote, and Wolfersberger 2017; Busch and Ferretti-Gallon 2017). Further, we control for the number of legal acts (either new or amended legal provisions) relating to forests, biodiversity and land use (Wuepper, Wiebecke, et al. 2024). Finally, we include a variable for political stability of the government (Kaufmann, Kraay, and Mastruzzi 2010) because corruption and instability delays the transition (Barbier and Tesfaw 2015).

In additional models, we include controls to address concerns about omitted variable bias. For instance, reforms are costly to incumbents when implemented close to elections (Rickard and Caraway 2014), which is why we include a dummy variable for upcoming elections (legislative or executive) (Coppedge et al. 2020). Finally, we include a binary indicator for whether a country is a temporary member in the UN Security Council (Dreher, Sturm, and Vreeland 2009) and voting affinity in the UN General Assembly (Voeten 2012). Both of these allow countries to get more lenient lending conditions from the IMF (e.g., Dreher, Sturm, and Vreeland 2015; Steinwand and Stone 2008). Table 1 provides summary statistics of these variables.

Our estimation includes both country and year fixed effects. The former absorb all time-invariant country-specific information and the latter absorb common shocks to all countries. Thus, we are effectively examining whether greater exposure to IMF programs increases rates of deforestation within a given country over time (Kropko and Kubinec 2020). As illustrated in Appendix B, the within-country variation in annual tree cover loss is considerably smaller than the between-country variation. This makes our regression analysis more challenging because standard errors will be higher and smaller effects are more difficult to detect. The ANOVA analysis suggests that the IMF program dummy accounts for about one-seventh of the variation explained in our dependent variable.

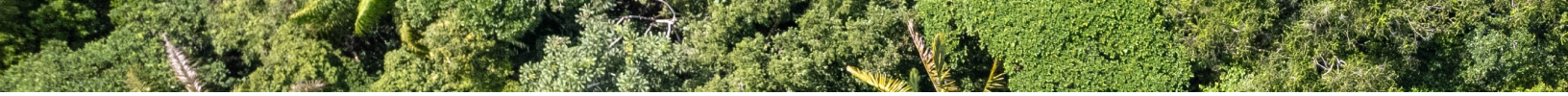


TABLE 1: SUMMARY STATISTICS

Variable	Missing (%)	Mean	SD	Min	Median	Max
Forest cover loss (log of ha)	0	8.06	3.58	0	8.45	15.11
IMF program	0	0.27	0.45	0	0	1
IMF program (binding) [R]	0	0.31	0.46	0	0	1
IMF environmental reforms [R]	6	0.01	0.11	0	0	1
GDP (log)	2	23.74	1.97	18.87	23.52	30.31
GDP growth (%)	2	3.93	5.89	-50.34	4.3	86.83
Current account balance (% of GDP)	4	-4.01	10.49	-84.11	-3.8	63.39
Debt service (% of exports)	15	7.91	8.75	0	5.86	134.72
Population growth (%)	0	1.62	1.22	-4.53	1.58	6.56
Forest rents (% of GDP)	2	2.68	4.69	0	0.55	40.41
Value added agriculture (% of GDP)	3	16.13	11.73	0.89	12.43	79.04
Forest policies	0	0.46	1.55	0	0	25
Political stability	11	-0.56	0.85	-3.31	-0.45	1.39
Liberal democracy index	5	0.31	0.19	0	0.28	0.86
Inflation (%) [R]	2	8.44	19	-26.7	5.33	558.56
Election (legislative or executive) [R]	5	0.28	0.45	0	0	1
UN Security Council member [R]	0	0.05	0.22	0	0	1
UNGA voting affinity with US [R]	2	0.31	0.12	0	0.28	0.98

Source: Compiled by authors.

Notes: Sample of up to 125 low- and middle-income tropical countries, as defined above. [R] indicates that this variable is used in robustness checks.

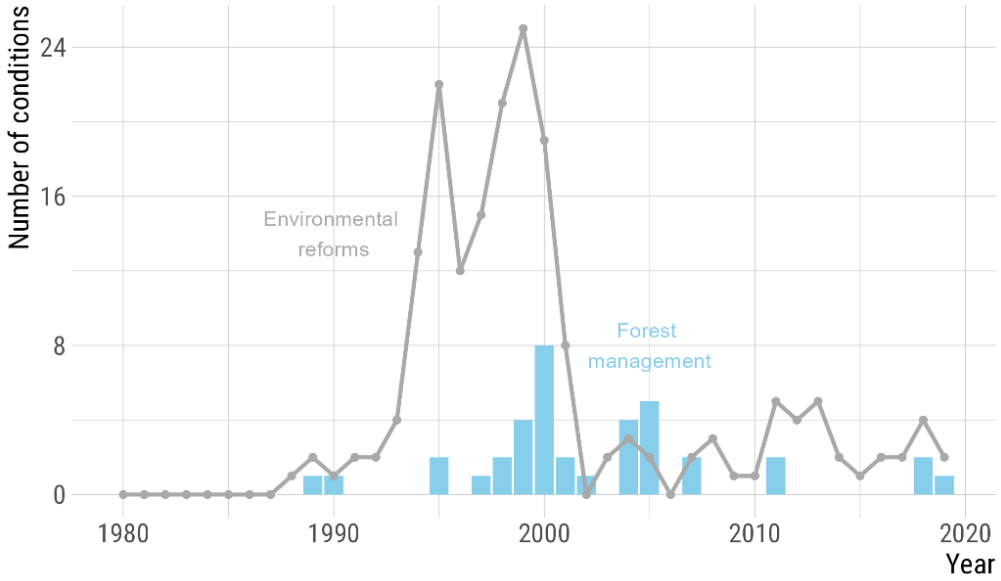
RESULTS

Documenting the Lack of Forest Conditionality

Before presenting the results of the regression analysis, we first address an intermediary question: We do not have any systematic knowledge on the content and extent of IMF conditionality pertaining explicitly to forest policy. Thus, we performed a quantitative text analysis on the texts of all IMF reforms over the last two decades (Kentikelenis and Stubbs 2023). We identify merely 34 out of 35,915 conditions that explicitly target forest policy, compared to 200 environmental conditions (reforms about land registries, granting of property rights, environmental regulations and access to commons), as displayed in Figure 1.

We identify three types of such reforms, as illustrated in Table 2 (Appendix C lists all 34 conditions): conditionality aimed at liberalizing trade in forest products, reforms that target sustainable forest management and measures that increase transparency in forest governance. These are, or potentially relate to, determinants of changes in forest cover (e.g., Busch and Ferretti-Gallon 2017, 2023). For instance, restricting or liberalizing trade in forest products

FIGURE 1 Conditionality on Forest Policy and Environmental Governance



Source: Compiled by authors, drawing on data from Kentikelenis and Stubbs (2023).

Notes: Counts of conditions pertaining explicitly to forest management (blue bars) and environmental reforms (grey points) administered in IMF lending programs in low- and middle-income countries between 1980 and 2019.

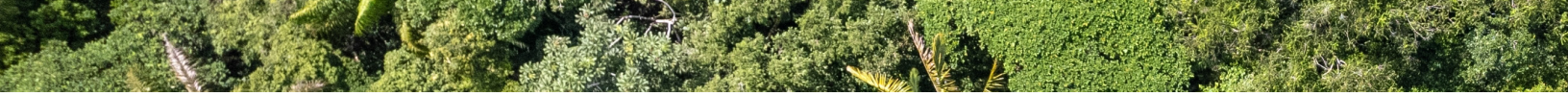
directly affects the incentives to deforest. Increased transparency allows governments to better manage forest resources. Nonetheless, the small number of conditions pertaining to forest management makes them unlikely to drive any association between IMF programs and deforestation—we report on the statistical analysis of this association next.

TABLE 2 Conditionality Explicitly Targeting Forest Policy

Type	Country	Year	Text
Liberalizing trade	Albania	1995	Eliminate export licensing requirement for **wood**.
	Indonesia	1998	Introduce resource rent tax on **forestry** products and reduce export tax on **logs** and sawn **timber** to 30 percent.
Sustainable forest management	Cambodia	2000	Cancel three **forestry** concessions and reduce the annual allowable cut by 50-70 percent for other concessions.
	Gabon	2007	Return to the public domain of 116 **forestry** permits with tax arrears since 2002-03, representing a total surface of 1.8 million hectares.
Promote transparency	Peru	2000	Announce results of bidding on the concession for management of the **Biabo forest**.
	Central African Republic	2018	Publish all **forestry** permits issued before June 30, 2018, on a government website, notably on the Ministry of Finance and Budget website.

Source: Compiled by authors, drawing on data from Kentikelenis and Stubbs (2023).

Notes: Selected examples of conditionality administered between 1980 and 2019 which explicitly pertains to forest policy and management.



IMF Programs and Increased Forest Cover Loss

In Table 3, we present the estimates from our regression analysis. In our baseline specification (Model 1), the point estimate of the coefficient on IMF programs is 0.088, indicating that an IMF program is associated with an increase in tree cover loss (in ha) by 9.2 percent ($p<0.03$). We also display the estimates of the coefficients on the control variables although we refrain from interpreting them because as discussed in Sections 2 and 3, we are interested in estimating the effect of IMF programs on forest cover, rather than the selection into IMF programs or determinants of deforestation (Keele, Stevenson, and Elwert 2020). Across Models 2-5, we include the additional control variables mentioned above. The results remain substantively the same. Throughout, our models explain a very high share of variation in annual tree cover loss, mainly due to the country fixed effects (see also Appendix B for a visualization and decomposition of the variation). In Appendix Table D1, we also run the models without the IMF program dummy, and the point estimate of the coefficients on the control variables remain largely the same.

What do our findings in Table 3 mean in substantive terms? Assuming an average three-year duration of an IMF program, our estimates imply that each IMF loan is, at the average, associated with a decrease in forest area of 258km^2, almost the size of the Maldives. For illustrative purposes, in our sample of 125 countries between 2000 and 2020, we record 978 country-years with IMF programs. According to our statistical estimates, the marginal increase in tree cover loss associated with IMF programs in these country-years totals 41,500km^2, or 2,075km^2 per year—about 5 percent of the global tropical primary forest loss of 2022 (Weisse, Goldman, and Carter 2023).

We perform five sets of additional analyses, all detailed in Appendix D: In short, we show that these effects are not driven by reforms targeting forest management explicitly; they are robust to an alternative indicator of an IMF program and to the exclusion of any country in our sample; and we find that applying different cut-offs of forest cover for our sample does not change our results substantially. Further, an examination of the effective sample indicates that our estimates are driven not by countries with large forest cover in absolute terms, such as Brazil, Indonesia or the Democratic Republic of Congo.

First, we investigate whether the results are driven by environmental reforms mandated in IMF programs specifically, or other components of IMF policy advice. To this end, we re-estimate the baseline model by employing a binary indicator for environmental conditionality instead of the IMF program dummy. As we show in Table D2, the point estimate of the coefficient on environmental reforms is statistically insignificant. Thus, consistent with the results of the text analysis, explicit targets of forest policy and environmental reforms cannot account for the changes in forest cover experienced by countries during IMF lending programs.

Second, we replace our indicator for an IMF program with a more stringent type. In the baseline model, we record an IMF program if it has been active for at least five months, regardless of the policy reforms attached to the lending arrangement. In Table D3, we show that the results remain statistically significant if we recode the IMF program treatment

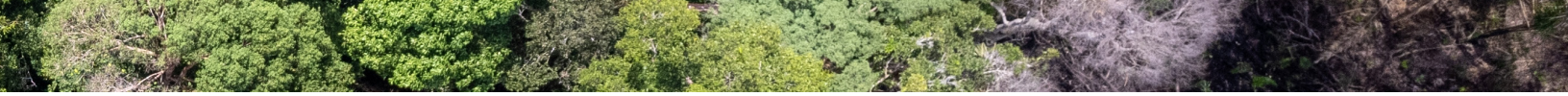
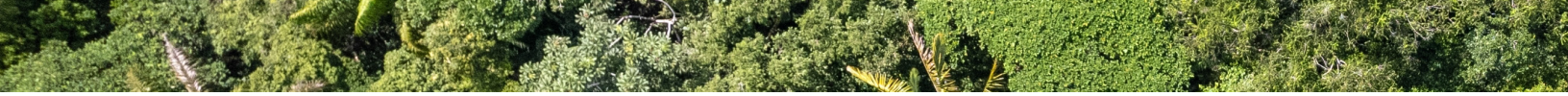


TABLE 3: IMF PROGRAMS AND FOREST COVER

	Dependent variable:				
	Tree cover loss (log ha) t+1				
	(1)	(2)	(3)	(4)	(5)
IMF program	**0.088****	**0.087****	**0.088****	**0.088****	**0.093****
	(0.043)	(0.043)	(0.043)	(0.043)	(0.044)
GDP (log)	0.037	0.027	0.037	0.043	0.088
	(0.425)	(0.426)	(0.425)	(0.426)	(0.421)
GDP growth (%)	0.010	0.010	0.010	0.010	0.009
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Current account balance (% of GDP)	-0.002	-0.002	-0.002	-0.002	-0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Debt service (% of exports)	-0.004	-0.004	-0.004	-0.004	-0.004
	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)
Population growth (%)	-0.218**	-0.219**	-0.218**	-0.218**	-0.222**
	(0.092)	(0.092)	(0.092)	(0.092)	(0.092)
Forest rents (% of GDP)	-0.032	-0.032	-0.032	-0.032	-0.033
	(0.020)	(0.020)	(0.020)	(0.020)	(0.021)
Agriculture value added (% of GDP)	-0.002	-0.002	-0.002	-0.002	-0.001
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Forest policies	-0.015	-0.015	-0.015	-0.015	-0.016
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Political stability	0.133	0.130	0.133	0.134	0.139
	(0.098)	(0.098)	(0.098)	(0.098)	(0.098)
Liberal democracy	-0.638	-0.632	-0.634	-0.634	-0.670
	(0.388)	(0.389)	(0.388)	(0.389)	(0.404)
Inflation		-0.001			
		(0.000)			
Election			0.014		
			(0.021)		
UN Security Council member				-0.053	
				(0.053)	
UNGA voting affinity with US					1.628***
					(0.564)
Observations	1896	1896	1896	1896	1881
R^2	0.965	0.965	0.965	0.965	0.965
Country FEs	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes

Source: Compiled by authors.

Notes: Tree cover loss is net of forest loss due to fires. Standard errors clustered on the country. *p<0.10; **p<0.05; ***p<0.01



dummy as equal to 1 if a program includes binding conditions—the type of conditions the IMF places most weight on when assessing the disbursement of loan tranches.

Third, we examine the sensitivity of our results to any single country in our sample. Brazil, the Democratic Republic of the Congo and Indonesia are the three countries with the largest tropical forest cover by some distance. Are our findings driven by these countries? To address this concern, we have re-estimated our baseline model by leaving out each of our 125 countries in the sample, one at a time. As we show in Appendix Figure D1, the estimates of our coefficient on IMF programs are closely within the baseline estimate of 0.088; they range from 0.067 (when excluding Kyrgyzstan) to 0.099 (when dropping Senegal from our sample).

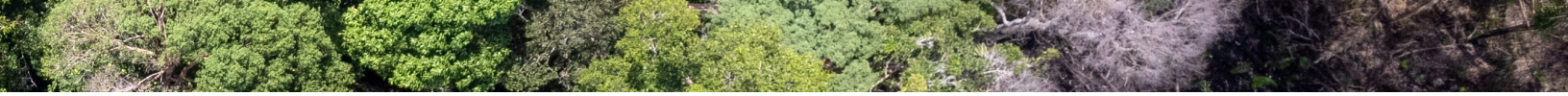
Fourth, a final robustness check pertains to the threshold used for defining the sample of countries with forest cover. In our baseline model, we included all 125 low- and middle-income countries. In Appendix Table D4, we apply the following cut-offs for the level of forest area in 2000, the start of our analysis: 5 percent, 10 percent, 15 percent, 30 percent and 50 percent. The results remain substantively the same up until 15 percent; when employing a 30 percent or 50 percent threshold, the number of observations decreases to 1,012 and 508, respectively (compared to 1,896 observations in the baseline model), thereby leading to more imprecise estimates.

Finally, the models above are fitted with ordinary least squares, which implies that individual observations (country-years) contribute differently to the regression results. Following the logic of partialing out, most weight in determining the point estimate of the coefficient on the IMF program dummy goes to the country-years that are least explained by the other regressors. Following this logic, we calculate the individual weights of observations (see Aronow and Samii 2016), which helps us evaluate whether our results are driven by countries with large forest covers, such as Brazil, Indonesia or the Democratic Republic of Congo. As displayed in Appendix Figure D2, however, this is not the case. None of these countries appear in the top 20 observations and our estimates are rather driven by countries with smaller forest areas—e.g., Ethiopia, Nepal and Sierra Leone.

CONCLUSION

International organizations play an important role in steering the international financial architecture towards national and global policy challenges. We have examined how one important international organization, the IMF, has contributed to deforestation through policy reforms mandated in its lending programs. Our core findings are twofold. First, we have documented the lack of forest conditionality. Second, employing two-way fixed effects models, we have found that countries with IMF lending arrangements exhibit higher rates of tree cover loss—consistent with previous work on this issue (Shandra, Shircliff, and London 2011).

Before discussing the policy implication of these findings, we note two limitations of our work. First, we have focused on IMF programs as a whole and not differentiated between

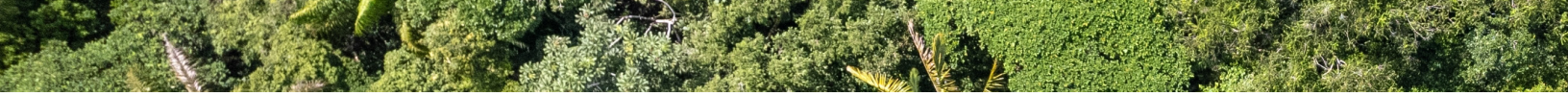


the individual policy area. Our reasoning for this was that the effects stem from the reduced fiscal policy space given to borrowing countries and the adverse consequences on economic growth. Consistent with this broad mechanism, we have rejected the notion that the IMF explicitly designs lending programs with regard to forest policy. Thus, what we identify is likely an unintended consequence, but we encourage future research to probe the mechanism in more detail. Second, we have focused on deforestation—the third biggest emitter of carbon if it were a country (Seymour and Busch 2016)—to understand one piece of the climate puzzle. Yet year-to-year changes in deforestation are relatively small. Related work examines how the IMF impacts climate mitigation and adaptation, e.g., by changing fossil fuel extraction incentives (Goes 2023; Goes and Chapman 2024) or how Fund policies may heighten climate vulnerability (Task Force on Climate, Development and the IMF 2023), respectively.

What do our findings suggest for policy? The text analysis of conditionality suggests that any effect of IMF programs on forest-related outcomes, including deforestation, is unlikely to stem from explicit targets. Yet we do find that under IMF monitoring, countries have harmed global forests' capacity to absorb carbon emissions, and this may be difficult to reverse once global forests' capacity to act as carbon sinks is impaired (Xu et al. 2022). In view of this, the IMF should comprehensively reorient its surveillance and lending policies to facilitate country practice and IMF program alignment with the Paris Agreement. Traditional components of IMF programs are currently being redressed, e.g., austerity measures give way to 'green fiscal consolidation.' Our findings echo a recent assessment of the IMF's approach to climate change (Task Force on Climate, Development and the IMF 2023) that this is inconsistent with sustainable growth. In addition, the Fund's Climate Strategy (IMF 2021a) mentions 'forests' only once, casting doubts on whether it will eliminate past practices of conditionality that we have shown to be associated with higher tree cover loss, let alone develop new approaches that increase forest cover.

In terms of academic debates, this study contributes to our understanding of IFIs and their impact on environmental outcomes in general and forests and climate change in particular—and also speaks more broadly to questions of global environmental governance (Newell 2008). Our research demonstrates the power of international institutions such as the IMF to govern issues with repercussions for environmental policies and outcomes in developing countries. Of course, how international-level determinants interact with domestic policy-making and institutions varies by country, and we encourage future work to shed more light on this, e.g., through the use of comparative case studies.

We are facing "a rapidly closing window of opportunity to secure a livable and sustainable future for all," the latest synthesis report by the United Nations (UN) Intergovernmental Panel on Climate Change (IPCC) (2023) warned. Most IFIs have recognized this urgency and are revamping their operations. As our findings have shown, social scientists are ideally positioned to contribute to this ongoing reform process by reminding IFIs how their own policy advice has helped or hindered environmental progress in the past.



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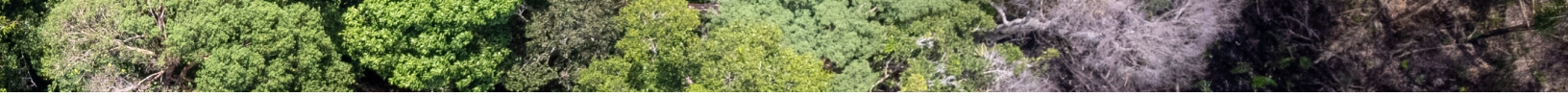

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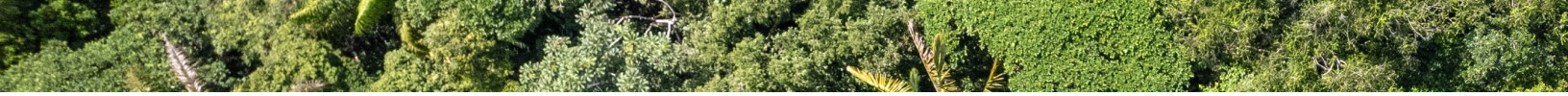

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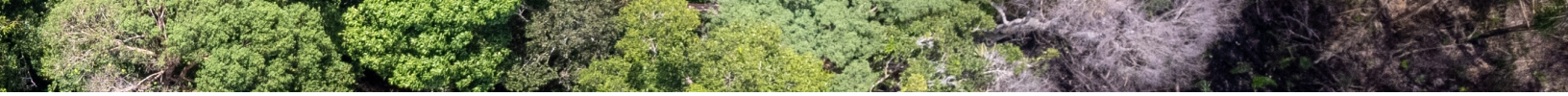

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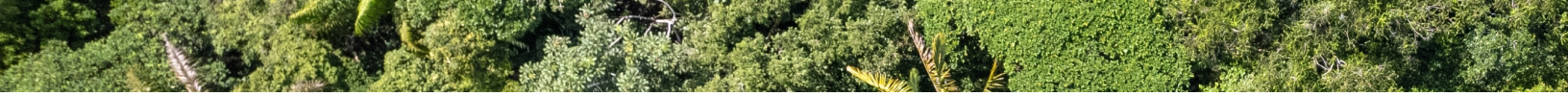

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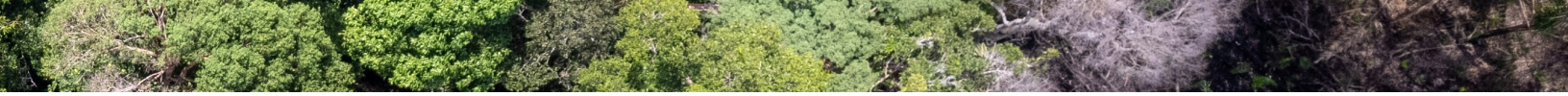


APPENDIX

A. List of Countries in Sample

Afghanistan; Albania; Algeria; American Samoa; Angola; Argentina; Armenia; Azerbaijan; Bangladesh; Belarus; Belize; Benin; Bhutan; Bolivia; Bosnia and Herzegovina; Botswana; Brazil; Bulgaria; Burkina Faso; Burundi; Cabo Verde; Cambodia; Cameroon; Central African Republic; Chad; China; Colombia; Comoros; Congo, Dem. Rep.; Congo, Rep.; Costa Rica; Côte d'Ivoire; Djibouti; Dominica; Dominican Republic; Ecuador; Egypt, Arab Rep.; El Salvador; Equatorial Guinea; Eritrea; Eswatini; Ethiopia; Fiji; Gabon; Gambia, The; Georgia; Ghana; Grenada; Guatemala; Guinea; Guinea-Bissau; Guyana; Haiti; Honduras; India; Indonesia; Iran, Islamic Rep.; Iraq; Jamaica; Jordan; Kazakhstan; Kenya; Kiribati; Kosovo; Kyrgyz Republic; Lao PDR; Lebanon; Lesotho; Liberia; Libya; Madagascar; Malawi; Malaysia; Maldives; Mali; Marshall Islands; Mauritania; Mauritius; Mexico; Micronesia, Fed. Sts.; Moldova; Mongolia; Montenegro; Morocco; Mozambique; Myanmar; Namibia; Nepal; Nicaragua; Niger; Nigeria; North Macedonia; Pakistan; Palau; Papua New Guinea; Paraguay; Peru; Philippines; Russian Federation; Rwanda; Samoa; São Tomé and Principe; Senegal; Serbia; Sierra Leone; Solomon Islands; Somalia; South Africa; South Sudan; Sri Lanka; St. Lucia; St. Vincent and the Grenadines; Sudan; Suriname; Syrian Arab Republic; Tajikistan; Tanzania; Thailand; Timor-Leste; Togo; Tonga; Tunisia; Türkiye; Turkmenistan; Tuvalu; Uganda; Ukraine; Uzbekistan; Vanuatu; Venezuela, RB; Vietnam; Yemen, Rep.; Zambia; Zimbabwe

B. Variation in Tree Cover Loss

In Figure B1, we visualize the level of annual tree cover loss (non-related to fires) in our sample. Each line represents a low- or middle-income country. As is evident, our dependent variable varies considerably more between countries than within countries over time. This may pose an inferential challenge to our regression analysis because by employing two-way fixed effects, we are left with relatively little variation to explain. To examine this more systematically, the ANOVA analysis displayed in Figure B2 separates the variation explained by IMF program dummy, country fixed effects, year fixed effects and residuals. Accordingly, the IMF dummy accounts for about one seventh of the total variation.

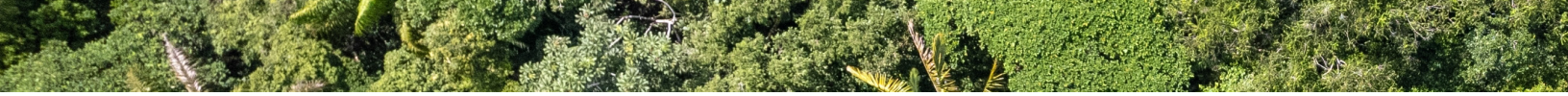
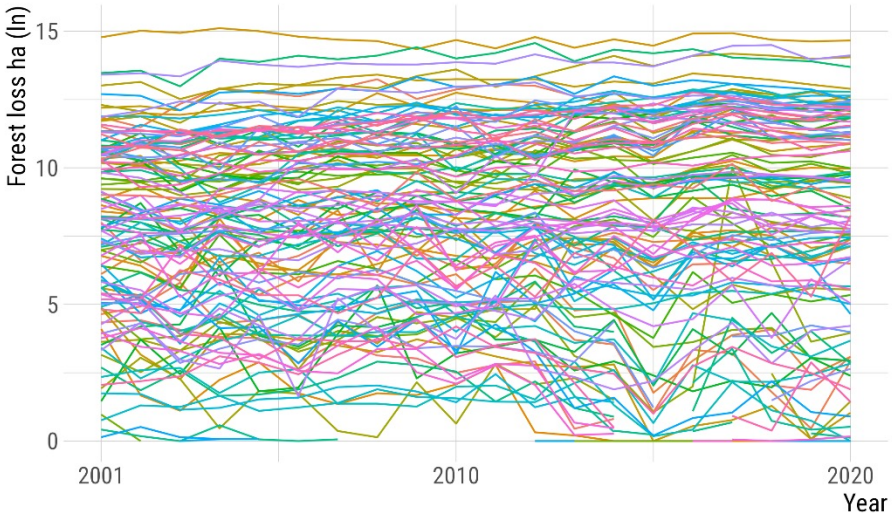


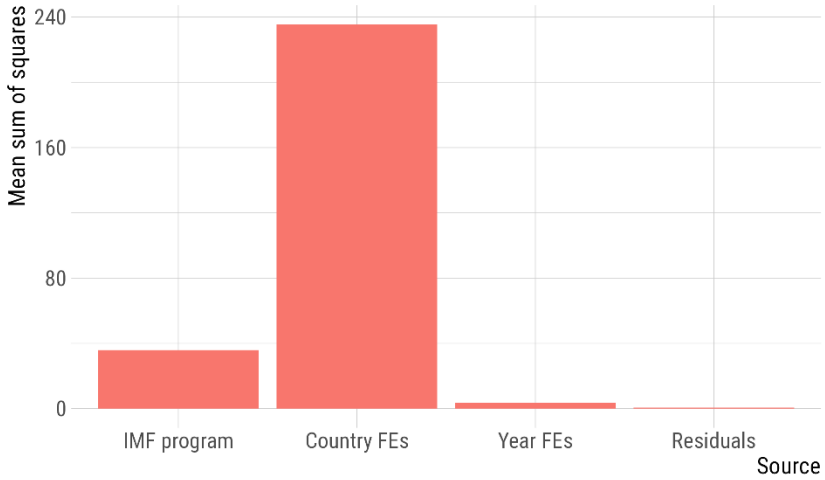
FIGURE B1: VARIATION IN TREE COVER LOSS OVER TIME AND ACROSS COUNTRIES



Source: Compiled by authors, drawing on data from Tyukavina et al. (2022).

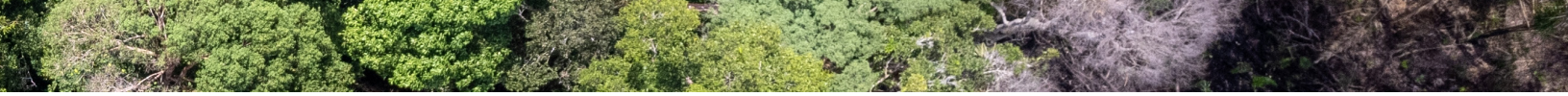
Notes: Observed values of annual deforestation, approximated by the log of tree cover loss unrelated to fires (ha), in up to 125 low- and middle-income countries.

FIGURE B2: ANOVA OF TREE COVER LOSS



Source: Compiled by authors, drawing on data from Kentikelenis and Stubbs (2023) and Tyukavina et al. (2022).

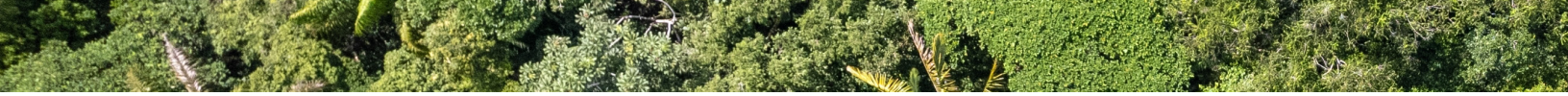
Notes: Variation explained by the IMF program dummy, country fixed effects, and year fixed effects.



C. Details of Forest Conditionality

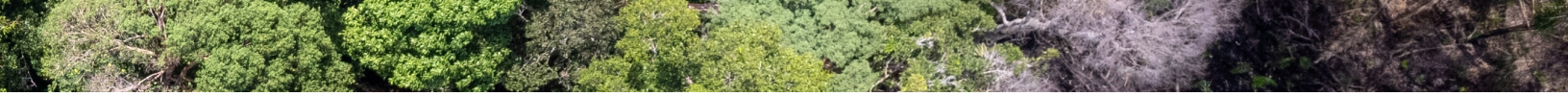
TABLE C1: FOREST CONDITIONALITY, 1980-2019

Country	Condition text	Year	Source
Albania	Eliminate export licensing requirement for **wood**,	1995	EBS/95/68
Bulgaria	Abolish registration (automatic licensing requirement) for live animals, meat, dairy products, Christmas **trees**, grapes, wheat, barley, maize, rice, cereal flour, sunflower seeds and oils, sugar, yeast, alcohol, brans, oil cakes, forage, tobacco, skins and hides, and wool	1999	EBS/98/162
Bulgaria	No new extrabudgetary funds or state-owned enterprises (with the possible exception of the companies set up for **forestry** and ports management and two funds to protect the environment and cover possible future pension gaps) to be created during the program period	2004	EBS/04/107
Cambodia	Prepare and publish a revised **forest** management code by end-December 1995, in accordance with the objectives described in paragraph 43 of the MEFP.	1995	EBS/95/145
Cambodia	establishment of a strict monitoring and control system for **logging** activities and the full transfer of **forestry** revenues to the budget	1997	EBS/97/76
Cambodia	Establish **forestry** crime monitoring unit, and submit the first quarterly report of the Unit to Council of Ministers and to the public.	1999	EBS/99/188
Cambodia	Submit subdecree on concession management [**forestry**] to Council of Ministers	1999	EBS/99/188
Cambodia	Cancel three **forestry** concessions and reduce the annual allowable cut by 50-70 percent for other concessions.	2000	EBS/00/186
Cambodia	Review of overall progress in budget management, **forestry** policy, and military demobilization.	2000	EBS/00/186
Cambodia	Complete review of [**forestry**] concession contracts and cancel concessions in violation.	2000	EBS/01/2
Cambodia	Complete review of [**forestry**] concession contracts and cancel concessions in violation.	2000	EBS/99/188
Cambodia	Cancel remaining **forestry** concessionaires that have not completed Structural performance criterion restructuring agreements with the government	2001	EBS/01/2
Cameroon	Completion of economic and financial study of the **forestry** sector by an independent qualified firm, with a view to rationalizing the sector's taxation.	2000	EBS/99/153
Central African Republic	Publish without delay all applications for licenses in the **forestry** and mining sectors.	2004	EBS/04/97
Central African Republic	Completion of an external audit of the **forestry** fund and the telecommunications regulations agency	2018	CAF_20160720_d
Central African Republic	Publish all **forestry** permits issued before June 30, 2018 on a government website, notably on the Ministry of Finance and Budget website	2018	CAF_20160720_e
Congo, Dem. Rep.	For the **forestry** sector, cancellation of concessions whose holders failed to pay the **forest** area fee for 2003 and publication of the list of cancelled concessions and list of concessions that are still valid. Publication of reports on the collection of **forest** area fees in 2003 and 2004.	2005	EBS/05/123
Congo, Dem. Rep.	Full and timely reporting and transfer of proceeds (signing bonuses, royalties, and other payments) accruing to the Treasury from any mining, **forestry**, and oil sector concessions, production sharing agreements, and partnership contracts between public entities and private enterprises, once they have entered into force.	2011	ZAR_20091211_c



Country	Condition text	Year	Source
Congo, Dem. Rep.	Publication of mining, **forestry**, and oil sector concessions, production sharing agreements, and partnership contracts between public entities and private enterprises within 60 days of signature (including information on signing bonuses, taxation system, private shareholders, and members of the Board of Directors).	2011	ZAR_20091211_c
Congo, Rep.	Certification of **forestry** revenues in 2004 by an audit firm of international reputation, and submission of the report to the government.	2005	EBS/05/110
Congo, Rep.	Publish on the government website KPMG oil reconciliation reports and a table with all mining, **forestry**, and oil concessions holders.	2019	COG_20190711_a
Gabon	to provide the staff with the terms of reference of the studies on factor costs, the **wood** sector, and ministerial staffings.	1989	EBS/90/7
Gabon	**Forestry** and **wood** processing: Submission of the new **forestry** code to Parliament.	2000	EBS/00/197
Gabon	Adoption by Council of Ministers of the letter of development policy for the **forestry** sector, prepared in consultation with the World Bank, including a priority agenda for 2004-05 (MEFP, para. 43).	2004	EBS/04/60
Gabon	No granting of exemptions to any company beyond those already provided for under the mining, **forestry**, and investment code, and no renewal of existing exemptions (MEFP, para. 19).	2004	EBS/04/60
Gabon	No granting of exemptions to any company beyond those already provided for under the mining, **forestry**, and investment code, and no renewal of existing exemptions (MEFP, para. 19).	2005	EBS/04/60
Gabon	Return to the public domain of 116 **forestry** permits with tax arrears since 2002-03, representing a total surface of 1.8 million hectares.	2007	EBS/07/42
Guinea	Lift the prohibition against exports of agricultural, **forestry**, and fishery products.	2007	EBS/07/140
Guyana	Elimination of exemptions from consumption tax and import duty granted to imports of agriculture, **forestry** and mining equipment, and the introduction of a sales tax as described in paragraph IR of the MOE	1990	EBS/90/125
Indonesia	Introduce resource rent tax on **forestry** products and reduce export tax on **logs** and sawn timber to 30 percent.	1998	EBS/98/73
Indonesia	Allow transferability of **forestry** concessions and delink their ownership from processing for new concessions.	1998	EBS/98/73
Lao PDR	Introduce automatic licensing for exports, except **forestry** and mining products.	2001	EBS/01/53
Peru	Announce results of bidding on the concession for management of the Biabo **forest**.	2000	EBS/00/47
Ukraine	Implement increases in fees/charges for **forestry**, water resources, radio waves, and oil loading in a manner that would yield additional revenues of HRV [Hryvnia] 100 million for the remainder of 1999.	1999	EBS/99/79

Source: Compiled by authors, drawing on data from Kentikelenis and Stubbs (2023).



D. Additional Analyses

TABLE D1: PREDICTING TREE COVER LOSS WITHOUT IMF TREATMENT

	Dependent variable:				
	Tree cover loss (log ha) t+1				
	(1)	(2)	(3)	(4)	(5)
GDP (log)	-0.003	-0.014	-0.004	0.002	0.046
	(0.425)	(0.425)	(0.425)	(0.425)	(0.420)
GDP growth (%)	0.010	0.010	0.010	0.010	0.009
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Current account balance (% of GDP)	-0.002	-0.002	-0.002	-0.002	-0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Debt service (% of exports)	-0.004	-0.004	-0.004	-0.003	-0.004
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Population growth (%)	-0.221**	-0.221**	-0.221**	-0.220**	-0.225**
	(0.093)	(0.093)	(0.093)	(0.093)	(0.093)
Forest rents (% of GDP)	-0.032	-0.032	-0.032	-0.032	-0.034
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
Agriculture value added (% of GDP)	-0.002	-0.002	-0.002	-0.002	-0.001
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Forest policies	-0.015	-0.015	-0.015	-0.015	-0.016
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Political stability	0.133	0.129	0.132	0.134	0.138
	(0.099)	(0.099)	(0.099)	(0.099)	(0.099)
Liberal democracy	-0.555	-0.550	-0.551	-0.551	-0.580
	(0.386)	(0.386)	(0.385)	(0.386)	(0.400)
Inflation		-0.001			
		(0.001)			
Election			0.014		
			(0.021)		
UN Security Council member				-0.054	
				(0.053)	
UNGA voting affinity with US					1.612***
					(0.562)
Observations	1,896	1,896	1,896	1,896	1,881
R^2	0.964	0.964	0.964	0.964	0.965
Country FEs	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes

Source: Compiled by authors.

Notes: Tree cover loss is net of forest loss due to fires. Standard errors clustered on the country. *p<0.10; **p<0.05; ***p<0.01

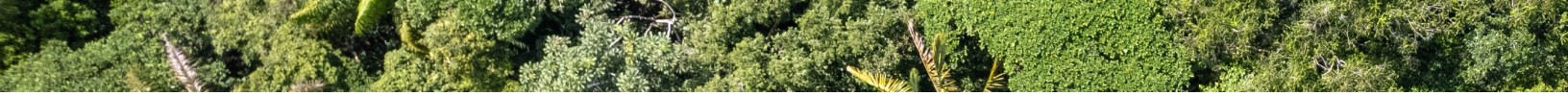


TABLE D2: IMF ENVIRONMENTAL REFORMS AND FOREST COVER

	Dependent variable:				
	Tree cover loss (log ha) t+1				
	(1)	(2)	(3)	(4)	(5)
IMF environmental reforms	**-0.023**	**-0.024**	**-0.023**	**-0.023**	**-0.044**
	(0.116)	(0.116)	(0.116)	(0.116)	(0.110)
GDP (log)	0.012	-0.003	0.012	0.017	0.061
	(0.431)	(0.431)	(0.431)	(0.432)	(0.426)
GDP growth (%)	0.011	0.011	0.011	0.011	0.010
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Current account balance (% of GDP)	-0.002	-0.001	-0.002	-0.002	-0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Debt service (% of exports)	-0.004	-0.004	-0.004	-0.004	-0.004
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Population growth (%)	-0.216**	-0.217**	-0.216**	-0.215**	-0.220**
	(0.092)	(0.092)	(0.092)	(0.092)	(0.092)
Forest rents (% of GDP)	-0.030	-0.030	-0.030	-0.030	-0.032
	(0.020)	(0.020)	(0.020)	(0.020)	(0.021)
Agriculture value added (% of GDP)	-0.002	-0.002	-0.002	-0.002	0.000
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Forest policies	-0.016	-0.016	-0.016	-0.016	-0.016
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Political stability	0.136	0.130	0.135	0.137	0.141
	(0.101)	(0.101)	(0.101)	(0.101)	(0.101)
Liberal democracy	-0.580	-0.571	-0.574	-0.578	-0.621
	(0.403)	(0.403)	(0.402)	(0.403)	(0.418)
Inflation		-0.001*			
		(0.001)			
Election			0.019		
			(0.024)		
UN Security Council member				-0.049	
				(0.053)	
UNGA voting affinity with US					1.600***
					(0.552)
Observations	1,812	1,812	1,812	1,812	1,798
R^2	0.965	0.965	0.965	0.965	0.965
Country FEs	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes

Source: Compiled by authors.

Notes: Tree cover loss is net of forest loss due to fires. IMF environmental reforms is a binary variable taking the value of 1 if an IMF program has environmental conditions; and 0 otherwise. Standard errors clustered on the country. *p<0.10; **p<0.05; ***p<0.01

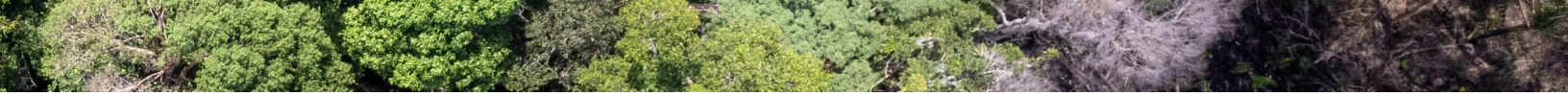


TABLE D3: IMF PROGRAMS (BINDING REFORMS) AND FOREST COVER

	Dependent variable:				
	Tree cover loss (log ha) t+1				
	(1)	(2)	(3)	(4)	(5)
IMF program (binding condition)	**0.116****	**0.115***	**0.116****	**0.115****	**0.125****
	(0.058)	(0.058)	(0.058)	(0.058)	(0.059)
GDP (log)	0.937	0.926	0.935	0.937	0.988
	(2.442)	(2.446)	(2.442)	(2.443)	(2.413)
GDP growth (%)	0.009	0.009	0.009	0.009	0.008
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Current account balance (% of GDP)	-0.002	-0.002	-0.002	-0.002	-0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Debt service (% of exports)	-0.004	-0.004	-0.004	-0.004	-0.004
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Population growth (%)	-0.219**	-0.219**	-0.218**	-0.218**	-0.222**
	(0.091)	(0.091)	(0.091)	(0.091)	(0.091)
Forest rents (% of GDP)	-0.032	-0.032	-0.032	-0.032	-0.034
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
Agriculture value added (% of GDP)	-0.001	-0.001	-0.001	-0.001	0.000
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Forest policies	-0.016	-0.016	-0.016	-0.016	-0.017
	(0.012)	(0.012)	(0.011)	(0.011)	(0.011)
Political stability	0.130	0.127	0.130	0.131	0.136
	(0.097)	(0.098)	(0.097)	(0.098)	(0.097)
Liberal democracy	-0.718*	-0.712*	-0.714*	-0.713*	-0.752*
	(0.402)	(0.403)	(0.402)	(0.403)	(0.416)
Inflation		-0.001			
		(0.000)			
Election			0.015		
			(0.021)		
UN Security Council member				-0.050	
				(0.051)	
UNGA voting affinity with US					1.650***
					(0.565)
Observations	1,896	1,896	1,896	1,896	1,881
R^2	0.965	0.965	0.965	0.965	0.965
Country FEs	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes

Source: Compiled by authors.

Notes: Tree cover loss is net of forest loss due to fires. IMF program (binding condition) is a binary variable taking the value of 1 if an IMF program has binding conditions; and 0 in years without an IMF program or in years with an IMF program without binding conditions. Standard errors clustered on the country. *p<0.10; **p<0.05; ***p<0.01

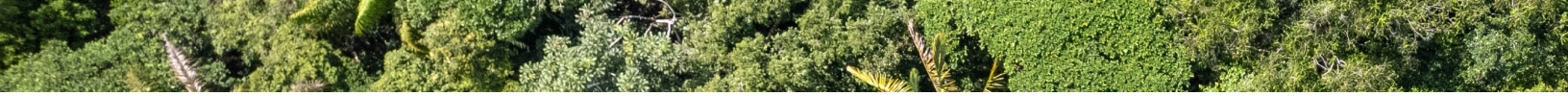


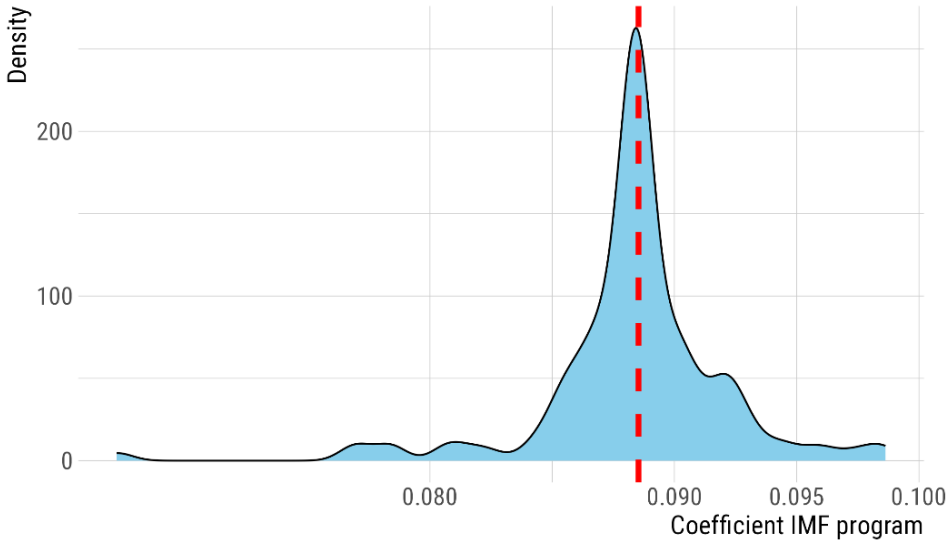
TABLE D4: IMF PROGRAMS AND FOREST COVER: DIFFERENT SAMPLES

	Dependent variable:				
	Tree cover loss (log ha) t+1				
	(1)	(2)	(3)	(4)	(5)
IMF programs	**0.090****	**0.090****	**0.083***	**0.060**	**0.064**
	(0.044)	(0.040)	(0.044)	(0.051)	(0.049)
GDP (log)	0.324	0.401	0.584*	1.197***	0.488
	(0.422)	(0.371)	(0.320)	(0.333)	(0.321)
GDP growth (%)	0.011	0.012	-0.001	-0.005	-0.005
	(0.010)	(0.010)	(0.006)	(0.006)	(0.006)
Current account balance (% of GDP)	-0.002	-0.005*	-0.004	0.000	0.002
	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)
Debt service (% of exports)	-0.003	-0.005	-0.003	-0.001	0.001
	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)
Population growth (%)	-0.217**	-0.139*	-0.079	-0.137	0.080
	(0.107)	(0.077)	(0.164)	(0.175)	(0.157)
Forest rents (% of GDP)	-0.025	-0.020	-0.015	-0.021	0.005
	(0.020)	(0.024)	(0.023)	(0.035)	(0.024)
Agriculture value added (% of GDP)	0.002	-0.003	-0.003	-0.004	-0.018
	(0.016)	(0.012)	(0.013)	(0.015)	(0.011)
Forest policies	-0.013	0.002	-0.004	-0.008	-0.040**
	(0.011)	(0.006)	(0.007)	(0.007)	(0.020)
Political stability	0.143	0.059	0.091	-0.069	-0.006
	(0.114)	(0.114)	(0.140)	(0.095)	(0.103)
Liberal democracy	-0.796	-0.312	-0.310	-0.038	0.810*
	(0.545)	(0.514)	(0.560)	(0.495)	(0.398)
Forest cover (% of land area, 2000)	5%	10%	15%	30%	50%
Observations	1,706	1,566	1,340	1,012	508
R^2	0.958	0.963	0.962	0.964	0.968
Country FEs	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes

Source: Compiled by authors.

Notes: Tree cover loss is net of forest loss due to fires. Sample of countries defined by varying the threshold of forest cover as a share of land area in 2000. Standard errors clustered on the country. *p<0.10; **p<0.05; ***p<0.01

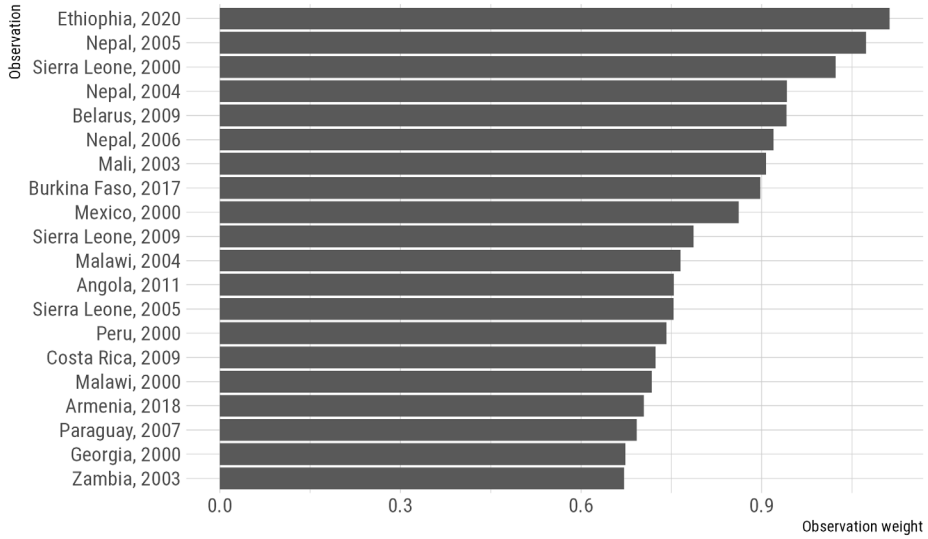
FIGURE D1: IMF PROGRAMS AND DEFORESTATION: LEAVING OUT ONE COUNTRY AT A TIME



Source: Compiled by authors.

Notes: The histogram shows the distribution of the point estimate of the coefficient on the binary IMF program indicator, by leaving out each of the 125 low- and middle-income countries in our sample, one at a time. The red dashed line depicts the baseline estimate for reference.

FIGURE D2: EFFECTIVE SAMPLE: TOP 20 OBSERVATIONS



Source: Compiled by authors.

Notes: The bar chart plots the top 20 observations (country-years) in terms of weight for the calculation of the point estimate of the coefficient on the IMF program dummy in our baseline model. The observation weights are calculated following the partialing-out logic and the procedure described in Aronow and Samii (2016).

TASK FORCE ON CLIMATE, DEVELOPMENT AND THE INTERNATIONAL MONETARY FUND

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