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POLITICAL ECONOMY OF EXTRACTIVES GOVERNANCE AND SUSTAINABLE DEVELOPMENT FINANCE: DOES TRANSPARENCY PAY?

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« L'Université n'entend donner aucune approbation ou improbation aux opinions émises dans cette thèse. Ces opinions doivent être considérées comme propres à leur auteur. »

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- Dédicace

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Abstract

The 2030 Agenda that emerged from the International Conference on Financing for Sustainable Development in Addis Ababa highlighted the priority of all national and international resource flows, policies, and agreements with economic, social, and environmental priorities. Resource-rich developing countries (RRDCs) are encouraged to focus on transparency and governance in the extractive industries in order to improve domestic resource mobilization (DRM). This thesis investigates the environmental and economic impacts of the political economy of extractive industry governance in resource-rich developing countries. It begins by extending the literature on the resource curse to issues of environmental sustainability (Chapter 1), then analyzes the impact of the Extractive Industries Transparency Initiative (EITI) on deforestation (Chapter 2), domestic revenue mobilization (Chapter 3), and finally financial development (Chapter 4).

Chapter 1 revisits the links between man-made and natural capital in developing countries, focusing on the case of forest cover loss. Considering a theoretical model of income maximization, we assess through empirical observation the impact of extractive industries on forest cover loss. Based on a panel of 52 resource-rich developing countries from 2001-2017, we adopt a dynamic specification with the two-step Generalized Method of Moments (GMM) system to address the inherent bias. Our main results show that the total rent from the extractive industries harms the forest. More specifically, mineral and gas rents accelerate forest cover loss. In contrast, oil rents contribute to reducing forest cover loss. In addition, we find that natural resource tax revenues contribute to reducing forest cover loss. To promote corporate environmental management, stakeholders must overcome regulatory inefficiencies in exploration and exploitation contracts so that environmental compensation is at least equal to the marginal damage

caused by the extractive industries.

Chapter 2 assesses the "treatment effect" of implementing the Extractive Industries Transparency Initiative (EITI) standard on deforestation in resource-rich developing countries. Using a sample of 83 resource-rich developing countries from 2001–2017, we use entropy balancing methods to address the self-selection bias associated with EITI membership. Compared with the non-EITI country, the results show that implementing the EITI standard significantly reduces the loss of forest cover by approximately 300–760 ha. This result supports the conclusion that EITI, but not a panacea, is an effective policy program for limiting the negative impacts on forests partly caused by extractive industries. This study provides clear guidance to both the EITI Board and the EITI National Committees, and more generally, to the governments of extractive resource-rich developing countries on the vital role of the EITI in combating forest cover loss and sustainable development finance.

Chapter 3 assesses the "treatment effect" of the Extractive Industries Transparency Initiative (EITI) membership on tax revenues through two main channels. The first (direct effect) works through an equitable and transparent resource tax regime. The second is the indirect effect EITI has on non-resource revenue once transparency enhances accountability and resource allocation to productive expenditures. Using a sample of 83 resource-rich developing countries for the period 2001 to 2017, we use propensity score matching (PSM) and a control function approach to address the self-selection bias associated with EITI membership (the dates of countries' commitment, candidacy, and compliance). Results show that EITI commitment or candidates significantly and positively affect tax revenue collection compared to non-EITI. EITI compliance generates a considerable surplus of tax revenues compared to non-compliance. The results are robust, with a substantial increase in non-resource tax revenues, income

tax, and resource tax revenue. The paper reveals that EITI members have higher levels of tax revenue than non-members and that tax revenue is higher when countries are compliant with the initiative, even higher with quality of governance, and heterogeneous due to structural factors.

Chapter 4 hypothesizes that the EITI, an international norm that aims to promote transparency in natural resources management, may mitigate this negative impact. Using the Fixed-Effects and Entropy Balancing methods, we provide empirical support for this hypothesis in a panel of 71 resource-rich countries, including 30 EITI and 41 non-EITI countries, between 1995 and 2019. Our results are robust to the use of different sets of controls and alternative measures of financial development. In addition, we provide a discussion on the transmission channels through which the financial resource curse may occur.

Résumé

L'Agenda 2030 issu de la Conférence internationale sur le financement du développement durable à Addis-Abeba a mis en évidence la priorité de tous les flux de ressources, politiques et accords nationaux et internationaux avec des priorités économiques, sociales et environnementales. Les pays en développement riches en ressources (PDRR) sont encouragés à se focaliser sur la transparence et la gouvernance dans les industries extractives afin d'améliorer la mobilisation des ressources nationales (MRN). Cette thèse analyse d'abord, les effets des industries extractives sur l'environnement (chapitre 1), puis analyse l'impact de l'initiative pour la transparence des industries extractives (ITIE) sur la déforestation (chapitre 2), sur la mobilisation des recettes nationales (chapitre 3) et en fin sur le développement financier (chapitre 4).

Le chapitre 1 réexamine les liens entre les richesses créées et le capital naturel dans les pays en développement, en se concentrant sur le cas de la perte de la couverture forestière. Sur la base d'un modèle théorique de maximisation des revenus, nous évaluons par des observations empiriques l'impact des industries extractives sur la perte de couverture forestière. Sur la base d'un panel de 52 pays en développement riches en ressources naturelles de 2001 à 2017, nous adoptons une spécification dynamique avec la méthode des moments généralisés (GMM) en deux étapes pour traiter le biais inhérent. Nos principaux résultats montrent que la rente totale provenant des industries extractives nuit à la forêt. Plus précisément, les rentes minières et gazières accélèrent la perte du couvert forestier. En revanche, les rentes pétrolières contribuent à réduire la perte du couvert forestier. En outre, nous constatons que les recettes fiscales tirées des ressources naturelles contribuent à réduire la perte du couvert forestier. Pour promouvoir la gestion environnementale des entreprises, les parties

prenantes doivent surmonter les inefficacités réglementaires dans les contrats d'exploration et d'exploitation afin que la compensation environnementale soit au moins égale au dommage marginal causé par les industries extractives.

Le chapitre 2 évalue l'effet de la mise en œuvre de la norme de l'initiative pour la transparence des industries extractives (ITIE) sur la déforestation dans les pays en développement riches en ressources. Avec un échantillon de 83 pays en développement riches en ressources naturelles entre 2001 et 2017, nous utilisons des méthodes d'équilibrage de l'entropie pour remédier au biais d'autosélection associé à l'adhésion à l'ITIE. Les résultats montrent que la mise en œuvre de la norme ITIE réduit significativement la perte de couverture forestière d'environ 300 à 760 ha par rapport à un pays non-membre de l'ITIE. Ce résultat soutient la conclusion selon laquelle l'ITIE, sans être une panacée, est un programme politique efficace pour limiter les impacts négatifs sur les forêts causés en partie par les industries extractives. Cette étude fournit des indications claires au conseil d'administration et aux comités nationaux de l'ITIE et, plus généralement, aux gouvernements des pays en développement riches en ressources extractives sur le rôle vital de l'ITIE dans la lutte contre la perte du couvert forestier et le financement du développement durable.

Le chapitre 3 évalue l'effet de l'adhésion à l'initiative pour la transparence des industries extractives (ITIE) sur les recettes fiscales par le biais de deux canaux principaux. Le premier (effet direct) se traduit par un régime fiscal équitable et transparent sur les ressources. Le second est l'effet indirect de l'ITIE sur les recettes non liées aux ressources, une fois que la transparence renforce la responsabilité et l'allocation des ressources aux dépenses productives. À partir d'un échantillon de 83 pays parmis ceux-ci, entre 2001-2017, nous utilisons l'appariement par score de propension (PSM) et une approche de fonction de contrôle pour traiter le biais d'autosélection associé

à l'adhésion à l'ITIE (les dates d'engagement, de candidature et de conformité des pays). Les résultats montrent que l'engagement ou même la candidature à l'ITIE ont une incidence significative et positive sur la perception des recettes fiscales par rapport aux pays qui ne sont pas membres de l'ITIE. La conformité à l'ITIE génère un surplus considérable. Les résultats sont robustes, avec une augmentation substantielle des recettes fiscales non liées aux ressources et de l'impôt sur le revenu et les recettes fiscales tirées des ressources. L'étude révèle que les pays membres de l'ITIE ont des niveaux de recettes fiscales plus élevés que les non-membres et que les recettes fiscales sont plus élevées lorsque les pays se conforment à l'initiative, et encore plus élevées avec la qualité de la gouvernance, et ils sont hétérogènes en raison de facteurs structurels propres à chaque pays.

Le chapitre 4 émet l'hypothèse que l'ITIE, étant une norme internationale qui vise à promouvoir la transparence dans la gestion des ressources naturelles, peut atténuer l'impact négatif des ressources naturelles sur le développement financier. En utilisant les méthodes des effets fixes et de l'équilibrage de l'entropie, nous apportons un soutien empirique à cette hypothèse dans un panel de 71 pays riches en ressources naturelles, dont 30 pays ITIE et 41 pays non ITIE, entre 1995 et 2019. Nos résultats sont robustes à l'utilisation de différents ensembles de contrôles et de mesures alternatives du développement financier. En outre, nous discutons des canaux de transmission par lesquels la malédiction des ressources financières peut se produire.

Contents

List of Tables

List of Figures

GENERAL INTRODUCTION

0.1 Contexte et motivations

Les conférences internationales de Monterrey (2002), Doha (2008) et Addis-Abeba (2015) ont toutes abordé la question cruciale du financement du développement. L'Agenda 2030, issu de la conférence de Addis-Abeba en 2015, met en évidence l'importance des flux de ressources, des politiques et des accords nationaux et internationaux pour atteindre les objectifs économiques, sociaux et environnementaux. Une attention particulière est accordée aux ressources publiques nationales en tant que source fiable et soutenable de financement du développement dans les économies émergentes. Les pays en développement dépendants des ressources naturelles sont encouragés à renforcer la transparence et la gouvernance dans les industries extractives afin d'augmenter les recettes nationales, compte tenu de la malédiction des ressources longtemps expérimentée.

En théorie, les économistes pensent que la dotation en ressources naturelles joue un rôle important dans le processus du développement économique. Grâce aux revenus importants qu'elles génèrent, aux devises étrangères, à la création d'emplois et à la diversification économi-que, les industries extractives ont le potentiel de stimuler la croissance, le développement et la réduction de la pauvreté. Selon la croyance populaire selon laquelle le développement économique se produit lorsque les pays passent d'une économie basée sur l'agriculture à une économie industrielle, les dotations en ressources naturelles permettraient aux pays en développement de passer du sous-développement au décollage industriel (Rostow, 1961; Viner, 1952). Plus tard, certains chercheurs, tels que Van der Ploeg (2011), ont généralement convenu que les ressources naturelles encourageraient l'investissement public et privé, faciliteraient le développement industriel

et créeraient des marchés. Par exemple, les pays industrialisés comme l'Australie, l'Allemagne, la Grande-Bretagne, le Canada et les États-Unis ont réussi à transformer l'exploitation des ressources naturelles en croissance et développement économique (Acemoglu, 2008). Des pays en développement comme le Botswana, le Chili, la Malaisie et l'Afrique du Sud ont récemment atteint les revenus les plus élevés, en partie grâce aux industries extractives (Halland et al., 2016). Cependant, la richesse en ressources naturelles n'est pas toujours synonyme de développement durable. Un certain nombre de pays en développement riches en ressources naturelles sont confrontés à un certain nombre de problèmes de gouvernance, tels que la qualité des institutions, la complexité des réformes, la dépendance économique, les effets négatifs sur le système social et environnemental et les inégalités de genre. La situation dans de nombreux pays en développement suggère que la dotation en ressources naturelles non renouvelables (mines, pétrole et gaz naturel) semble plutôt être une "malédiction" plutôt qu'une "bénédiction" [1] (Auty et Auty, 1990 ; Auty et Warhurst, 1993).

Sachs and Warner (1995a) ont été les précurseurs en matière d'évidences empiriques sur les effets négatifs de la dépendance à l'égard des ressources naturelles sur la croissance, à travers une étude comparative à l'échelle mondiale, généralement connue sous le nom de *"malédiction des ressources"*. Depuis cette analyse empirique pionnière, plusieurs études se sont focalisées sur le secteur extractif et son impact sur le développement économique (voir, Badeeb et al., 2017; Frankel, 2010; Van der Ploeg, 2011).

Sur le plan politique, de nombreux auteurs considèrent la recherche

[1] Le terme "malédiction des ressources" a été introduit plus tard par Auty (1993a) pour décrire le phénomène selon lequel certains pays dépendants des ressources naturelles connaissent une croissance plus lente, voire négative, par rapport aux pays moins dotés en ressources naturelles.

de rentes (Sachs et Warner, 2001) et la corruption comme des éléments essentiels à l'origine de la malédiction (Auty, 2001; Stevens, 2003; Torvik, 2002). Le terme "recherche de rente" a été introduit par Krueger (1974), mais la théorie correspondante avait déjà été développée par Tullock (1967)[2]. En général, les élites ou les groupes de pression s'approprient une grande partie des revenus des ressources au profit de leurs cercles immédiats, au détriment de l'investissement productif (Deacon et Rode, 2015) et du développement économique (Gylfason, 2001; Hodler, 2006; Iimi, 2007). En outre, les mannes financières provenant des ressources sont souvent une source de conflit découlant des revendications de droits de propriété entre les parties prenantes nationales, telles que les politiciens, les tribus locales et les citoyens en général selon les analyses de Davis et Tilton, (2005) et de Bodea et al. (2016). D'autres chercheurs considèrent que la corruption et la faiblesse des institutions sont les principaux mécanismes liant la dépendance des ressources à de mauvaises performances économiques. Selon Lynn Karl (2004), les pays qui dépendent du pétrole sont souvent caractérisés par une mauvaise gouvernance, une culture de recherche de rentes et une forte probabilité de conflits civils et de guerres. Les rentes de ressources sont considérées comme une source de conflits, de corruption et de pression à la baisse sur la qualité des institutions (voir, Hodler, 2006; Collier et Hoeffler, 2009; Bhattacharyya et Hodler, 2010; Haber et Menaldo, 2011; Tsui, 2011; Eregha et Mesagan, 2016; Badeeb et al., 2017). Les preuves suggérant que les ressources ont un impact négatif sur la qualité des institutions sont parfois relativisées. Arezki et Brückner (2011) ont découvert qu'une augmentation des rentes pétrolières entraîne une augmentation significative de la corruption, une détérioration significative des droits politiques et

[2]L'idée est simple mais puissante. On dit que les gens recherchent des rentes lorsqu'ils essaient d'obtenir des avantages pour eux-mêmes dans l'arène politique (Henderson, 2008).

une amélioration significative des libertés civiles. Selon ces auteurs, l'élite politique serait incitée à étendre les libertés civiles mais à réduire les droits politiques en présence des manne pétrolières pour échapper à la redistribution et aux conflits. Ross (1999) montre que les rentes pétrolières nuisent de manière significative à la démocratie, alors que Haber et Menaldo (2011) constate que le pétrole ne favorise pas de manière significative l'autoritarisme. De même, Brunnschweiler (2008) ne trouve pas que les institutions jouent un rôle causal significatif dans le résultat de la malédiction des ressources. Un grand nombre d'auteurs à travers des approches différentes soutiennent que la qualité institutionnelle est décisive pour déterminer si les revenus des ressources sont une malédiction ou une bénédiction. Torvik (2009) soutient qu'un bon appareil institutionnel prévient les effets négatifs des dotations en ressources naturelles sur la croissance. De même, Sarmidi et al. (2014) soutient qu'à mesure que la qualité institutionnelle s'améliore, l'effet négatif de l'abondance des ressources sur la croissance devrait se dissiper.

Outre les mécanismes politiques, des mécanismes économiques sont également examinés dans le but d'établir un lien entre la malédiction des ressources et les performances économiques des pays riches en ressources. Premièrement, les mécanismes économiques liés à la malédiction des ressources sont souvent décrits sous le nom de syndrome hollandais (Dutch disease). Le syndrome hollandais se produit lorsqu'un boom des ressources entraîne un déplacement des facteurs de production vers les activités extractives, au détriment d'autres secteurs d'exportation traditionnels tels que l'industrie manufacturière et l'agriculture. Le syndrome hollandais comprend également un effet de dépense, car les revenus des ressources extractives stimulent la demande globale, créant une demande intérieure excédentaire, qui génère de l'inflation et une appréciation du taux de change réel, et une perte conséquente de compétitivité pour l'économie nationale en

termes d'exportations (Sachs et Warner, 1995b ; Gylfason, 2011 ; Papyrakis et Gerlagh, 2004). Cette perte de compétitivité des exportations nationales, pour un pays donné, se traduit par une baisse de la demande mondiale de produits non liés aux ressources, qui entraîne à son tour une baisse de l'offre de biens non liés aux ressources et une réduction des revenus et de l'emploi dans les industries non liées aux ressources Badeeb et al. (2017). Conformément au syndrome hollandais, Benigno et Fornaro (2014) considèrent que l'abondance des entrées de capitaux étrangers stimule la demande de biens nationaux non échangeables. Cela induit une réallocation de l'activité économique nationale du secteur échangeable vers le secteur non échangeable, réduisant les profits dans le secteur échangeable et conduisant les entreprises à réduire leurs investissements dans l'innovation et à diminuer la croissance de la productivité (Gylfason et al., 1999). Benigno et Fornaro (2014) appellent cet effet la "malédiction financières des ressources" et affirment que les contrôles des capitaux peuvent jouer un rôle dans l'atténuation de ce phénomène. De nombreux pays exportateurs de pétrole ont créé des fonds souverains pour atténuer la volatilité des prix du pétrole et protéger les dépenses publiques pendant les périodes où les prix du pétrole baissent. Les fonds souverains ont la capacité de réduire les effets néfastes de la malédiction des ressources naturelles. Les fonds souverains sont particulièrement intéressants, car leurs objectifs d'investissement visent à maximiser les rendements financiers afin de garantir des revenus permanents pour le pays et de répondre aux besoins de développement économique (Bernstein et al., 2013). Selon Corden et Neary (1982), les pays qui dépendent des exportations de matières premières énergétiques peuvent établir des fonds souverains pour diversifier les portefeuilles de réserves, générer des rendements plus élevés et lutter contre le "syndrome hollandais".

Deuxièmement, la volatilité diminue la croissance économique en

fonction de la fluctuation des prix des matières premières. En raison de la volatilité des prix des produits de base, les fluctuations procycliques des recettes publiques et des recettes d'exportation diminuent toutes deux pendant les périodes de baisse des prix des produits de base (Davis et Tilton, 2005). Cela rend plus difficile la planification des dépenses et l'alignement des recettes et des finances publiques, ce qui réduit l'efficacité des investissements publics et privés. Cela peut également entraver la capacité des pays à tirer parti d'une politique monétaire expansionniste anticyclique lorsqu'elle serait avantageuse (voir, Badeeb et al., 2017; Gylfason, 2001; Halland et al., 2015a). Dans les années 1970, lorsque les prix des matières premières étaient élevés, les pays riches en ressources naturelles les utilisaient comme garantie de leur dette, mais dans les années 1980, les prix des matières premières ont chuté de manière significative, plongeant de nombreux pays riches en ressources naturelles dans des crises d'endettement (Aghion et al., 2009). Lorsque les prix des matières premières sont volatils, les contraintes de liquidité sont plus susceptibles de se faire sentir, ce qui entraîne une baisse de l'innovation et de la croissance selon analyses de Aghion et al. (2009) et de Van der Ploeg et Poelhekke (2009). Un grand nombre d'ouvrages ont établi que les économies riches en ressources souffrent généralement d'un développement financier plus faible (voir, Bhattacharyya et Hodler, 2014 ; Beck, 2011). Les pays riches en ressources souffrent également de systèmes financiers sous-développés et d'éloignement financier, et sont donc susceptibles de connaître une plus grande volatilité macroéconomique (Rose and Spiegel, 2009). Grâce à des données transnationales, Aghion et al. (2009) suggère que la volatilité du taux de change réel peut sérieusement compromettre la croissance de la productivité à long terme, en particulier dans les pays à faible niveau de développement financier. De même, Kinda et al. (2018) ont établi que les chocs sur les prix des produits de base entraînent souvent une fragilité du secteur

financier et parfois même des crises financières.

Troisièmement, la richesse en ressources peut être préjudiciable à la performance économique en raison d'une mauvaise gestion économique. Les relations entre les gouvernements et leurs citoyens ont souvent été affectées par une mauvaise gestion des ressources, principalement par le lien entre la fiscalité et la responsabilité. Les revenus exceptionnels tirés des ressources peuvent amener le gouvernement à réduire la collecte d'impôts et la nécessité d'imposer une discipline fiscale. Dans plusieurs pays en développement, ce phénomène est également connu sous le nom d'éviction des recettes non liées aux ressources par les recettes liées aux ressources (Bornhorst et al., 2009a ; Ndikumana et Abderrahim, 2010 ; Crivelli et Gupta, 2014 ; Mawejje, 2019). Les rentes de ressources peuvent conduire les gouvernements à ignorer ou à retarder l'urbanisation, l'augmentation de l'offre éducative, l'innovation technologique et le développement d'autres infrastructures qui faciliteraient le développement économique à long terme (Ross, 2007). Par exemple, il a été démontré que le capital naturel est inversement lié aux dépenses publiques d'éducation rapportées au revenu national Gylfason (2001). Idéalement, les gouvernements devraient également utiliser les mannes financières des ressources naturelles pour investir dans les infrastructures nécessaires ou faciliter la mise en œuvre des réformes politiques nécessaires d'une manière qui améliore le Pareto et compense les perdants (Badeeb et al., 2017).

En guise de récapitulation, cette littérature qui se concentre sur l'économie politique des industries extractives souligne deux aspects importants. En premier lieu, les connaissances acquises au cours des cinquante dernières années ne semblent pas avoir permis à de nombreux pays exportateurs de ressources naturelles d'éviter les difficultés économiques liées à la malédiction des ressources naturelles. En deuxième lieu, le débat autour de la malédiction des ressources na-

turelles a souligné à plusieurs reprises le rôle clé que jouer les institutions pour traduire la richesse des ressources naturelles en une bénédiction pour le développement économique (voir, Buonanno et al., 2015; Kolstad and Wiig, 2009b; Mehlum et al., 2006; Van der Ploeg, 2011).

0.2 Industries extractives et financement du développement durable

Les activités extractives (mines, gaz et pétrole) sont menées de diverses manières, notamment sous terre, en surface, en creusant des puits ou en exploitant les fonds marins. La rente des ressources naturelles représente la différence entre le prix d'une marchandise et le coût moyen de sa production. Pour ce faire, on estime le prix des unités de produits spécifiques et on soustrait les coûts unitaires moyens estimés de l'extraction (y compris un rendement normal du capital). Ces rentes unitaires sont ensuite multipliées par les quantités physiques que les pays extraient ou récoltent afin de déterminer les rentes pour chaque produit de base rapportée au produit intérieur brut (PIB).

La prise en compte de la contribution des ressources naturelles à la production économique est importante dans l'élaboration d'un cadre analytique pour le développement durable. Dans certains pays, les revenus tirés des ressources naturelles, en particulier des combustibles fossiles et des minéraux, représentent une part importante du PIB, et une grande partie de ces revenus prend la forme de rentes économiques, c'est-à-dire de revenus supérieurs au coût d'extraction des ressources. Selon la théorie de la taxation optimale, taxer jusqu'à 100 % de la rente n'affecte pas les décisions d'investissement et d'exploitation (Ricardo, 1971 ; Garnaut et Clunies-Ross, 1983). Les rentes provenant des ressources non renouvelables – combustibles fossiles et minéraux – ainsi que les rentes provenant de la surexploitation des

forêts, indiquent la liquidation du stock de capital d'un pays. Lorsque les pays utilisent ces rentes pour soutenir la consommation courante plutôt que d'investir dans de nouveaux capitaux pour remplacer ce qui a été épuisé, ils empruntent en fait sur leur avenir. Les figures 1 et 2 montrent la contribution des ressources dans 71 pays en développement riches en ressources naturelles sur la période 2000 - 2019. Il existe une corrélation positive entre les ressources naturelles et le PIB par habitant (figure 1). Il existe une forte corrélation positive entre les ressources naturelles et les recettes fiscales totales, ainsi qu'avec les recettes fiscales non liées aux ressources (Fig. 2). Ces résultats peuvent s'expliquer par le boom des ressources extractives depuis les années 2000 marqué par la hausse des prix des matières premières. Plusieurs études ont établi un effet d'éviction des recettes fiscales liées aux ressources naturelles sur les autres types recettes fiscales dans les pays riches en ressources naturelles (voir, Bornhorst et al., 2009a; James, 2015; Tsoungui Belinga et al., 2017).

FIGURE 1 : Ressources naturelles et PIB par habitant

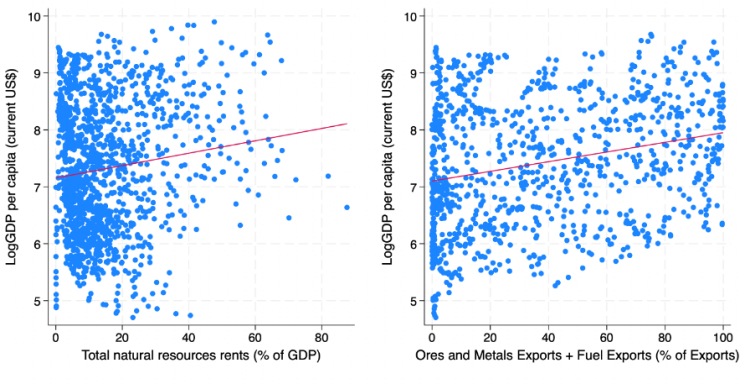
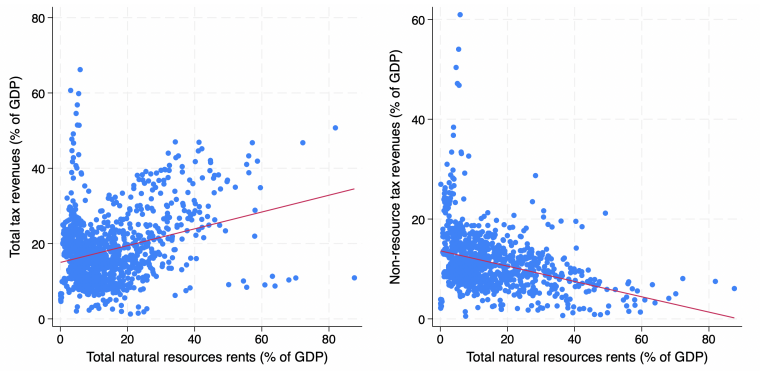


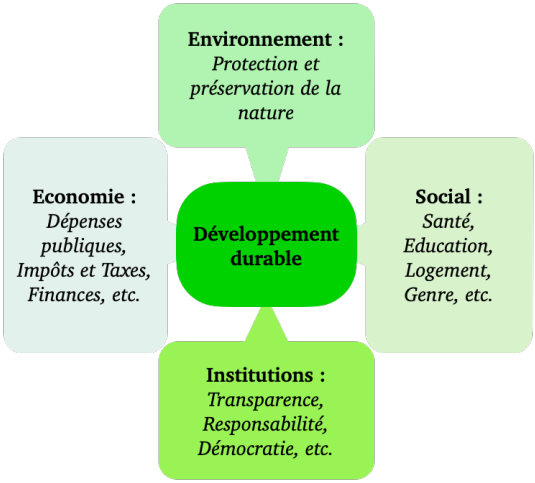
FIGURE 2 : Ressources naturelles et recettes fiscales nationales



0.3 Les grandes lignes de la thèse

Le développement durable (et/ou le développement humain durable) exige que chaque génération transmette un stock total de capital intact à la génération suivante, répondant ainsi à une exigence d'équité intergénérationnelle et de consommation sans déclin au fil du temps. Cela nécessite une combinaison de performances environnementales et sociales solides, d'efficacité économique (Solow, 1986) et d'institutions fortes. Pour les partisans de la soutenabilité faible, une perte de forêts peut être compensée par une augmentation de la production ou du capital humain. Cela signifie que le capital naturel est substituable, notamment par le capital humain et le capital physique (Hartwick, 1977). La soutenabilité forte, qui présente une version pessimiste du concept de durabilité, soutient que le capital naturel et le capital créé par l'homme sont complémentaires et non substituables dans le contexte où les dommages causés au capital naturel sont, au moins dans une certaine mesure, irréversibles. La question principale de cette thèse est : **Comment les industries extractives peuvent-elles favoriser le développement durable ?**

FIGURE 3 : Dimensions principales du développement durable



Il y a de nos jours de nouvelles initiatives visant à transformer la manne des ressources naturelles en bénédictions pour la croissance et le développement économique durable, notamment des conseils et des consultations en matière de gouvernance. La société civile mondiale, y compris Global Witness et Oxfam America, ainsi que la "Natural Resources Governance Institute" (NRGI) et des organisations industrielles telles que le Conseil international des mines et métaux (CIMM), ont travaillé pour améliorer les performances du secteur extractif. L'ITIE, qui a été fondée en 2003, est l'un des exemples les plus notables outils de gouvernance de l'industrie extractive. Il est communément admis qu'une gouvernance efficace de l'industrie extractive peut contribuer au développement durable (voir, Addison et Roe, 2018). Cette thèse aborde les défis politiques et les opportunités de ce nouvel agenda qui propose une "bonne gouvernance des industries extractives" comme outil essentiel pour parvenir au développement durable. Cette thèse se concentre sur les pays en développement, en

particulier les pays à faible revenu (PFR) et les pays à revenu intermédiaire (PRI), et se concentre sur deux thèmes principaux liés qui sont structurés en quatre chapitres politiques complémentaires.

Les conséquences environnementales de l'exploitation des industries extractives sont de plus en plus préoccupantes, bien qu'elles soient relativement peu mentionnées dans la littérature sur la malédiction des ressources naturelles. Selon plusieurs auteurs, l'industrie minière représente une menace pour la biodiversité (Edwards et al., 2014). Ces derniers préconisent le développement de mécanismes compensatoires, tel qu'un versement dans une banque foncière de biodiversité, qui protège les habitats clés près de la mine ou d'un habitat similaire, ou en payant pour sauvegarder les aires protégées existantes, qui souffrent actuellement de l'empiétement des industries extractives (Blom, 2004; Laurance et al., 2012). Ainsi, la thèse aborde en premier lieu la question de la "malédiction des ressources naturelles et souténabilité environnementale" (en particulier dans le chapitre 1) à travers une analyse des effets des rentes des industries extractives sur la déforestation dans les pays développement.

Les ressources naturelles peuvent contribuer à la croissance, au développement économique et à la diminution de la pauvreté. Selon la Banque mondiale, les industries extractives jouent un rôle économique important dans 63 pays en développement, qui sont très dépendants de ces ressources et soumis à une mauvaise gouvernance, ce qui décourage la mise en place d'institutions démocratiques et transparentes pour lutter contre la corruption et la mauvaise gestion des ressources (Robinson et al., 2006a). En deuxième lieu cette thèse aborde la question de la "souténabilité de la gouvernance extractive, à travers l'initiative pour la transparence des industries extractives (ITIE), analysée en trois chapitres. D'abord, nous évaluons l'impact de l'ITIE sur la déforestation (chapitre 2), ensuite l'impact de l'ITIE sur la mobilisa-

tion des recettes nationales (chapitre 3) et enfin l'impact de l'ITIE sur le développement financier en présence de malédiction des ressources naturelles (chapitre 4).

0.4 Initiative pour la transparence des industries extractives | ITIE

De nos jours, 57 pays sont membres de l'initiative pour la transparence des industries extractives (ITIE). L'initiative a reçu le soutien de nombreuses organisations internationales telles que la Banque mondiale, le Fonds monétaire international et l'OCDE, qui ont également apporté un soutien technique et financier pour la mise en œuvre de la norme ITIE. Sa mission est de promouvoir la bonne gestion des ressources naturelles, de renforcer la gouvernance et la responsabilité des gouvernements et des entreprises, et de fournir les données nécessaires à l'élaboration des politiques et au dialogue multipartite dans le secteur des industries extractives. Plus spécifiquement, le but initial de l'ITIE est d'améliorer la transparence dans la collecte des revenus des industries extractives (pétrole, gaz et mines) dans les pays riches en ressources extractives. Les pays membres mettent en œuvre la norme ITIE 2023, qui a récemment été mise à jour pour inclure de nouvelles dispositions sur la transition énergétique, la lutte contre la corruption et l'égalité des sexes. Suite à une campagne menée par Global Witness et ses partenaires de la société civile au sein de la coalition Publish What You Pay, la norme ITIE 2013 comprenait une nouvelle disposition appelant les pays à divulguer publiquement les propriétaires réels des entreprises pétrolières, gazières et minières. Depuis janvier 2016, cette disposition a été ajoutée à la norme précédente. L'ITIE a choisi de tester cette nouvelle fonctionnalité dans onze pays : le Burkina Faso, la République démocratique du Congo, le Honduras, la République kirghize, le Liberia, le Niger, le Nigeria, le Tadjikistan, la

Tanzanie, le Togo et la Zambie. Le secrétariat international de l'ITIE est basé à Oslo.

Principes et mise en œuvre de l'ITIE

L'ITIE a été officiellement créée en 2003 suite à la campagne "Publiez ce que vous payez" initiée en 2002 par un groupe d'organisations de société civile qui demandaient une plus grande transparence dans le secteur des ressources naturelles extractives. L'ITIE est une organisation multipartite composée de représentants de la société civile, des entreprises extractives et du gouvernement. La norme ITIE exige que les entreprises extractives publient tous les paiements effectués en détail dans les comptes gouvernementaux. Les gouvernements doivent également publier tous les paiements reçus des entreprises extractives afin de lutter contre la corruption. En d'autres termes, les gouvernements et les entreprises divulguent des informations sur les principales étapes de la chaîne de valeur de la gouvernance des industries extractives, telles que les activités d'exploration, les licences et les contrats, les propriétaires réels, la production, la collecte et l'utilisation faite des revenus. Le processus de mise en œuvre de l'ITIE comprend trois étapes principales : l'engagement, la candidature et la conformité. Tout d'abord, le gouvernement s'engage publiquement à adhérer à l'ITIE. Le gouvernement, les entreprises et la société civile doivent établir conjointement un secrétariat national de l'ITIE et un groupe multipartite dont le but est de superviser le processus de mise en œuvre de la norme ITIE. Le goupe multipartite exige une participation indépendante, active et efficace de toutes les parties prenantes. Ainsi, le goupe multipartite adopte un plan de travail chiffré pour définir les objectifs et les priorités du pays pour la mise en œuvre de l'ITIE. Cette étape prend du temps et permet d'examiner les effets de l'adhésion avant d'être accepté en tant que pays candidat Corrigan (2014). Deuxièmement, le pays obtient le statut de candidat si le

conseil d'administration de l'ITIE considère que toutes les conditions d'adhésion ont été remplies. Troisièmement, pour obtenir le statut de pays conforme à la norme ITIE, les pays ayant le statut candidats doivent publier un premier rapport dans un délai de 18 mois, suivi d'un rapport final dans un délai de deux ans et demi. Les pays qui n'ont pas satisfait aux exigences du processus de validation ou qui n'ont pas soumis leur rapport dans les délais impartis risquent la suspension.

Certains pays avaient précédemment commencé à mettre en œuvre l'ITIE et se sont retirés volontairement ou ont été radiés de la liste des pays membres. Il s'agit notamment de l'Azerbaïdjan, de la Guinée équatoriale, des Îles Salomon, des États-Unis et du Yémen. Une mauvaise mise en œuvre de l'ITIE, qui ne répond pas aux normes établies, l'instabilité politique et la décision du pays lui-même de quitter l'ITIE font partie des raisons pour lesquelles un pays est suspendu de la liste des membres. Le conseil d'administration de l'ITIE a suspendu le Niger le 26 octobre 2017 en raison de progrès insuffisants dans la mise en œuvre de l'ITIE. Le pays a réintégré l'ITIE en février 2020. Après avoir échoué à soumettre un rapport de validation dans les délais, le Gabon a été suspendu en février 2013 et a réintégré l'ITIE le 21 octobre 2021. En raison de l'instabilité politique, le conseil d'administration de l'ITIE a pris la décision de suspendre temporairement la République centrafricaine à partir du 10 avril 2013.

Trois points clés doivent être mis en avant. Premièrement, l'engagement de l'ITIE ne demande pas une utilisation spécifique des revenus des ressources naturelles, mais plutôt une transparence dans la collecte de ces revenus. Ensuite, cette action ne se limite pas aux institutions gouvernementales, elle implique également des parties prenantes privées telles que les entreprises et les organisations de la société civile. Il s'agit d'un élément important de l'ITIE car la mauvaise

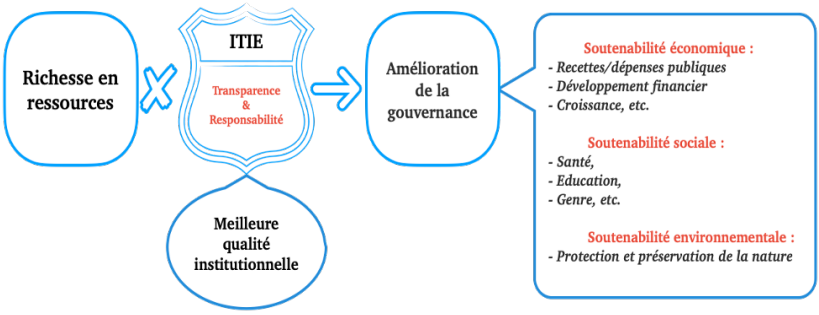
gestion des ressources naturelles peut se produire à n'importe quel niveau de la chaîne de valeur et ne se limite pas au gouvernement central. Finalement, la décision d'adhérer à l'ITIE est en théorie purement volontaire et est donc susceptible d'être la conséquence (et pas seulement la cause) d'une amélioration de la gouvernance publique ou privée. Cependant, même si la mise en œuvre de l'ITIE n'améliore pas directement la gouvernance ou la responsabilité, elle peut être perçue comme un bon signal par les investisseurs privés et les organisations internationales. Les ressources naturelles sont essentielles au développement et à la prospérité des pays riches en ressources. Dans la plupart des pays en développement, les ressources naturelles sont la propriété des états, ce qui donne le droit aux citoyens de connaître les propriétaires des entreprises extractives et de qui bénéficie des revenus générés. Le manque de transparence peut entraver la confiance entre les gouvernements, les citoyens et les entreprises, pouvant ainsi engendrer des conflits. Révéler la propriété des entreprises extractives évite les conflits d'intérêts qui permettent à des fonctionnaires corrompus de détourner des fonds qui pourraient être utilisés pour financer des écoles, des hôpitaux et des formations dans des pays qui en ont grand besoin.

Comment la transparence favorise-t-elle le développement durable ?

Les pays riches en ressources non renouvelables sont à la fois confrontés à une opportunité et à un défi. Lorsqu'elles sont bien utilisées, ces ressources peuvent créer une plus grande prospérité pour les générations actuelles et futures. Si elles sont gaspillées, elles peuvent entraîner une instabilité économique, des conflits sociaux et des dommages environnementaux graves. Les citoyens, les entreprises privées et les gouvernements doivent prendre un large éventail de décisions pour tirer profit de la richesse des ressources. Chacune d'entre elles

nécessite que les dirigeants proposent des options et des compromis complexes, ainsi que des stratégies pour mettre en œuvre ces décisions politiques. L'ITIE promeut la transparence et la responsabilité dans la gestion et la gouvernance du secteur des ressources extractives, améliorant ainsi la qualité des institutions pour atténuer les effets négatifs de la richesse de la dépendance aux ressources naturelles (Figure 4)

FIGURE 4 : Richesse en ressources naturelles et logique de l'ITIE



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0.5 Contributions de la thèse

Cette thèse apporte une variété de contributions à la littérature économique, aux spécialistes des finances publiques et aux décideurs politiques en termes d'analyse, d'informations nouvelles et d'orientations sur le secteur des industries extractives, y compris ses implications économiques et environnementales, sa gouvernance et, par conséquent, les défis de la politique publique en matière de financement du développement durable.

Chapitre 1 étudie la relation entre les richesses créées à partir de l'exploitation des industries extractives et le capital naturel dans les pays en développement, en mettant l'accent sur l'impact des rentes des ressources extractives sur la déforestation. Nous testons empiri-

quement l'hypothèse théorique Combes et al. (2018) selon laquelle le capital créé par l'homme a des impacts hétérogènes sur les secteurs économiques, en utilisant le cas spécifique des industries extractives. Les industries extractives peuvent contribuer à la perte de couverture forestière en raison de sa nécessité d'une grande superficie pour les activités de production industrielle et le développement des infrastructures et habitats (routes, déménagement des communautés résidentes, etc.). L'hypothèse tester consiste à dire que l'accès aux rentes des industries extractives peut avoir un impact non homogène sur le couvert forestier, selon l'utilisation faite des revenus. En d'autres termes, le fait d'investir les revenus des ressources à des activités vertes peut réduire la perte de couverture forestière et inversement. La déforestation et l'accumulation de capital étant des phénomènes de long terme, cette étude est basée sur un échantillon de 52 pays en développement riches en ressources naturelles sur une période allant de 2001 à 2017. À notre connaissance, cette étude est la première à réaliser une analyse économétrique rigoureuse comparant l'effet des rentes extractives sur la perte de couverture forestière. Nos résultats montrent que la rente de l'industrie extractive est préjudiciable à la couverture forestière. En outre, les résultats suggèrent que l'accès aux rentes de l'industrie extractive a des impacts non homogènes sur le couvert forestier dans les pays riches en ressources, en fonction du type de rente (mines, gaz, ou pétrole). Enfin, les résultats montrent que l'augmentation des recettes fiscales des gouvernements sur les ressources réduit la perte de couverture forestière. Ensuite, pour promouvoir la gestion environnementale des entreprises, les parties prenantes doivent surmonter les inefficacités réglementaires dans les contrats d'exploration et d'exploitation afin que la compensation environnementale soit au moins égale aux dommages marginaux causés par les industries extractives. En vue de formuler des politiques efficaces, la gouvernance de l'industrie extractive est essentielle si nous voulons transformer les

ressources extractives en une bénédiction en améliorant la soutenabilité environnementale, la mobilisation des recettes nationales et le développement financier.

Chapitre 2 analyse l'impact de l'ITIE sur la préservation de l'environnement. Premièrement, elle fournit des éléments sur lesquels les comités nationaux des pays membres de l'ITIE, le conseil d'administration de l'ITIE et les institutions financières qui soutiennent ses opérations peuvent s'appuyer pour renforcer les mesures de préservation de l'environnement et de réhabilitation des sites industrielles. Deuxièmement, à notre connaissance, cette étude est la première à évaluer de manière empirique et rigoureuse l'impact environnemental de l'ITIE utilisant des outils économétriques pour résoudre le problème de l'autosélection. À partir d'un échantillon de 83 pays en développement riches en ressources naturelles sur la période 2001-2017, nous utilisons des méthodes d'équilibrage de l'entropie pour traiter le biais d'autosélection associé à l'adhésion à l'ITIE. Les résultats montrent que la mise en œuvre de la norme ITIE réduit significativement la perte de couverture forestière d'environ 300 ha à 760 ha par rapport aux pays n'ayant pas adhéré à l'ITIE. Ces résultats soutiennent que l'ITIE, sans être une panacée, est un programme politique efficace pour limiter les impacts négatifs sur les forêts causés en partie par les industries extractives. Cette étude fournit des indications claires au conseil d'administration et aux comités nationaux de l'ITIE et, plus généralement, aux gouvernements des pays en développement riches en ressources extractives sur le rôle vital de l'ITIE dans la lutte contre la perte de couverture forestière et le financement du développement durable.

Chapitre 3 évalue "l'effet de traitement" de l'adhésion à l'initiative pour la transparence des industries extractives (ITIE) sur la mobilisation des recettes nationales. Premièrement, cette étude prend en compte le problème de l'autosélection tout en examinant l'impact de

la mise en œuvre de l'ITIE sur les recettes nationales. Deuxièmement, notre analyse est plus complète car elle prend en compte les trois principales étapes du processus de mise en œuvre de l'ITIE : l'engagement, la candidature et la conformité. Troisièmement, nous considérons le total des recettes fiscales comme une variable dépendante principale, pour l'analyse de sensibilité, nous considérons les recettes fiscales hors ressources naturelles, les recettes fiscales tirées des ressources naturelles et l'impôt sur le revenu (l'impôt sur revenu des sociétés, l'impôt sur le revenu des personnes physiques et les gains en capital). Quatrièmement, nous utilisons une approche de régression de la fonction de contrôle pour analyser l'hétérogénéité des effets du traitement sur la mobilisation des recettes fiscales en fonction des facteurs structurels des pays. Sur la base d'un échantillon de 83 pays en développement riches en ressources naturelles (44 pays ITIE et 39 pays non ITIE) sur la période 1995 - 2017, les résultats montrent que l'engagement et/ou la candidature à l'ITIE affectent de manière significative et positive la mobilisation des recettes fiscales par rapport aux pays non ITIE. La conformité à l'ITIE génère un surplus considérable de recettes fiscales. Les résultats sont robustes, avec une augmentation plus significative des recettes fiscales non liées aux ressources, de l'impôt sur le revenu et de l'impôt sur les ressources.

Chapitre 4 revisite la littérature selon laquelle les revenus des ressources naturelles peuvent entraver le développement financier dans les pays dotés d'institutions faibles. Notre hypothèse que l'initiative pour la transparence des industries extractives, qui est une norme internationale visant à promouvoir la transparence dans la gestion des ressources extractives, peut atténuer l'impact négatif de la dépendance aux ressources naturelles. Tout d'abord, elle démontre que la transparence dans le secteur des ressources naturelles peut grandement contribuer à éviter la malédiction des ressources financières dans les pays riches en ressources. Il existe beaucoup de recherches

sur l'impact des ressources naturelles sur le développement du secteur financier, mais aucune étude n'a abordé le rôle de l'adhésion à l'ITIE dans la réduction des effets négatifs des ressources naturelles sur divers indicateurs socio-économiques importants, conformément à la théorie de la malédiction des ressources. Cependant, les responsables politiques des nations dotées de ressources naturelles sont préoccupés par cette question, car le secteur financier joue un rôle essentiel dans le progrès économique en favorisant les échanges, en diversifiant l'économie, en contrôlant les risques et en incitant les investissements. Deuxièmement, nous utilisons une spécification économétrique récente et robuste qui nous permet de comparer les pays membres de l'ITIE à des pays comparables et de résoudre la majorité des problèmes d'endogénéité rencontrés dans les analyses empiriques précédentes. Cette étude an examiné 71 pays riches en ressources naturelles, dont 30 membres de l'ITIE et 41 non membres de l'ITIE, entre 1995 et 2019. Nos résultats sont solides malgré l'utilisation de divers contrôles et mesures alternatives pour le développement financier. De plus, nous examinons les canaux de transmission qui peuvent conduire à la malédiction des ressources financières.

Chapitre 1

The Effects of Extractive Industries Rent on Deforestation in RRDC

Abstract[1] **:** The extractive industries (oil, gas, and mining) play a dominant economic, social, and political role in the lives of approximately 3.5 billion people living in 81 countries across the world. However, the benefits come at a cost that is no longer limited to the problems of the 'curse of natural resources', but also includes the damage of greenhouse gas emissions, pollution, and biodiversity that extraction wreaks on the environment. This chapter revisits the links between man-made and natural capital in developing countries, focusing on the case of forest cover loss. Considering a theoretical model of income maximization, we assess through empirical observation the impact of extractive industries on forest cover loss. Based on a panel of 52 resource-rich developing countries (RRDC) over the period 2001-2017, we adopt a dynamic specification with the two-step Generalized Method of Moments (GMM) system to address the inherent bias. Our main results show that the total rent from the extractive industries is detrimental to the forest. More specifically, mineral and gas rents accelerate forest cover loss. In contrast, oil rents contribute to reducing forest cover loss. In addition, we find that natural resource tax revenues contribute to reducing forest cover loss. Our results suggest substitutability between oil rents (natural resource tax revenues and forest natural capital) and complementarity between mineral rents (gas rents and forest natural capital). To promote corporate environmental management, stakeholders must overcome regulatory inefficiencies in exploration and exploitation contracts so that environmental compensation is at least equal to the marginal damage caused by the extractive industries.

Keywords : Extractive Industries – Taxation – Deforestation ; **JEL Classification. :** C33 ; H23 ; Q32 ; Q5 ; H5

[1] This chapter was written with Noel Thiombiano, and a version is published in *Resources Policy*

1.1 Introduction

In recent decades, natural capital has been recognized as playing a fundamental role in determining "the economic output and social well-being of developing countries (Corvalán et al., 2005)". Natural capital is defined as the stocks of natural resources, land, and ecosystems, it constitutes a more fundamental form of capital than man-made capital (i.e., human capital, social capital, manufactured capital, and financial capital) since it provides the basic conditions for human existence, biodiversity, food, clean water, and air, as well as essential resources (The World Bank, 2005).

However, the dependence of humans and their economic activities on natural capital can result in serious environmental consequences, such as land conversion, climate change, deforestation, and biodiversity loss (including the extinction of some animal and vegetal species). In the specific case of the extractive industries sector (oil, gas, and mining), the consequences are no longer limited to the problems related to the so-called natural resources "curse" or depletion but include the degradation of natural capital induced by the extractive industries. Some studies point to the specific case of the mining industry as a threat to biodiversity and particularly to deforestation (Bridge, 2004; Pepper et al., 2011; Ranjan, 2019; Siqueira-Gay et al., 2020). Sonter et al. (2017) found that mining activities caused 11.67 km² of deforestation between 2005 and 2015 in the Amazon rainforest. The environmental damage caused by mining has often led to complaints from local communities and has raised questions about the opportunity to continue the mining activity (Cook et al., 2011; Evangelinos and Oku, 2006; Khenisa, 2017). Moffat (2004) suggests that a forest established on sites reclaimed after mining has occurred is more susceptible to destructive agents, such as drought, insect attack, and infertility than undisturbed land. In the case of oil and natural gas, extraction poses

environmental threats, such as leaks and spills during drilling and the extraction of wells, and air pollution from the burning of natural gas in oil wells (Cook et al., 2011; Pepper et al., 2011)

In several developing countries, extractive resources account for a significant share of GDP (Hailu and Kipgen, 2017). The extractive industries play a dominant economic, social, and political role in the lives of nearly 3.5 billion people living in 81 countries across the world. The extractive industries sector accounts for at least 20% of exports and government revenues in twenty low- and middle-income countries (Halland et al., 2015b). The Extractive Dependence Index (EDI) from Hailu and Kipgen (2017) shows that all countries dependent on extractive resources are developing economies. Mining is mainly carried out by multinational companies. Thus, the extractive industries can have a significant impact on economic development because they generate income both for governments and foreign exchange earnings, and create jobs, directly and indirectly, in local communities. However, the extractive industries can also exacerbate or cause environmental and social problems, such as deforestation, pollution, conflict, depletion of nonrenewable resources, and disruption of ecosystems, endangering the health and safety of workers and the overall well-being of local communities.

Given the multiple effects associated with natural resource extraction, the debate on the opening of the Eagle mine (in the US state of Michigan) has focused on the trade-off between the economic benefits versus the potential environmental and social costs of the mine (Campbell and Roberts, 2010). Several studies show that economic development, demographic pressure, and institutions are the main determinants of forest cover loss in the tropics (Delacote and Angelsen, 2015). Similarly, the expansion of both large- and small-scale agriculture has been identified as the main driver of forest loss and green-

house gas (GHG) emissions. In contrast, the impacts of the extractive industry and infrastructure expansion, and the linkages between these two factors, have received less explicit attention.

Nowadays, empirical macroeconomic studies on deforestation data have yielded useful results regarding the factors that account for periodic deforestation rates. First, the literature has questioned the impact of economic development on deforestation, examining the existence of an environmental Kuznets curve for deforestation (see, Culas, 2012). These studies provide contrasting results, as the meta-analysis of Choumert et al. (2013) shows. Second, institutional factors, such as corruption, internal conflict, the quality of land tenure, and, more broadly, the quality of governance in countries, have been found to be an important macroeconomic factor in deforestation (Barbier et al., 2001; Bhattarai and Hammig, 2001; Culas, 2012; Galinato and Galinato, 2016). Strong institutions seem to be environmentally friendly and thus contribute to the preservation of forests (Campbell and Roberts, 2010; Ferreira and Vincent, 2010). However, this effect seems debatable. Besley (1995) suggests that better quality institutions can encourage productive investments that potentially encroach on forested areas. The overall effect of institutions is, therefore, likely to be ambiguous. Other studies have found evidence that other macroeconomic factors are correlated with deforestation. These factors include the role of real exchange rates (Arcand et al., 2008), agricultural activity, access to capital, public policies (Benhin and Barbier, 2004; Combes et al., 2019), population (Cropper and Griffiths, 1994), timber harvesting (Damette and Delacote, 2011), and the impact of plantations on forests (Heilmayr, 2014).

This chapter contributes to the literature on the relationship between man-made and natural capital in developing countries, with a specific focus on the impact of the benefits of extractive industries

on deforestation. We empirically test the theoretical hypothesis of (Combes et al., 2018) that man-made capital has heterogeneous impacts on economic sectors, using the specific case of the extractive industries. The extractive industries may contribute to forest cover loss because of the need for a large land area for industrial production and access to infrastructure. The hypothesis to be tested is that the access to rents from extractive industries can have a non-homogenous impact on forest cover, according to the type of rent. In other words, dedicating resource revenues for non-deforestation-related activities can reduce forest cover loss, and vice-versa. As deforestation and capital accumulation are long-term phenomena, this study is based on a sample of 52 resource-rich developing countries over a period spanning from 2001 to 2017. Such a timeframe is often used in the literature as it is considered necessary for the long-term effects to become apparent (Combes et al., 2018; Ouoba, 2020; Ranjan, 2019). To our knowledge, this study is the first to perform a rigorous econometric analysis comparing the effect of extractive rents on forest cover loss. Our results suggest that access to extractive industry rents has non-homogenous impacts on forest cover in resource-rich countries, according to the type of rent accessed.

The chapter proceeds as follows. In Section 1.2, we briefly present the context of our research question and the literature review. Section 1.3 describes the methodology and data. Section 1.4 presents the results obtained and discusses them in Section 1.5. Section 1.6 checks robustness. The last section 1.7 summarizes the main findings and offers concluding remarks.

1.2 Extractive industries and deforestation

The first theoretical analysis of the "curse of natural resources" was established by Sachs and Warner (1995b), who indicate that coun-

tries rich in natural resources paradoxically appear to perform less well than countries without them. Indeed, this curse may stem from Dutch disease (Sachs and Warner, 1995b), the volatility of natural resource prices (Arezki and Ploeg, 2007), or institutional factors (Robinson et al., 2006a; Torvik, 2002).

Although the abundance of extractive resources in developing economies and their dependence on them has been studied in the literature, the environmental repercussions still raise several questions. Deforestation, which can be defined as all the practices and processes that lead to an irreversible loss of forest area to economic activities, is due to both direct and indirect factors. The direct factors are those that cause the immediate conversion of forestland into land for other uses. These include infrastructure extension, agricultural expansion, wood extraction, and expansion of settlement areas and could be explained as a response to some indirect causes, such as strong population growth and increasing economic needs, technological factors, political and institutional factors, cultural and sociopolitical factors (see, for instance, Geist and Lambin, 2002; Hosonuma et al., 2012; Madeira, 2008; Makunga and Misana, 2017; Su et al., 2011). In addition, a large strand of literature examining the drivers of deforestation and forest degradation focuses on underlying (indirect) causes. Indeed, economic growth has long been considered an important driver of environmental destruction (see, for instance, Cropper and Griffiths, 1994; Grossman and Krueger, 1995; Holtz-Eakin and Selden, 1995; Koop and Tole, 1999; Shafik, 1994). Using a sample from 76 developing countries, Koop and Tole (1999) find no statistically significant empirical regularity between deforestation and GDP per capita. However, Shafik (1994) finds that forest cover loss exhibits a weak inverted-U-shape relationship with rising incomes. Cropper and Griffiths (1994) find an inverted-U-shape relationship between per capita income and the annual rate of deforestation in Africa and Latin America but not in

Asia. Other indirect factors include the quality of political institutions (Barbier et al., 2005; Galinato and Galinato, 2012; Van and Azomahou, 2007) and exchange rates (Arcand et al., 2008). For example, controlling corruption induces technological development, which can favor extensive agriculture if the technology is complementary to agricultural production (Galinato and Galinato, 2016). However, controlling corruption favors better institutions that are presumed to be environmentally friendly, which can preserve forests (Ferreira and Vincent, 2010). According to Koop and Tole (1999), when inequality levels are high in a country, the development will tend to exacerbate deforestation rates. Nevertheless, when distributions tend to be more egalitarian, the negative effects of economic development on forest cover are reduced. Additionally, the effects of public spending (Combes et al., 2018; Galinato and Galinato, 2016; Lopez et al., 2011) and climatic factors, such as temperature and rainfall, are worth noting. The theoretical intuition of Combes et al. (2018) is that man-made capital accumulation (public credits and expenditure) can have non-homogenous impacts on natural capital, according to the sector of activity. Their empirical framework suggests that public credits and expenditure increase deforestation in developing countries. Thus, we enumerate two main channels that link extractive industries to forest cover, namely, the channel of industry (total rents to GDP) and the channel of public expenditure through the government's share of rents (resource tax revenues to GDP).

1.2.1 Channel of industrial production

In recent decades, there has been a significant flow of foreign direct investment into developing countries. Foreign direct investment in Africa increased fivefold between 2000 and 2012, from $10 billion to $50 billion. The development of extractive industries is the main sti-

mulus for investment in these countries. According to Morisset (1999), multinationals are motivated to invest in the presence of natural resources. The natural resources sector, mainly mining, attracts foreign direct investment (FDI) to developing countries, even to those with low schooling rates (Kinda, 2008). For example, in 2009 in Madagascar, the percentage of FDI in the extractive industries sector was estimated at 74% of all FDI and estimated at 2.3 billion US dollars (Raharinirina, 2013). This activity leads to deforestation, soil degradation, loss of biodiversity, and air and water pollution. In 2008, Burkina Faso had only ten industrial mining sites. These sites covered 1031.56 km² or 0.38% of the nation's area and 3% of the cultivated areas (Maradan et al., 2011). In 2016, there were twelve sites in operation, ten of which were gold and the other two zinc and manganese mining, and several others were in the process of being set up. The rents from nonrenewable resources, (i.e., those from fossil fuels and minerals, as well as the rents from the overexploitation of forests) are indicators of the liquidation of a country's capital stock. Some studies in Mexico, Central America, the Brazilian and Western Amazon, and Indonesia suggest that extractive industries and infrastructure are often associated (Humphreys Bebbington et al., 2018). The investment in both sectors and synergies between them lead to legal and institutional reforms that modify the management of forests. Notably, these reforms have contributed to reducing the status of protected areas, to weakening the protection of indigenous territories, to relaxing of environmental assessment procedures, and to increased violence against environmental defenders (Humphreys Bebbington et al., 2018). Hall, (1991) focuses on the social costs, rural violence and intimidation, land grabbing, and forced population displacements caused by the Grande Carajàs program which has worsened social and environmental conditions for most of the rural population and resulted in social conflict. The Grande Carajás project in Brazil is one of the world's largest re-

serves of copper (iron ore, manganese, and gold) and extends over 900,000 km² (Bebbington and Unerman, 2018). The exploitation of this mine leads to annual deforestation of 6,100 km² through the conversion of wood from the surrounding forest into charcoal to feed the smelting plants (Moran et al., 1994). Similarly, Ranjan (2019) shows that mining contributed to deforestation in 314 districts of India between 2001 and 2014. Charcoal, iron, and limestone-producing districts suffered 450 km² of additional forest cover loss, while the production of dolomite, quartz, fire clay, and manganese were not associated with forest loss. However, districts not producing any of these minerals had 350 km² less of forest loss.

These various works suggest that an increase in the area occupied by extractive industries leads to a loss of forest cover and, therefore, constitutes a threat to biodiversity conservation. However, the authors do not provide any answers regarding the effects of economic rents on deforestation in terms of public expenditure through natural resource tax revenues. Nevertheless, this review shows us that forest cover is encroached upon due to extractive activities.

1.2.2 Channels of public expenditure

Several development studies are investigating the impact of natural resource wealth on long-term economic growth, but the results are still controversial. Havranek et al. (2016) review the empirical literature and find that approximately 40% of the articles find a negative effect ; however, 20% find a positive effect and 40% find no effect. According to Lopez et al. (2011), public expenditure accounts for 20% to 45% of GDP. However, natural capital has not recently been valued in the calculation of GDP. Currently, due to the adverse effects of climate change, leaders are beginning to develop an understanding of the importance of natural capital for economic development. Ideally,

natural capital should be considered in all consumption and/or investment decisions.

The World Bank encourages resource-rich countries to better national resource mobilization by strengthening transparency, which promotes inclusive growth that meets the vital needs of populations while simultaneously protecting the environment. Through an effective fiscal policy, revenues from extractive industries can contribute significantly to financing productive expenditures (Daniel et al., 2013). This fact draws attention to the need to consider other factors, such as job creation in related activities and environmental and social effects, in addition to revenue objectives. Combes et al. (2018) used a theoretical analysis supported by empirical evidence and found a relationship of complementarity between natural and artificial capital. In their article, they argue that artificial capital derives from public credits and expenditure, the increase of which, due to a decrease in the cost of access, affects the activities related to deforestation in developing countries more than the activities not related to deforestation. They also hypothesize that countries that are heavily dependent on the agricultural sector and the exploitation of natural resources are likely to experience complementarity. This means that public expenditures in developing countries foster the loss of forest cover. While Lopez et al. (2011) draw attention to the composition of public expenditure, they argue that increasing the share of revenue allocated to public and social goods reduces environmental pollution.

Economic rent is composed of the share of the producers' profit, the state's revenue, and the amount of reinvestment. From the channel of production, economic rents have a direct and negative impact on forest cover (i.e., a positive effect on deforestation) and the public expenditure has a heterogeneous impact, which explains the allocation of revenues to deforestation-related and non-deforestation-related ac-

tivities. If the allocation of resource revenues from non-deforestation-related activities prevails, then we have a situation of substitutability between economic rents (artificial capital) and natural capital. Otherwise, we have a situation of complementarity between economic rents and natural capital. For example, the Grande Carajàs project included the construction of a hydroelectric plant to power the mine, a railway, and a port to transport minerals It also required the creation of some 800,000 hectares of protected areas and indigenous reserves to partially compensate for the damage caused (Humphreys Bebbington et al., 2018).

1.3 Data and methodology

1.3.1 Data

We use a panel of 52 developing countries rich in extractive resources across several regions of the world (Table A4 (appendix)). Our data are annual in frequency and cover the period from 2001 to 2017. The main variables concern extractive rents (minerals, oils, and natural gas rents). Resource tax revenues are used as the interest variables and forest cover loss as the dependent variable. We wanted to extend the study to all resource-rich countries over a longer period, but unfortunately, there are problems regarding data availability for the dependent variable and many missing data points for the variable of interest. Following Combes et al. (2018), the time horizon considered is quite consistent for our analysis.

To define countries rich in extractive resources, we used the Extractive Dependence Index (EDI) proposed by Hailu and Kipgen (2017). This index measures a country's dependence on the extraction of oil, gas, and mineral resources. This measure seems more complete at our level because it integrates the three essential components that express

a country's wealth in extractive resources, i.e., the combination of the share of export earnings from extractive industries, their share in terms of income of the country's total income, and their value in terms of economic rents as a percentage of GDP. This measure considers the volatility of economic growth and affects its sustainability. Thus, our EDI is as follows :

$$EDI_{it} = \sqrt{[EIX_{it}(1 - HTM_{it})] \,.\, [REV_{it}\,(1 - NIDC_{it})] \,.\, [EVA_{it}(1 - MVA_{it})]} \tag{1.1}$$

where EDI_{it} is the Extractive Dependence Index of country i at time t; EIX_{it} is the sum of export revenues from oil, gas, and minerals in the total export revenues of country i at time t; HTM_{it} represents the export revenues of highly competitive and technology-intensive manufacturers of country i at time t as a percentage of the HTM_{it} exported worldwide; REV_{it} is the share of total income generated by the extractive industry in the total tax revenues of country i at time t; $NIDC_{it}$ is the share in GDP of tax revenue from non-resource-related income, capital gains, and profits of country i at time t; EVA_{it} is the share of total economic rents from the extractive industries in the GDP of country i at time t; and MVA_{it} is the manufacturing/inhabitant value-added, used as a proxy for the industrial capacity of country i at time t. By considering the values in parenthesis, i.e., $((1 - HTM_{it}), (1 - NIDC_{it}), (1 - MVA_{it}))$, it is possible to take into account their influence on the values $(EIX_{it}, REV_{it}$ and $EVA_{it})$.

In this study, we have selected those countries that had an EDI score above 10 in 2011. Additionally, the calculation takes time into account, and we notice that many countries have an almost constant EDI between 2000 and 2011 (see (Hailu and Kipgen, 2017)). Our proxy for annual deforestation or forest cover loss (Forest Loss Year) is from Hansen et al. (2013) and is available in the Global Forest Change dataset on Earth Engine (http://earthenginepartners.appspot.

com/science-2013-global-foreston). This data set is based on Landsat satellite images between 2000 and 2019 and is available at 30 meters' spatial resolution. 'Forest cover loss' is a change from a forest to a non-forest state during the period. Inversely, 'forest cover gain' reflects an entire non-forest to forest change. 'Forest loss year' is a disaggregation of total forest loss at the annual scale. The dataset is mainly from the University of Maryland and was published and made freely available for use by Hansen et al. (2013). This dataset remains a potentially valuable source of information on forest cover, although it is criticized for inaccuracies in the distinction between forests and plantations at the local level (Tropek et al., 2014). This study considers a forest as any area with more than 20% trees in 2000, thus, excluding all areas with a lower percentage of trees.

For the variables of interest, we use the share of rents from extractive industries as a percentage of GDP (RENTS) and industry tax revenues. Natural resource rents are a measure of the sustainable development of extractive industries in the new millennium. As explained above, this variable represents the profit from the extraction of natural resources. It takes the form of economic rents since it is not produced. We use it because it captures the size of the extractive sector in the national economy in monetary terms. Therefore, it depends on the size of the operation, the volume of production, the general level of prices, and many other institutional factors. More specifically, we consider mineral rents, oil rents, and natural gas rents (percentage of GDP).

The data on total natural resource revenues, including natural resource revenues reported as "tax revenue" or "non-tax revenue" of a given government (Gov.Res-revenues to-GDP), are from the ICTD website. We test the effect of this variable on forest cover. The goal is to determine if the use of this income considers the negative effects of the extractive industries on forest cover. This variable affects the national economy significantly in terms of capital and consumer spending. We expect a negative relationship between resource revenues and deforestation. The data on the gross fixed capital formation (GFCF) and final consumption current (Consum) permit the effects of public expenditures on forest loss to be considered. Other variables likely to influence deforestation are introduced to serve as controls, in order to allow us to obtain more robustness in our econometric results.

We thus test the endogeneity of these variables in our model. From the current literature, we retain the following : GDP growth per capita captures

the effect of national wealth on forest loss. The works of Foster and Rosenzweig (2003) in India show that neither agricultural productivity expansion nor rising wages have increased local forest cover. Based on the level of a country's development, the expected impact of the GDP growth on deforestation may be mixed.

Total population growth is a mid-year estimate of all residents of the country regardless of their legal status or citizenship. This variable can have an impact on the availability of natural resources, the size of the habitat, and farms. An increase in population fuels the demand for arable lands, fuelwood, and charcoal because the increases in basic needs such as food, energy, water, social services, and infrastructure can foster deforestation (Cropper and Griffiths, 1994). Foster and Rosenzweig (2003) find that the demand for forest products associated with population and income growth leads to forest growth. Therefore, the expected impact of population growth may be ambiguous.

Internal conflict is one of the major institutional shocks associated with extractive activities because of the infrastructure footprint on forests. An analysis exploring these issues in Mexico and Central America, the Brazilian and Western Amazon, and Indonesia indicates that resource extraction has induced more mobilization and protest from local communities than have road, railway, or waterway building projects (Humphreys Bebbington et al., 2018)). We consider the internal conflict index as a measure of the influence of political institutions. This is an assessment of the political violence in the country and its actual or potential impact on governance. A score of 4 points equates to Very Low Risk and a score of 0 points to Very High Risk. Internal conflict may generate higher or lower levels of deforestation Larcom et al. (2016).

The average rainfall shock, which is defined as the deviation of the mean annual rainfall from its long-term trend (mean rainfall from 1901 to 2016), is data extracted from the database of the Climate Research Unit (CRU) of the University of East Anglia. This climate variable is expected to control agricultural profitability as well as the natural causes underlying the loss of forest cover. Countries with low rainfall tend also to experience extreme temperatures. This can be detrimental to plants, leading to a loss of forest cover. It should be noted that high climate variability can also lead policymakers to increase environmental standards, which can reduce deforestation.

Thus, we can expect an ambiguous effect of rainfall shocks on deforestation.

The net official development assistance (ODA) received per capita is purposefully promoting economic development and improving living conditions in recipient countries, according to the Development Assistance Committee (DAC) of the Organization for Economic Co-operation and Development (OECD). We expect a negative impact of the net ODA received on the loss of forest cover.

1.3.2 Descriptive statistics and stylized facts

Table A3 (Appendix) shows that the variables do not have the same number of observations, but this will be considered in our estimation. For all variables, we notice that the standard deviation is very high for the dependent variable compared to the explanatory variables. We use the variables in logarithms to minimize these deviations and to smooth the data that are widely spread out. This facilitates our interpretation of the econometric estimation results.

Figure 1.1 shows the relationship between natural resource rents (oil, mining, and gas rents) and forest cover, on one hand, and the linkage between resources tax revenue and forest cover loss, on the other hand. We can observe a negative relationship between oil rents and tax revenue from natural resources and forest cover loss. However, we can also observe a positive relationship between mineral and gas rents and forest cover loss. Our statistical analysis clearly shows that mineral rents and gas rents contribute to increasing deforestation, but oil rents and government revenue from extractive industries also contribute to reducing deforestation. To be able to draw conclusions from these results, we conduct an econometric verification, as the stylized representation of economic variables does not consider specific endogenous factors. In the following section, we use the dynamic panel method and the GMM system estimator in the analysis.

1.3.3 Theoretical analysis

Main hypotheses

This section examines the channels through which maximizing econo-

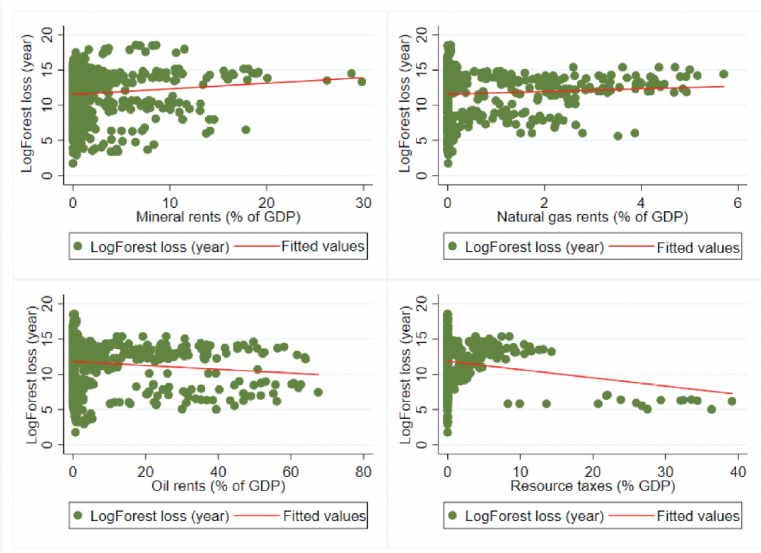


Figure 1.1 : Extractive resource rents, resources tax revenue, and forest cover loss

mic rents from the extractive industries can affect forest cover loss. As a reminder, exploitation by the extractive industries requires the occupation of large areas, and thus, land use planning leads to a loss of forest area. Moreover, industrialists and the government of a given country are the main actors benefiting from the profits of the extractive industries. The increase in tax revenue through extractive resources leads to an increase in public expenditure, all other things being equal. While the value of the economic rent depends on several other factors such as costs and price levels, as well as other institutional and geographical factors, the quantity of production is likely to be crucial. An increase in tax revenue, therefore, depends not only on the tax system but also on the total value of rents.

Going back to our theoretical model, it should be noted that, in addition to the technological factor, an increase in the quantity produced by the extractive industries also depends on the size of the operations and/or the number of extractive industries (increase in the consumption of natural capital). We end up with a classic production function augmented by natural

capital, where profit maximization will depend on the natural capital, in addition to the constraints cited above (production costs and price level), in the producer's program. The economic theory had historically ignored this reality of the role of natural capital in the production process, but in recent decades, it has increasingly become an indisputable truth. The 2012 Rio+20 summit has generated milestones towards the integration of natural capital considerations into financial products and services. Natural capital is still a major limitation in the assessment of the gross domestic product (GDP).

$$MaxI(R) = B(D, Q) - c(D) - c(Q) \tag{1.2}$$

From equation 1.2, industry I maximizes the rent that depends on the level of capital $B(D, Q)$ also related to deforestation under the constraint of the costs of the natural factor $c(D)$ and other "traditional" factors of production $c(Q)$. This equation is very simplistic because it does not integrate the indirect deforestation D' likely to be generated by using tax revenue (public expenditure) and its cost $c(D')$. We, therefore, integrate public expenditure to analyze the case of developing countries where the State that owns the property rights collects the taxes and duties from the economic rents. According to the theory of optimal taxation, the rents can be taxed up to 100% since they are neutral in terms of investment and operating decisions (Ricardo, 2015). Surface royalties are paid each year in proportion to the area granted by the mining title, but they are not required in all countries. However, not all countries include surface taxes (Laporte et al., 2015).

Theoretical demonstration of the assumptions with the integration of public expenditure

The remainder of our theoretical analysis is based on the theoretical model of Combes et al. (2018). The authors consider a country in which a representative agent maximizes its net income derived from economic activities that use natural capital D (deforestation) and artificial capital K. K requires both government appropriations and expenditures. The intuition is that K affects the economic sectors heterogeneously. $A(D,\ \delta K)$ is the income from activities related to deforestation and $O((1-\delta)K)$ is the income from activities not related to deforestation, of which $\delta\ and\ (1-\delta)$ are the shares of the allocated K. Combes et al. (2018), therefore, assume standard properties indicating second and first derivatives, such as the following :

$A_i \geq 0,\ A_{ii} \leq 0,\ \forall i = \{D, K_D\},\ O_{K_o} \geq 0; and\ O_{K_o K_o} \leq 0$. The costs $c(D)$ of $Deforestation$ and the costs $c(K)$ of $Capital\ access\ K$ are increasing and convex, as follows : $c_i \geq 0,\ c_{ii} \geq 0,\ \forall i = \{D, K\}$. $c(K)$ are lower when forests are open access, higher when property rights are safe and well defined, higher when forests are a scarce resource. The authors consider the existence of a trade-off between consumption and investment in the cost functions, and thus, the optimized levels of D and K become steady-state variables, and their partial derivatives are responses to shocks. Hence, the following agent I maximization problem is as follows :

$$MaxI(D, K, \delta) = A(D, \delta K) + O((1-\delta))K - c(D) - c(Q) \tag{1.3}$$

The first derivatives $D^*,\ K^*,\ and\ \delta^*$ represent the level of deforestation, capital, and the share of capital allocated to economic activities related to deforestation, respectively, with the following :

$$A_D - c_D = 0 \tag{1.4}$$

$$\delta A_{K_D} + (1-\delta) O_{K_O} - c_K = 0 \tag{1.5}$$

$$K A_{K_D} + K O_{K_O} = 0 \tag{1.6}$$

Note, Equation 1.4 indicates the equality between the marginal revenue from deforestation D^* and its marginal cost ; equation 1.5 indicates that capital K^* is chosen for the equalization between the marginal productivity and the marginal cost of capital, and equation 1.6 defines δ^*as the level of equalization between the marginal productivity of capital from deforestation-related and non-deforestation-related activities. Equations 1.4, 1.5, and 1.6 by substitution resulted in the following condition :

$$\frac{A_{K_D}}{C_K} = \frac{O_{K_D}}{C_K} = \frac{A_D}{C_D} \tag{1.7}$$

Equation 1.5 states that deforestation choices and capital allocation are made so that each activity equals the marginal benefit/marginal cost ratio. Thus, the authors show that the main argument is that an increase in government credit or spending would lead to a decrease in the marginal cost of capital. This will influence not only the agent's total capital but also the

allocation of capital between deforestation-related and non-deforestation-related activities and, thus, the level of deforestation. Combes et al. (2018) thus go further in their demonstration to characterize cases of complementarity and substitution between artificial and natural capital (See their article for this demonstration). They use the implicit function theorem to derive three cases. The first case is that the decrease in the cost of artificial capital c_K increases the capital allocated to deforestation δK and the level of deforestation. In the second case, decreasing c_K increases δK but decreases the total level of deforestation. In the third case, decreasing c_K decreases both the capital allocated to deforestation and the total amount of deforestation. The authors therefore favor the case that they consider most likely with developing country characteristics. They believe that the experience of complementarity is more likely to be observed in countries highly dependent on agriculture and natural resources. This is explained by the tendency to allocate artificial capital to agricultural activities whose expansion is a source of deforestation.

Our theoretical model is based on Combes et al. (2018) but with the difference that in our model, deforestation comes not only from the allocation of artificial capital c_{d1} (between deforestation-related and non-deforestation-related activities) but also from the natural capital c_{d2} itself linked to its production, including $\mathbf{c_D = c_{d1} + c_{d2}}$. As mentioned above, the representative agent receives only part of the artificial capital (taxes and taxes on the rent). However, he must bear the deforestation cost of producing artificial capital in addition to the cost of allocating his share between deforestation-related and non-deforestation-related activities. It should be noted that when the share of capital allocated to non-deforestation-related activities increases, it reduces the total amount of deforestation.

In our analysis, it is a question of the State putting in place a fiscal policy that allows it to maximize its revenues. It is also the case that increasing government revenues can exacerbate deforestation. Therefore, how do changes in rents and tax revenues affect deforestation ? All other things being equal, an increase in the rent increases the total amount of deforestation. On the other hand, if the increase in rents is accompanied by an increase in revenues and is allocated to activities not related to deforestation, the total level of deforestation could decrease. We support this last sentence through equation (1.4) of Combes et al. (2018), which states that there is equality between

the marginal income from deforestation D^* and its marginal cost. A strong hypothesis is that if the marginal income from deforestation is strictly directed into activities not related to deforestation (e.g., subsidies, reforestation, as well as money allocated to saving forests that are suffering from natural loss), this could partly lead to a decrease in the total amount of deforestation. The share of the rent accruing to the state in the form of revenue will be used as artificial capital. We, thus, simplify the problem in order to be consistent with Combes et al. (2018). In the empirical part, we test the existence of situations of complementarity and/or substitutability between natural capital and artificial capital based on the rents and tax revenue.

1.3.4 Empirical strategy

Our theoretical analysis considers conditions under which maximizing artificial capital can foster deforestation. However, we argue that when the marginal income from deforestation is strictly invested into reforestation activities and safeguarding the natural loss of forests, a reduction in the total amount of deforestation may be observed. Thus, a situation of complementarity between natural and artificial capital is evoked when these maintain a positive relationship. In the case of a negative relationship, a situation of substitutability will then be envisaged (Combes et al., 2018; Delacote and Angelsen, 2015). Our empirical analysis includes economically verifying the existence of a case of complementarity and/or substitutability for developing countries with large stocks of forests and extractive resources.

Econometric model specification and estimation method

In this study, we adopt a dynamic panel specification that identifies the specific impact of two interdependent determinants of artificial capital, namely, total rent and tax revenue from extractive industries. It is an autoregressive model that distinguishes between the short-term and long-term impact of a variable. We argue here that increasing economic rents leads to increased deforestation and facilitates access to artificial capital. We consider the effects of a few control variables highlighted in the literature.

Specification of the dynamic panel model

The specification of the dynamic panel model allows us not only to study the relationship between artificial capital (total extractive industry rent and

tax revenue) and the loss of forest cover but also to test the dynamic effect of the loss of forest cover. We thus adopt the method of Combes et al. (2018). From the theoretical model analysis, the static description of the allocation of deforestation capital corresponds to an equilibrium condition. This suggests the existence of a steady-state value of the logarithm of forest cover loss. The authors define $z_{it} = lnFloss_{it} - lnFloss^{*}_{it}$ as the difference between the logarithms of forest cover loss for country i in year t and its steady-state value. They assume that the dynamics of z described by $\dot{z} = -\beta z$, a homogeneous first-degree differential equation with $0 < \beta < 1$, i.e., the rate of convergence of the loss of forest cover to its steady-state value, decreases from β. The resolution results in the following basic dynamic specification of forest cover loss (See Combes et al. (2018) for more detail.) :

$$lnFloss_{it} \cong \beta lnFloss^{*}_{it} + (1-\beta) lnFloss_{it-1} \tag{1.8}$$

We obtain the following specifications by integrating the variables of interest :

$$lnFloss_{it} = \alpha_o + v_i + (1-\beta) lnFloss_{it-1} + \gamma_1 lnRents_{it} + X^{'}_{it}\beta' + \varepsilon_{it} \tag{1.9}$$

$$lnFloss_{it} = \alpha_o + v_i + (1-\beta) lnFloss_{it-1} + \gamma_2 lnGov.Res\_rev_{it} + X^{'}_{it}\beta' + \varepsilon_{it} \tag{1.10}$$

In equations (1.9) and (1.10) $lnFloss_{it}$ represents the present value of forest cover loss in hectares in country i in year t, v_i is the country fixed effect and ε_{it} is the idiosyncratic error term. Extractive industry rents are represented by $Rents_{it}$, extractive resource tax revenues are denoted by $Gov.Res\_rev_{it}$, $(1-\beta)$ is the estimated coefficient of the lagged explained variable, and γ_1 and γ_2 represent those of the interest variables. $X^{'}_{it}$ represent the vector of control variables and β' is the vector of estimated coefficients. The vector of the control variables includes GDP per capita, total population, corruption as an indicator of the institutional quality of the country, and rainfall as an indicator of the potential effect of climate variability on forest cover.

Dynamic panel estimation by the GMM system estimator

The presence of the lagged endogenous (dependent) variable characterizes the dynamic panel model. Its appearance among the explanatory variables makes the OLS estimator non-convergent since the lagged endogenous variable is positively correlated with the error term due to the presence of the specific effect. The OLS estimator is biased because of the correla-

tion of the lagged endogenous variable with the error term (Nickell, 1981). We then use the two-step GMM system estimator (SYS-GMM) proposed by Blundell and Bond (1998) with Windmeijer (2005)'s small sample robust correction, which combines two instrumentations designed to overcome some of the limitations of the DIF-GMM (Arellano and Bond, 1991). This approach includes the use of lagged variables in levels and lagged variables in differences as instruments. It has the advantage of addressing both the problem of endogeneity and the problem of unobserved heterogeneity. In addition, the GMM system is preferred to the standard first difference GMM because if the dependent variable is close to a random walk process, then the level variables are poor instruments of the difference variables. The System-GMM solves the problem of weak instruments and significantly improves the accuracy of the estimators. It also reduces the bias in short period samples (T small). Indeed, the GMM considers the inertia that may exist in the determination of the dependent variables and will therefore reduce the potential reverse causality bias of the explanatory variables by systematically using predetermined and exogenous variables as instruments. We assume in the regression that the lagged dependent variable and the economic rents variable of interest are endogenous and that the other explanatory variables are weakly endogenous, except "population", which is assumed strictly exogenous. Of course, we check the Sargan/Hansen incremental test for the validity of the additional moment restrictions required by the SYS-GMM and the Chi-square test (Bond, 1998). Since our panel is unbalanced, in this case, the flexible GMM framework takes into account this problem and that of multiple endogenous variables. Their use is atomized in the STATA-15 software used in this study (Bond, 1998; Roodman, 2006).

Other studies use the Dynamic Ordinary Least Squares (DOLS) of Kao and Chiang (2001)for cointegrated panel data with a homogeneous covariance structure. When the variables are nonstationary and cointegrated, this method allows a cointegration regression to be obtained between the dependent variable and the regressors. It considers the problem of endogeneity, and the possible non-sphericity of the residuals and is asymptotically unbiased. We do not use it in this work since this method requires a greater number of individuals and a longer time horizon ($N \to \infty,\ T \to \infty$).

1.4 Main results

1.4.1 Econometric hypothesis tests of the dynamics of forest cover loss

First, we test for heteroscedasticity, although its presence in the model does not violate the estimator's convergence hypothesis, as it is no longer at minimum variance. This requires the correction of the variance-covariance matrix to make the perturbations spherical. The presence of the matrix has the advantage of requiring only consideration of Hansen's test for assessing the validity of the instruments since **?** shows that Sargan's test is biased when considering the "robust" option in the Stata xtabond2 command.

For the set of estimates, Hansen's over-identification test tells us that there is no correlation between the instruments and the error term. The instruments are therefore valid. Similarly, there is not enough evidence to reject the null hypothesis of no second-order serial correlation of the error term at the 5% threshold, which requires maintaining the assumption of serial independence in the error term ε_i in equations (1.9) and (1.10). The second difference explanatory variables can therefore be used as appropriate instruments for their level values because there is no correlation with the error term. For all estimates, the number of instruments is smaller than the number of groups (number of countries). According to Roodman (2009), this eliminates the problem of the proliferation of instruments, which is often underestimated in the application of the first difference model.

Our basic estimates of equations (1.9) and (1.10), reported in Tables 1.1 and 1.2, respectively, present the characteristics of the dynamic process of forest cover loss. For all regressions, we always find a coefficient β of the lagged dependent variable significantly different from zero. The associated Chi2 statistic verifies that $\beta < 1$ and is positive. Our results also show that forest cover loss is governed by the stationary $AR\,(1)$ process, ceteris paribus. According to Combes et al. (2018), this reinforces the ubiquitous nature of the gross forest cover loss concept invented by Hansen et al. (2013). Considering the most complete specifications (column 6 in Tables 1.1 and 1.2), the results show that a past 1% increase in forest loss induces an approximate 0.6 percent increase in current forest loss in developing countries.

We cannot provide an interpretation in terms of forest gains since the

data only measure the gross loss of forest cover. Following Combes et al. (2018), these results also suggest that forest loss is converging towards a steady-state value.

1.4.2 The effects of control variables

The determinants of deforestation are multiple. Several studies have attempted to identify the drivers of deforestation. On the one hand, there are direct factors whose effects have a direct impact on forests, namely, climatic conditions, occupation of forest areas, and logging. On the other hand, there are underlying factors that can amplify the effect of the so-called direct factors. These include macroeconomic and institutional factors.

We note a mixed effect of GDP growth per capita on forest cover loss for the basic model (Tables 1.1 and 1.2). This result is consistent with several theoretical and empirical studies and is relative to the level of a given country's development. According to Crespo Cuaresma et al. (2017), "theory predicts that economic growth in poor countries increases environmental depletion, but the effect disappears in developed economies". This may well illustrate the case of this study, even more so since all the countries in the sample are still in the first phase of development. Similarly, Kuznets' environmental curve shows that in the first phase of a country's economic development, the level of pollutant emissions is low because production is low, but subsequently, there will be an increase in pollution due to industrialization, which imposes significant pressure on the environment. The increase in the per capita income levels in countries rich in extractive resources could therefore be explained by industrial development, which is a source of deforestation. Population growth has a mixed effect on deforestation. This seems to support the idea of forest destruction caused by the expansion of agricultural land to meet people's food needs. Ehrlich and Holdren (1971) argue that environmental degradation is positively correlated with population size. The ecological footprint is sensitive to the population size since it decreases the bio-capacity. The net development assistance received (ODA) contributes to reducing the loss of forest cover in developing countries. Therefore, the average rainfall shocks contribute to accelerating the deforestation process in developing countries. Previous empirical studies such as Kirby et al. (2006) suggest that roads, high population densities, low annual rainfall, and long

dry seasons also increase the likelihood that a site will be deforested.

1.4.3 The effects of the basic models (economic rents and tax revenue)

Economic rents, according to our theoretical model, affect the forest cover directly or indirectly. The results in Table 1.1 show that economic rents have a positive impact on the loss of forest cover and are significantly different from zero. This reinforces the results of Combes et al. (2018), i.e., that mining rents positively impact deforestation. Our results are in line with the intuition that extractive industries are invasive and can, therefore, destroy forest areas. Considering Table 1.2, when economic rent increases by one percentage point, then deforestation increases by 0.13% to 0.34% (columns 6 and 2). This measures the overall effect of economic rents on deforestation. The positive impact suggests a complementarity between total economic rent and natural capital in resource-rich developing countries.

Table 1.2 shows that government revenue has a negative and significantly nonzero impact on deforestation. It can be interpreted that a one-percentage-point increase in government revenue from extractive industries is linked to a decrease in deforestation of 0.43% to 0.56% (columns 5 and 4). If we control for the presence of internal conflict, the effect remains negative but not significant. The result seems controversial in relation to Combes et al. (2018), who found that public spending increases the forest cover loss. However, our results are in line with the objective of the World Bank in terms of domestic resource mobilization to meet the needs of populations while protecting the environment. Similarly, the time horizon of our data coincides with the implementation of the Extractive Industries Transparency Initiative (EITI) in 2003. This initiative includes almost all the countries in our sample. Lopez et al. (2011) draw attention to the effect of the composition of tax expenditure on the environment and argue that a reallocation of the composition of public expenditure towards public and social goods reduces pollution.

Table 1.1 : Estimated impact of the total extractive rents on deforestation

Dependent variable : log forest loss						
	(1)	(2)	(3)	(4)	(5)	(6)
Log forest loss (-1)	0.712***	0.611***	0.625***	0.534***	0.557***	0.628***
	(0.0554)	(0.0710)	(0.0688)	(0.0775)	(0.0827)	(0.0809)
Log total rents	0.225***	0.342***	0.328***	0.328***	0.299*	0.133**
	(0.0767)	(0.123)	(0.126)	(0.124)	(0.153)	(0.0529)
GDP per capita growth		-0.161***	-0.157***	-0.148***	-0.141***	0.0657*
		(0.0420)	(0.0417)	(0.0414)	(0.0415)	(0.0346)
Population growth			-0.148**	-0.174*	-0.124	0.293*
			(0.0753)	(0.0934)	(0.0863)	(0.153)
Log rainfall shocks				0.0126***	0.0124***	0.0099***
				(0.00297)	(0.00313)	(0.00289)
Log NET ODA per capita					-0.285***	-0.331***
					(0.0962)	(0.121)
Log internal conflict						0.302
						(0.594)
Constant	3.028***	4.643***	4.715***	4.511***	5.111***	3.212**
	(0.596)	(0.843)	(0.852)	(0.812)	(0.960)	(1.423)
Nb. of observations	748	747	747	747	715	582
Hansen (p-value)	0.067	0.872	0.798	0.881	0.423	0.932
AR (1) p-value	0.000	0.042	0.047	0.039	0.034	0.078
AR (2) p-value	0.849	0.854	0.767	0.82	0.264	0.125
Nb. of instruments	5	7	8	9	10	11
Countries	49	49	49	49	48	39

Robust standard errors in parentheses. * p <0.10, ** p <0.05, *** p <0.01. GMM-System - Generalized method of moment's estimator with country-fixed effects for the study period 2001-2017. Delayed forest loss is a predetermined endogenous variable ; rents are contemporaneously endogenous ; population growth, GDP per capita growth rate, Net ODA per capita, internal conflict, and average rainfall are assumed to be weakly exogenous.

Table 1.2 : Estimated impact of government revenues from extractive industries on deforestation

Dependent variable : log forest loss						
	(1)	(2)	(3)	(4)	(5)	(6)
Log forest loss (-1)	0.723***	0.707***	0.673***	0.558***	0.615***	0.588***
	(0.0823)	(0.0992)	(0.103)	(0.117)	(0.135)	(0.0856)
Gov. res-revenues	-0.0481***	-0.0459**	-0.0499***	-0.0565***	-0.0431**	-0.0222
	(0.0178)	(0.0204)	(0.0186)	(0.0180)	(0.0190)	(0.0197)
GDP per capita growth		-0.00407	-0.00364	-0.00971	-0.0150	-0.00560
		(0.0122)	(0.00840)	(0.0151)	(0.0206)	(0.00910)
Population growth			0.312*	0.0714	0.0775	0.268
			(0.182)	(0.265)	(0.285)	(0.253)
Log rainfall shocks				0.00920**	0.00774**	0.011***
				(0.00382)	(0.00382)	(0.00278)
Log NET ODA per capita					-0.0844	-0.141**
					(0.132)	(0.0704)
Log internal conflict						-0.0519
						(1.194)
Constant	3.820***	4.070***	3.857***	4.842***	4.485***	4.081*
	(1.171)	(1.385)	(1.367)	(1.585)	(1.637)	(2.426)
Nb. of observations	301	301	301	301	292	259
Hansen (p-value)	0.137	0.114	0.221	0.256	0.18	0.541
AR (1) p-value	0.001	0.002	0.002	0.002	0.003	0.009
AR (2) p-value	0.706	0.691	0.674	0.626	0.319	0.341
Nb. of instruments	6	7	8	9	12	17
Countries	25	25	25	25	25	23

Robust standard errors in parentheses. * p <0.10, ** p <0.05, *** p <0.01. GMM-System - Generalized Method of Moment's estimator with country-fixed effects for the study period 2001-2017. Delayed forest loss is a predetermined endogenous variable ; res-revenues are contemporaneously endogenous ; population growth, GDP per capita growth rate, NET ODA per capita, internal conflict, and average rainfall are assumed to be weakly exogenous.

1.5 Robustness check

1.5.1 Sensitivity related to the composition of the total extractive rents.

We estimate individually the effect of each type of extractive rent on deforestation. The results show that mineral rents and gas rents have positive and significant impacts on deforestation (Table 1.3 and Table A1(in appendix)). However, oil rents have a negative impact on deforestation (Table A2 (in appendix)). This effect could be explained by the size of oil rents compared to mineral rents and gas rents. Additionally, the government share of revenue for an oil project is higher than that of other extractive projects. According to Baunsgaard and Sunley (2001), the extractive industries' tax regime predicts that oil regimes are higher than mining regimes, and anticipates higher profits for the former. This effect may be caused by the fact that oil projects require less surface area than mining projects. All other things being equal, we can argue that even oil rents contribute significantly to reducing forest cover loss. The robustness estimation shows that our theoretical predictions are not affected by a problem of multicollinearity. We also note that when considering only mining rents, growth in GDP per capita contributes significantly to forest cover loss. In contrast, for the individual oil and gas rent specifications, growth in GDP per capita contributes to a reduction in forest cover loss. This would imply that, unlike the oil and gas industries, income growth based on mining is detrimental to forest cover. The same is true for the effects of population growth. The effects of ODA and climate shocks remain unchanged.

Table 1.3 : The effects of mineral industry rents on forest cover loss

Dependent variable : log forest loss	(1)	(2)	(3)	(4)	(5)	(6)
Log Forest loss (-1)	0.661***	0.692***	0.690***	0.601***	0.602***	0.628***
	(0.0652)	(0.0814)	(0.0822)	(0.0848)	(0.0784)	(0.0809)
Log mineral rents	0.204***	0.137***	0.135***	0.150***	0.200***	0.133**
	(0.0401)	(0.0455)	(0.0454)	(0.0419)	(0.0495)	(0.0529)
GDP per capita growth		0.0396*	0.0398*	0.0563*	0.0292	0.0657*
		(0.0213)	(0.0217)	(0.0292)	(0.0430)	(0.0346)
Population growth			0.00725	0.0472	0.0407	0.293*
			(0.112)	(0.113)	(0.0931)	(0.153)
Log Rainfall shocks				0.0102***	0.0110***	0.0099***
				(0.00358)	(0.00292)	(0.00289)
Log NET ODA per capita					-0.338***	-0.331***
					(0.115)	(0.121)
Log Internal Conflict						0.302
						(0.594)
Constant	4.108***	3.582***	3.584***	3.487***	4.658***	3.212**
	(0.766)	(0.932)	(0.983)	(0.757)	(1.112)	(1.423)
Nb. of observations	671	671	671	671	647	533
Hansen (p-value)	0.568	0.14	0.138	0.106	0.379	0.439
AR (1) p-value	0.00	0.00	0.00	0.00	0.00	0.00
AR (2) p-value	0.698	0.522	0.518	0.518	0.969	0.887
Nb. of instruments	6	11	12	13	12	13
Countries	46	46	46	46	45	36

Robust standard errors in parentheses. * p <0.10, ** p <0.05, *** p <0.01. GMM-System - Generalized method of moment's estimator with country fixed effects for the study period 2001-2017. Delayed forest loss is a predetermined endogenous variable ; Rents are contemporaneously endogenous ; population growth, GDP/capita growthrate, ODA/capita, Internal Conflict, and average rainfall are assumed to be weakly exogenous.

1.5.2 Sensitivity related to the composition of public expenditure.

Table 1.4 shows that gross fixed capital formation (GFCF), final consumption, and household expenses have positive and significant impacts on deforestation. Following Combes et al. (2018), these results further confirm the hypothesis of complementarity between artificial and natural capital. However, the resource revenues to GFCF ratio and military expenditure contribute to reducing deforestation. This confirms the hypothesis of substitutability between artificial and natural capital. The government resource revenues to final consumption ratio are found to be insignificant. Although military expenditures do not have a direct impact on deforestation, their negative im-

pact can be explained by the decrease in the volume of expenditures related to deforestation. The negative impact of the resource revenues to GFCF ratio confirms that government revenue from extractive industries takes into account the negative impact of the extractive sector on forest cover. In other words, the share of resource revenues in capital investments fosters forest conservation.

1.6 Discussion

This chapter revisits the links between extractive industries and natural capital in developing countries. Certainly, many aspects of natural capital (such as biodiversity, clean air, land, and water) can be influenced by the extractive industries. However, this article focuses on the aspect relating to forest losses. Our main assumption was that the access to extractive industry rents could have non-homogenous impacts on forest cover, according to the type of rent. This assumption is confirmed by the results of the empirical analysis. First, the total economic rents from extractive industries significantly increase deforestation, confirming a situation of complementarity between rents and natural capital (forest cover). Second, the indirect effect of rents on deforestation shows that the increase in government resources tax revenue reduces deforestation, thus reflecting substitutability between the share of government rents (artificial capital) and deforestation (natural capital). Third, mineral rents and gas rents contribute significantly to accelerating forest cover loss, unlike oil rents, which have contributed significantly to reducing forest cover loss. Previous studies such as Gifford et al. (2010) indicate that about 70% of gold mining comes from developing countries, where the consequences related to environmental damage are often greater for the sustainability of local communities. Ranjan (2019) shows that mining contributed to deforestation in 314 districts of India in 2001-2014. However, districts not producing any of the main minerals had 350 km² less of forest loss.

A discussion could be held on the net effect of extractive industries on deforestation according to the type of rent and because of the non-homogeneity assumption. In other words, a negative effect suggests that the impact of rents in favor of forest gains outweighs the damage they cause in terms of forest losses, and vice versa. First, the extractive industries require the oc-

Table 1.4 : The effects of the composition of public spending on forest cover loss

Dependent variable : log forest loss (ha)						
	(1)	(2)	(3)	(4)	(5)	(6)
Log forest loss (-1)	0.537***	0.683***	0.503***	0.618***	0.479***	0.553***
	(0.0832)	(0.122)	(0.111)	(0.140)	(0.0953)	(0.122)
GDP per capita growth	0.158***	-0.00538	0.000372	-0.0100*	0.104**	-0.112***
	(0.0581)	(0.0576)	(0.0199)	(0.00563)	(0.0525)	(0.0321)
Population growth	0.252*	0.236	0.202	0.231	0.424**	-0.0839
	(0.143)	(0.170)	(0.146)	(0.230)	(0.189)	(0.184)
Log rainfall shocks	0.0123***	0.00853***	0.0129***	0.0115***	0.0155***	0.0091***
	(0.00294)	(0.00330)	(0.00360)	(0.00288)	(0.00444)	(0.00314)
Log NET ODA per capita	-0.230*	-0.0811	-0.0546	-0.0673	0.162	-0.277**
	(0.137)	(0.0688)	(0.127)	(0.131)	(0.211)	(0.118)
Log internal conflict	1.358*	0.0247	0.893	0.881	1.722	-0.199
	(0.764)	(0.912)	(1.031)	(1.070)	(1.112)	(0.793)
Log GFCF	0.266***					
	(0.0872)					
Gov. res-revenue/GFCF		-0.466**				
		(0.232)				
Log Consum.			0.400***			
			(0.117)			
Gov. res-revenue/Consum.				-1.195		
				(1.225)		
Log household expenses					0.760***	
					(0.285)	
Military expenditure						-0.351***
						(0.113)
Constant	-5.969*	2.885	-6.383**	1.546	-18.89**	6.799**
	(3.063)	(1.881)	(3.164)	(1.371)	(8.647)	(2.773)
Nb. of observations	594	255	589	234	522	572
Hansen (p-value)	0.501	0.259	0.148	0.199	0.227	0.213
AR (1) p-value	0.026	0.014	0.00	0.01	0.00	0.001
AR (2) p-value	0.338	0.284	0.898	0.425	0.356	0.230
Nb. of instruments	11	13	13	14	11	13
Countries	41	23	41	21	39	41

Robust standard errors in parentheses. * p <0.10, ** p <0.05, *** p <0.01. GMM-System - Generalized method of moment's estimator with country fixed effects with study period 2001-2017. Delayed forest loss is a predetermined endogenous ; res-revenue is contemporaneously endogenous ; population, consumption, GFCF, household expenses, military expenditure, GDP/capita growth rate, NET ODA/capita, internal conflict, and average rainfall are assumed to be weakly exogenous.

cupation of large areas for local installation and infrastructure such as hydroelectric plants, railways, and roads that lead to deforestation. Kirby et al. (2006) also found that road development is a key driver of the deforestation process. The relocation of local communities to new housing sites, and the

development of new agricultural fields leave significant environmental footprints. Second, economic rents can contribute to accelerating deforestation if the government's share of rents (i.e., resource taxes, fees, and shareholder participation) is funded to deforestation-related activities such as extensive agriculture and infrastructure. By contrast, economic rents can contribute to mitigating deforestation if the government's share of rents is used to fund non-deforestation-related activities. Compliance with environmental legislation and the inclusion of social, environmental, and economic concerns in the management systems of companies would compensate for the damage caused and contribute to forest restoration. For example, the Grande Carajàs mine required the creation of some 800,000 hectares of protected areas and indigenous reserves to partially compensate for the damage it caused (Humphreys Bebbington et al., 2018). Barbier (2011) addresses the funding challenge of bridging the shortfall between the global benefits that humanity receives from ecosystems and what it is willing to pay to maintain and conserve them.

Finally, we find that government revenue from extractive industries contributes to mitigating forest cover loss. Thus, the positive effect of mineral rents and natural gas rents on deforestation shows that the mechanisms of compensation for damages caused are not effective. This may be the result of ineffective tax systems, the under-valuation of environmental damage in tax regimes, or the reallocation by governments of part of the rehabilitation funds intended for deforestation-related activities. For example, the tax regime predicts that oil regimes are higher and anticipate higher profits than mining regimes (Baunsgaard and Sunley, 2001). The economic theory had historically ignored the reality of the role of natural capital in the production process. Its full value is not well recognized in political trade-offs and economic choices, despite its fundamental importance for well-being. At the microeconomic level, market prices do not reflect the full costs and benefits of a product, and at the macroeconomic level, environmental values are not reflected in national accounts (European Environment Agency, 2015).

Furthermore, the theoretical model indicates that the cost of access to natural capital is higher when property rights are safe and well defined. We use internal conflict to approach the influence of institutions and the management of property rights on deforestation. Our results show an ambiguous effect of internal conflict on deforestation. Larcom et al. (2016) found

that internal conflict might generate higher or lower levels of deforestation. The poor social and environmental conditions brought about by the Grande Carajàs project on the rural population have led to social conflict (Humphreys Bebbington et al., 2018). Given the stakeholders in the extractive industries (central government, local communities, companies), this could be close to Vincent and Elinor Ostrom's concept of polycentric governance, which includes the notions of "commons" and "natural resource systems" (Carlisle and Gruby, 2019) and "socio-ecological system" (Folke et al., 2005). The polycentric governance concept connotes a complex system of governance with multiple semiautonomous decision-making centers. In the case of extractive industries, the final decision to implement the mining projects rests with the central government, based on the profitability of a given project, the socio-economic and environmental damage that may be faced by local communities, and an equitable share of the revenue.

This study is limited to the aspect related to the loss of forest cover, although it is certain that several other natural capital factors are also affected in one way or another by the exploitation of extractive industries. In the spirit of complementing this study, future research should address the extinction of plant and animal species, air and water pollution, and the health of local communities. To simplify this study, we include only a few control variables that could influence forest cover, based on validated econometric tests. However, several other variables not included in our specifications also contribute significantly to changes in forest cover. Finally, the impacts of institutional factors, such as governance, transparency, and property rights, have not been the subject of consistent analysis.

1.7 Concluding remarks

This chapter contributes to the empirical literature on the relationship between extractive industries and deforestation, the source of the "curse of natural resources". The analysis focuses on the direct and indirect effects of economic rents on forest cover loss with a focus on comparing these effects according to the nature of the rents and the composition in terms of investment expenditure and final consumption. Previous studies have mainly analyzed the relationship between resource dependence and capital accumulation, with little attention paid to resource funds, which should be an

effective tool for such accumulation, particularly in oil-producing countries. To our knowledge, this study is the first to present a rigorous econometric analysis comparing the effect of extractive rents on forest cover loss. Our results suggest that access to extractive industry rents has non-homogenous impacts on forest cover in resource-rich countries, according to the type of rent.

Our results can be interpreted as indicating a "polluter pays" situation, where part of the natural resource benefits is obligatorily earmarked to compensate for forest encroachment by extractive industries. If this is the case for mineral and gas rents, since they significantly contribute to damaging forest cover, the share of revenues destined for compensation (e.g., area taxes) must be at least equal to the marginal damage. It is, therefore, necessary to strengthen tax regimes to obtain an equitable share of economic rents in order to improve forest protection. Public spending should target as much economic activity as possible in order to generate the least adverse environmental impacts. Companies and governments must ensure that exploitation by extractive industries results in real and positive social, economic, and environmental gains for affected communities, as also suggested by the Extractive Industries Transparency Initiative (EITI) standard (https://eiti.org/document/eiti-standard-2019).

Chapitre 2

Does Transparency Matter ? The Impact of EITI on Deforestation in RRDC

Abstract :[1] Exploiting extractive industries poses a serious environmental threat. However, exploiting extractive industries through an equitable and transparent resource tax regime can also finance alternative livelihoods that can prevent forest loss in the short, medium, or long term. Through two main channels, this chapter assesses the "treatment effect" of implementing the Extractive Industries Transparency Initiative (EITI) standard on deforestation in resource-rich developing countries. The first concerns a fair and transparent resource tax regime and environmental payments that can prevent forest loss. The second consists of improving citizens' institutions and living standards through increased government revenue. This study is the first to provide an empirical impact assessment of EITI standards on deforestation. Using a sample of 83 resource-rich developing countries from 2001–2017, we use entropy balancing methods to address the self-selection bias associated with EITI membership. Compared with the non-EITI country, the results show that implementing the EITI standard significantly reduces the loss of forest cover by approximately 300–760 ha. Additionally, the magnitudes of the effects are larger and more significant if we include institutional indicators that are more important for EITI-compliant countries. This result supports the conclusion that EITI, but not a panacea, is an effective policy program for limiting the negative impacts on forests partly caused by extractive industries. This study provides clear guidance to both the EITI Board and the EITI National Committees, and more generally, to the governments of extractive resource-rich developing countries on the vital role of the EITI in combating forest cover loss and sustainable development finance.

Keywords : Extractive Industries (oil, mineral, and gas) ; Transparency ; Taxation ; Deforestation. **JEL Classification codes :** C33 ; H23 ; Q32 ; Q5 ; H5

[1] This chapter was written with Noel Thiombiano, and a version is published in *World Development*

2.1 Introduction

Cop 26 in Glasgow was marked by the strong commitment of world leaders to halt and reverse global deforestation over the next decade by tackling human-caused greenhouse gas emissions. Among the human causes of environmental degradation, mining and onshore oil and gas extraction are serious and very specific threats. The extractive industries and their associated infrastructure are among the main causes of greenhouse gas emissions, forest landscape reduction, and threats to the rights of forest communities in forested areas (Bebbington et al., 2018a,b; Bebbington and Unerman, 2018). They rank as the fourth most crucial driver worldwide after industrial logging, agricultural expansion, and forest fires (Potapov et al., 2017) and are responsible for about 7% of total forest loss in Africa, Latin America, and Asia (Hosonuma et al., 2012). Kinda and Thiombiano (2021) show that extractive industries activity affects forest landscapes at multiple spatial scales (site, local, and regional) either through a direct link (i.e., linked to the extraction activity) and/or an indirect link (public and private investment via associated infrastructure such as roads, power facilities, hydroelectric dams).

While the direct footprint on forests can occur during all exploitation phases (exploration, exploitation, mineral processing, and closure), surface mining is the dominant form of land-based exploitation today and is particularly damaging to forests (Hirons, 2013). Thus, mining activities consume space and contribute directly to deforestation (Kinda and Thiombiano, 2021). Most research is directed at the impacts of these activities at the emergent site level and directly due to habitat degradation (Sonter et al., 2018). Impacts on biodiversity also occur across landscapes and regions. Research at this scale has focused on direct chemical and physical (i.e., dust and aerosols) impacts released from mining wastes; chemical emissions, including mercury or cyanide, are used to extract ores Sader et al. (1994), and acids are released from oxidized minerals when some ores are exposed to the air. In addition to the direct impact, mining can also induce deforestation in the surrounding area (Sonter et al., 2017). This is because the development of associated infrastructure requires the direct clearing of forests and opens up forest areas to new settlers and immigrants, who bring farming, logging, and hunting activities that further impact the forests Finer et al. (2008); Laurance et al. (2009).

Indirect effects may also include infrastructure induced by mining, urbanization, and toxic release (Bridge, 2004). In aggregate terms, infrastructure appears to be a more significant driver of forest loss than mining or hydrocarbon extraction, but in practice, the two sectors are better understood as existing in a synergistic relationship (Sonter et al., 2018). Furthermore, the expansion of investment in extractive industries affecting forested areas is driven by a combination of overlapping economic and political incentives. While resource extraction and infrastructure have been associated with growth, they have also been implicated in developmental underperformance (Ross, 2012). This paradox is widely known as the 'natural resource curse.' This paradox has several economic reasons (see, Matsuyama, 1992; Sachs and Warner, 1995b, 2001; van der Ploeg and Venables, 2013). However, the economic channel linked to the volatility of commodities prices could have more important environmental costs, especially for the forestry sector. Indeed, in resource-rich countries, the main source of public revenue is often the extractive sector. However, fossil fuel prices can fluctuate considerably, undermining the ability of governments to manage their energy rents effectively. The macroeconomic instability resulting from volatile natural resource prices can discourage investment. The great irony is that governments are attempting to expand natural resource extraction to boost the economy by relaxing land laws and encouraging mining and commercial agriculture (Bebbington et al., 2018b), thus creating the conditions for accelerated deforestation.

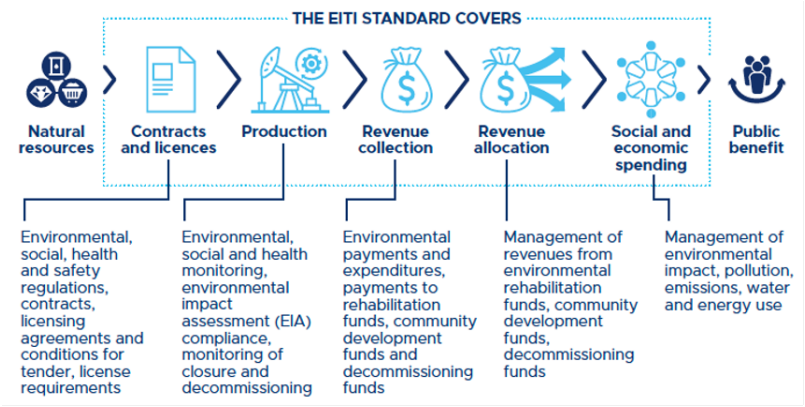
Furthermore, Other studies have found evidence that other macroeconomic factors are correlated with deforestation. These factors include the role of the real exchange rate (Arcand et al., 2008), agricultural activity, access to capital, public policies (Benhin and Barbier, 2004; Combes Motel et al., 2009), population (Cropper and Griffiths, 1994), timber harvesting (Damette and Delacote, 2011), and the impact of plantations on forests (Heilmayr, 2014). For example, Kahn and McDonald (1995) describe a significant positive association between public debt and deforestation in LDCs and defend debt relief to reduce pressure on deforestation (Hansen, 1989). Several countries, such as Indonesia, have recently engaged in debt-for-nature swaps to prevent future deforestation (Cassimon et al., 2011). As for the political transmission channels of the resource curse, many economists, such as Sachs and Warner (2001) and Hodler (2006), argue that in some countries, the windfall of

natural resource revenues increases the power of elites, which have the capacity to increase income inequality. Elites or powerful groups capture a large part of these revenues and distribute them for the benefit of their immediate entourage rather than investing them in sustainable economic development. This undermines political, institutional, and social stability (see, Collier and Hoeffler, 2004; Davis and Tilton, 2005; Sala-i Martin and Subramanian, 2013). Bebbington et al. (2018a) point out that corruption accelerates extractive industry expansion and is sometimes a direct driver. Extraction and infrastructure offer vast opportunities for corruption and illegal behavior involving significant private capture of resource rents, which induces additional pressure that weakens forest protection. The payments are used to obtain concessions, environmental approvals, exemption from environmental review, tax exemption, police and military security services, and other favors, all of which reduce what would otherwise be the actual costs of the projects under the procedures defined by law. In this case, some entrepreneurs obtain land more cheaply and can spread their activities over large areas while neglecting their social and environmental responsibilities. Several authors have established a positive link between political instability, weak democracy, and poor forest governance (see Bhattarai and Hammig, 2001; Deacon, 1994; Didia, 1997; Duval and Wolff, 2009). The expected public revenues from resource extraction and the growth effects of infrastructure investments are undoubtedly a driver of policies that facilitate such investments and, perhaps more importantly, a driver of the legitimization of such policies (Bebbington et al., 2018b)

Created in 2003 at the instigation of the NGO "Publish What You Pay," the Extractive Industries Transparency Initiative (EITI) is internationally recognized as a leading anti-corruption scheme that promotes transparency, accountability, and good governance of public oil, gas, and mining revenues. This chapter is motivated by the negative direct and indirect environmental impacts of extractive industries' investment (Kinda and Thiombiano, 2021) and by the challenges faced by resource-rich developing countries to generate adequate revenues to finance sustainable development. Because of the environmental damage caused by the extractive industries, EITI-implementing countries are increasingly covering taxes, levies, and other environmental payments in EITI reporting. Indeed, requirement 6.1 of the EITI standard requires that mandatory social expenditures and significant

environmental payments be disclosed and reconciled to the extent possible. Thus, the EITI reinforces a scrutiny mechanism in favor of applying the polluter-pays principle. Based on EITI requirement 6.4, Figure 2.1 shows that the environmental issue is integrated throughout the Natural Resource governance decision chain. Implementing countries are encouraged to disclose information on the management and monitoring of the environmental impact of the extractive industries. Stakeholders must assess the adequacy of the regulatory framework and monitoring efforts to manage extractive industries' environmental impact and assess extractive companies' adherence to environmental obligations.

Figure 2.1 : Environmental reporting across the value chain



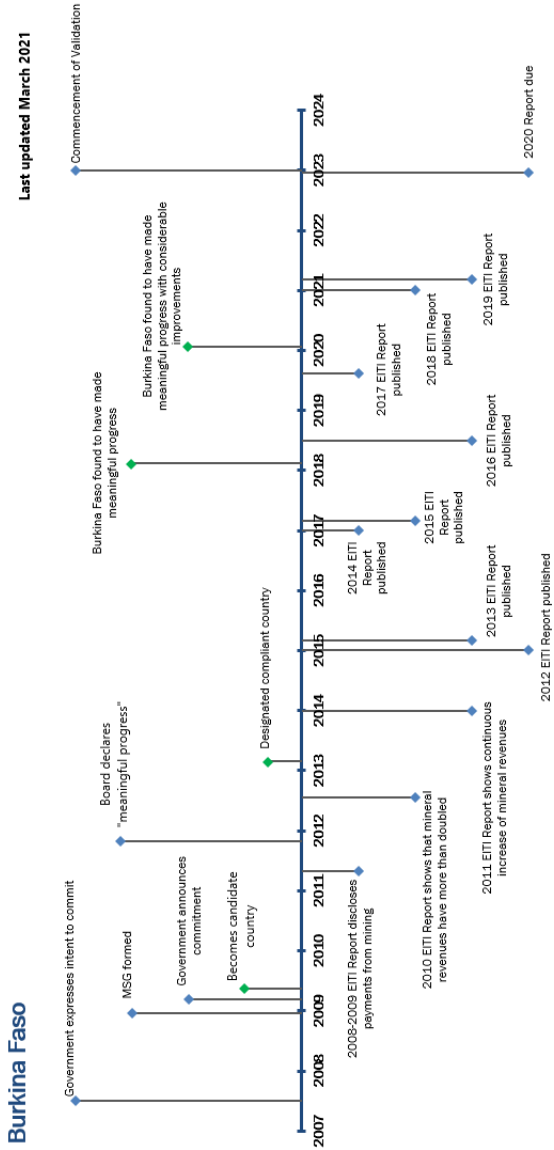
Based on the EITI standards, the EITI implementation process consists of three main steps : Commitment, Candidate, and Compliance. First, the government commits to joining the EITI and implementing the EITI standard. Following the announcement of the commitment, government, companies, and civil society must jointly commit to establishing both a national EITI secretariat and a multi-stakeholder group (MSG) to oversee the implementation process. The MSG requires all stakeholders' independent, active, and effective participation. Thus, the MSG adopts a cost work plan in line with the reporting and validation deadlines of the EITI Board. This work plan sets out the country's objectives and priorities for implementing the EITI. This step takes time and allows the effects of accession to be examined before being accepted as a candidate country. Thus, this demonstrates the coun-

try's intention and implies its willingness to change transparency policies and accommodate the requirements of EITI membership. After the requirements of Commitment Status, the government must submit a request to the EITI Board to become a candidate country. The country becomes an EITI Candidate if the Board considers that all conditions for membership have been met. The EITI Candidate countries must publish a first EITI Report within 18 months to achieve the status of EITI compliant. It must also submit the final report for approval by the Board of Directors and the MSG's support within two years and a half. Candidate countries that have not been able to comply with the requirements of the validation process and have not submitted their final validation report by the deadline then risk suspension. The suspension can also take place if the country is undergoing political instability. This situation was the case for the Central African Republic in 2013 and Madagascar in 2011. After compliance, the country must submit a validation report every three years as requested by the Board. Non-compliance with the latter obligation may also result in the suspension of the concerned nation. Figure 2.2 presents the illustrative case of the EITI implementation timeline in Burkina Faso. For instance, the Government intended to join the EITI in July 2007. In December 2008, the multi-stakeholder group (MSG) was formed, and the country became a candidate in May 2009[2]. In April 2011, Burkina Faso published its first EITI Report disclosing payments from the mining sector to the government in 2008 and 2009. In July 2012, the 2010 EITI report published shows that mineral revenues had more than doubled. With the recommendations of the validation Committee, the EITI Board designated Burkina Faso as an EITI-compliant country as of February 2013. In accordance with EITI standards, the country is required to publish annually on the previous year's activities, detailing progress in implementing the EITI and any recommendations from the validator.

This chapter aims to provide the first rigorous quantitative investigation of the EITI's impact on environmental protection and, more specifically, on deforestation in developing countries. We test two hypotheses : (i) the "extractive industries" that implement a fair and transparent resource tax re-

[2]In this chapter, we consider the date of application as the primary processing indicator, as this is the date that countries begin to implement the EITI Standard. After this date, it becomes a formality for the country to publish its EITI report annually, strictly following the requirements of the EITI standard.

FIGURE 2.2 : Timeline of EITI Implementation



gime and environmental payments can prevent forest loss, and (ii) EITI reduces deforestation by improving the quality of institutions and improving the living standard of citizens using the increase in government revenues from EITI implementation of a better tax regime and better environmental regulation.

The study uses a case-comparison approach, namely the propensity score matching (PSM) and entropy balancing methods to address the self-selection bias associated with EITI membership. We find that the implementation of EITI encourages a significant decrease in annual deforestation in developing countries.

This chapter contributes to the literature in several ways. First, this study sheds new light on the literature on the role of the EITI in environmental protection. It provides material on which the national committees of EITI member countries, the EITI Board, and the financial institutions that support its operations could draw to strengthen environmental preservation and site rehabilitation measures. Second, to the best of our knowledge, this study is the first to assess the environmental impact of the EITI empirically and rigorously address the self-selection problem. We use the entropy balancing method, which allows us to consider the factors that motivated countries to implement the EITI standard. In addition, the distinction of the three main stages of the EITI implementation process, namely engagement, application, and compliance, is crucial to assess the reach of the initiative. We control for time and country fixed effects, sensitivity to time since EITI implementation and other governance indicators. The main results support the conclusion that the EITI, while not a panacea, is nevertheless an effective policy program for limiting the negative impacts on forests partly caused by extractive industries.

The rest of the chapter is organized as follows : the next section 2.2 investigates the effectiveness of EITI in combating deforestation. In section 2.3, the data and empirical model are discussed. Section 2.4 presents and discusses the results, and section2.5 checks robustness. Finally, Section 2.6 concludes and gives policy implications.

2.2 Investigating the effectiveness of EITI as a scrutiny mechanism

The extractive industries play a central social and political role in at least 80 countries, accounting for a quarter of the GDP. However, these deposits often involve geopolitical contestation, they often generate conflict (and even regional or civil wars), and, above all, they can have considerable environmental and sustainable development impacts (Jennane and Mbarek, 2020). This unfortunate correlation between natural wealth, weak institutions, and environmental costs led to the Extractive Industries Transparency Initiative (EITI). The EITI was first introduced in 2002 by British Prime Minister Tony Blair at the World Summit on Sustainable Development in Johannesburg. With 56 members, the EITI makes public, voluntarily, the payments (royalties, taxes, bonuses, etc.) made by extractive companies on the one hand and the sums collected by public bodies on the other. Once seen as the exclusive domain of the state and ruling elites, the EITI has helped establish civil society's legitimacy to intervene in the governance of natural resources, aiming for a positive impact on people and the environment. The EITI emphasizes "that enhanced transparency of natural resource revenues helps reduce corruption, and that revenues from extractive industries can transform economies, reduce poverty, and improve people's living standards in resource-rich countries" while preserving the environment (EITI Association Constitution, Art.2.2).

Consideration of the forestry sector in the EITI standard also responds to the urgent need to improve public revenue collection. Indeed, despite legal and institutional provisions, the forestry sector is not spared from corruption. Public access to information on the revenues generated by the extractive industries represents a real opportunity to monitor the management of a sector that has long been considered opaque. Increased transparency should also help identify solutions to current challenges in forest governance. Following requirement 6.4 of the EITI standard, relating to the disclosure of information on the management and monitoring of the environmental impact of extractive industries, state institutions or entities are involved in the ecological management of extractive activities. For example, in the case of Senegal, the Ministry of the Environment is responsible for implementing the policies adopted by Senegal in terms of environmental monitoring, pol-

lution control, and the protection of nature, fauna, and flora (EITI, 2021). The Extractive Industries Transparency Initiative (EITI) "is a global standard for the good governance of oil, gas, and mineral resources. It seeks to address key governance issues in the extractive sectors. Thus, work analyzing the impact of democracy on deforestation has highlighted three important factors : *(i)* informal politics, *(ii)* property rights regimes (e.g., property risk), and *(iii)* political institutions that include both informal politics and property rights regimes (e.g., the rule of law and political stability) and power inequalities. From political institutions, Villar (2021) finds corruption scores have improved significantly among EITI member countries. The evidence is strongest by examining a sub-group of EITI members designated as fully compliant with the initiative's transparency standards. While some studies established a positive link between weak institutions and poor forest governance (see, Bhattarai and Hammig, 2001; Deacon, 1994; Didia, 1997; Duval and Wolff, 2009; Kishor and Belle, 2004; Mak Arvin and Lew, 2011). These are mainly the quality of the rule of law, political stability, the extent of political and civil rights, and power inequalities (Sader et al., 1994). However, extractive industries' exploitation can also finance alternative livelihoods that can prevent forest loss in the short, medium, or long term. Some studies suggest a trade-off between revenues from forest resources and access to alternative state funding sources. Mainardi (1998) showed in a case study that a high dependence on mineral exports allowed some countries, notably Gabon, to maintain a lower rate of deforestation during the 1980s compared to the least developed non-mineral countries. Therefore, EITI contributes to preserving the forest by improving the quality of institutions and increasing tax revenues (Kinda, 2021a), improving the investment climate (Sovacool, 2020), economic development (Corrigan, 2017a), and governance reform (Arond et al., 2019), mitigating corruption (Villar, 2021) and building accountability (Fenton Villar, 2020) in resource governance.

2.3 Data and empirical model

2.3.1 Data

We use a panel of 83 developing countries rich in extractive resources from 2001 to 2017. The main variables concerned are extractive rents (minerals, oils, and natural gas rents), EITI implementing status, and defores-

tation. The choice of this panel data sample is based primarily on our extractive resource dependence indicator and the availability of data on forest cover loss. Extractive-dependent countries are defined as countries that depend on minerals for at least 25% of their tangible exports (Haglund, 2011a). The sample includes 46 EITI countries (treated) and 37 non-EITI members (controls). Treatment variable. The variable of interest is a dummy of EITI implementation from the information available on the EITI website (Group, 2016). The EITI dummy takes the value *1* starting from the year that a country became an EITI member and 0 for the years that the government is not an EITI member. This study uses EITI commitment status as the primary treatment variable. But we also analyze the heterogeneity of the outcome concerning candidate and compliance status. As of January 2017, in the sample of 46 countries committed to implementing the EITI, 43 have achieved candidate status, and 24 have achieved compliance status (see Appendices A1 for the data sources & definitions of the different variables and A2 for the list of countries and their various stages of EITI implementation). Note that countries joined the EITI on different dates. Thus, countries that joined later may also constitute controls for countries that joined earlier. This implies that the number of EITI countries exceeding those of non-EITI countries is not a problem. Outcome variable. This study uses annual deforestation or forest cover loss (Forest Loss Year) from Hansen et al. (2013). It is available in the Global Forest Change dataset at Earth Engine as the outcome variable[3]. Following Kinda and Thiombiano (2021), the dataset is based on Landsat satellite images between 2000 and 2019 and is available at a spatial resolution of 20 meters. The "loss of forest cover" is the change from a forest to a non-forest state over time.

Conversely, "forest cover gain" reflects a complete shift from a non-forest to a forest state. The "forest loss year" disaggregates total forest loss at the annual scale. The dataset comes primarily from the University of Maryland and was recently published and made freely available by Hansen et al. (2013). This dataset remains a potentially valuable source of forest cover information, although it has been criticized for inaccuracies in distinguishing between forests and plantations at the local level (Tropek et al., 2014). This study considers any area with more than twenty percent trees in 2000 as a forest, thus excluding all areas with a lower percentage of trees. Controls

[3] http://earthenginepartners.appspot.com/science-2013-global-foreston

or matching variables. Lujala (2018) argues that examining factors influencing a country's decision to join and implement the Standard is crucial to understanding whether and how adherence to the EITI Standard can affect resource governance and development. We estimate the PS using a probit model with the binary variable EITI as the dependent variable. The aim is to measure the correlation of the control variables with the probability of implementing the EITI standard. The control variables are composed mainly of structural and institutional indicators. These factors are likely to explain the choice to implement EITI and tax revenues for a given country. Based on existing literature, our primary selection equation consists of three structural factors that can influence EITI implementation and revenue mobilization : internal motivation, internal capacities, and external pressure, such as development agencies and organizations (see, Lujala, 2018). We monitor the endogeneity of the following factors : the total f extractive rents in percent of GDP (oil, gas, mineral), GDP per capita growth, commodity prices, foreign direct investment (FDI), population density, climate shocks, industry value-added, forest rents, governance indicators such as control of corruption, government effectiveness, the rule of law, voice, and accountability, and political stability and non-violence. It is impossible to control for unobserved factors that may affect the likelihood of joining the EITI. However, the control variables allow us to consider some known sources of bias. These data come mainly from the datasets of World Development Indicators (WDI), the International Monetary Fund (IMF), and The World Governance Indicators (WGI). Resource rents measure the sustainability of extractive industries in the new millennium. As explained above, this variable represents the profit from the extraction of natural resources. It takes the form of economic rents since it is not produced. We use it because it captures the size of the extractive sector in the national economy in monetary terms. It thus depends on the operation's size, production volume, general price level, and many other institutional factors. We use the share of rents from extractive industries as a percentage of GDP (RENTS) and tax revenues from industries for the variables of interest. Specifically, we consider mining, oil, and natural gas rents (as a percentage of GDP). Data on total natural resource revenues, including natural resource revenues reported as "tax revenues" or "non-tax revenues" of a given government (Gov.Res-revenues to-GDP), are taken from the ICTD website. We test the effect of this variable on forest

cover. The objective is to determine if the use of this revenue accounts for the negative effects of extractive industries on forest cover. This variable affects the national economy significantly regarding investment spending and consumption. We expect a negative relationship between resource income and deforestation. Other variables that can influence deforestation are introduced as controls to allow us to obtain more robustness in our econometric results. We thus test the endogeneity of these variables in our model. From the current literature, we retain the following elements : GDP per capita growth captures the effect of national wealth on forest loss. Foster and Rosenzweig (2003) show that neither agricultural productivity nor wages have increased local forest cover. Depending on a country's level of development, the expected impact of GDP growth on deforestation may be mixed. Total population growth is a mid-year estimate of all country residents, regardless of legal status or citizenship. This variable can impact natural resource availability, habitat size, and agricultural holdings. An increase in population fuels the demand for arable land, fuelwood, and charcoal as increased basic needs such as food, energy, water, social services, and infrastructure can drive deforestation (Cropper and Griffiths, 1994). Foster and Rosenzweig (2003) find that the demand for forest products associated with population and income growth leads to forest growth. Therefore, the expected impact of population growth can be ambiguous. Internal conflict is one of the significant institutional shocks associated with extractive activities because of the infrastructure footprint on forests. An analysis exploring these issues in Mexico and Central America, the Brazilian and Western Amazon, and Indonesia indicates that resource extraction has induced more mobilization and protest from local communities than road, rail, or waterway construction projects (Bebbington et al., 2018b). We consider the internal conflict index to measure the influence of political institutions. It is an assessment of political violence in the country and its actual or potential impact on governance. A score of 4 points is equivalent to a shallow risk and 0 points to a very high risk. Internal conflicts can generate higher or lower levels of deforestation Larcom et al. (2016). Mean rainfall shock, which is defined as the deviation of mean annual rainfall from its long-term trend (mean rainfall from 1901 to 2016), is a data point extracted from the University of East Anglia's Climate Research Unit (CRU) database. This climate variable is thought to control the profitability of agriculture and the natural determinants of forest cover

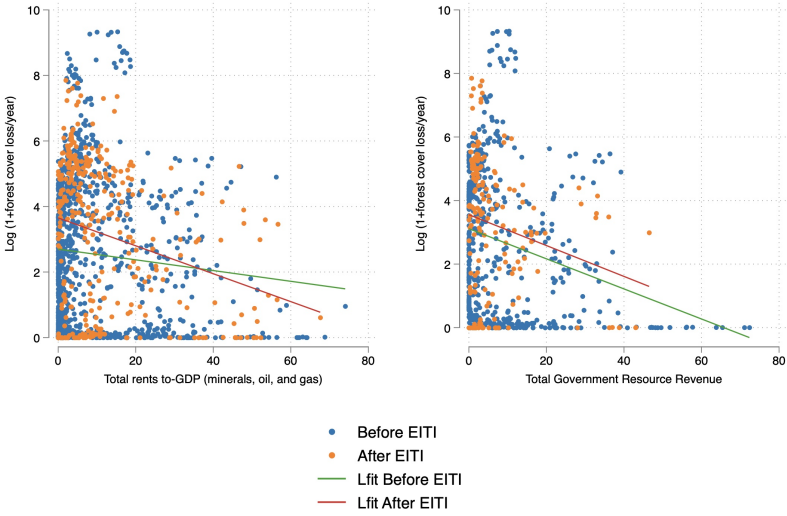
loss. Countries with low precipitation also tend to experience extreme temperatures. This can be detrimental to plants and lead to loss of forest cover. It should be noted that high climate variability may also lead policymakers to tighten environmental standards, reducing deforestation. Thus, an ambiguous effect of rainfall shocks on deforestation can be expected.

2.3.2 Descriptive statistics and stylized facts

Table B2 (Appendix) shows that the variables do not have the same number of observations, but we will consider this in our estimation. We notice that the dependent variable's standard deviation is very high compared to the explanatory variables. Figure 2.3 shows a negative relationship between total extractive rents (oil, mining, and gas rents), government resource revenues, and deforestation before and after EITI membership. Specifically for extraction rents, the slope of the adjustment line is steeper during the EITI period than the non-EITI period. This implies that implementing the EITI forces extractive companies to consider environmental damage in their production process and the rent-sharing system. For resource government revenues, the slopes of the adjustment lines remain slightly identical before and after EITI membership. This latter relationship is not surprising since the EITI so far has no particular requirement on the share of government revenues in green spending. But it is clear that with or without EITI, increased government revenues contribute significantly to reducing deforestation. This could be explained by the improvement in citizens' standard of living through increased public spending. Considering the types of rents individually, we can observe a negative relationship between oil and forest cover loss, which is more significant after EITI implementation. However, we also observe a positive relationship between mineral rents and forest cover loss before EITI and a negative relationship after EITI. Theoretically, this implies that compensation is small compared to the environmental damage caused by mining companies before EITI implementation. The mustache box diagram in Figure 2.4 visualizes the distribution of deforestation before and after EITI membership. The median deforestation decreases with the stages of EITI implementation (non-EITI, commitment, candidate, and compliance). Our statistical analysis suggests that EITI implementation reduces deforestation in resource-rich developing countries. Before concluding these results,

we conduct an econometric verification because the stylized representation of economic variables does not consider specific endogenous factors. Likewise, the periods before and after EITI are not necessarily comparable. We begin an analysis using propensity score matching on two more comparable groups in the following.

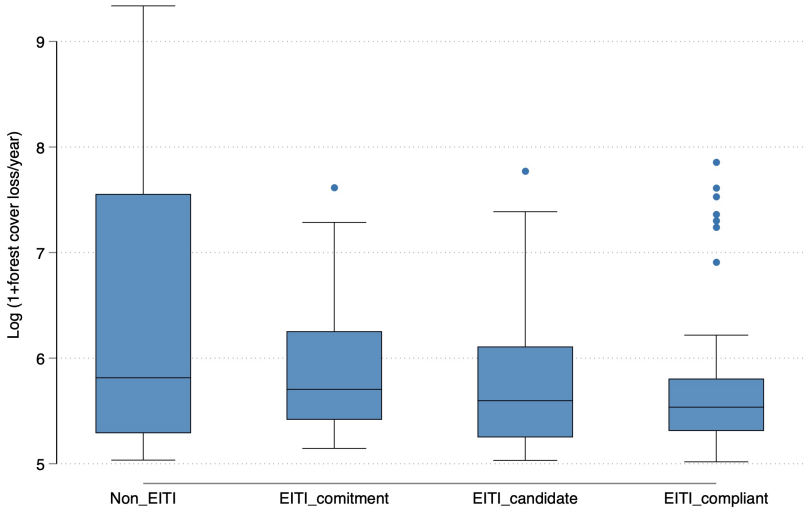
Figure 2.3 : Relationship between forest cover loss and total extractive rents



2.3.3 Empirical strategy : Entropy balancing

We primarily estimate the EITI treatment effect using the entropy balancing method developed by Hainmueller (2012a) and implemented by Neuenkirch and Neumeier (2016a). Entropy balancing consists of two main steps. The first requires the computation of weights assigned to the control units (non-EITI countries). In the second step, the weights obtained in the first step are used in a regression analysis with the treatment variable (EITI-countries) as the control variables. We then balance EITI countries and non-

Figure 2.4 : Distribution of forest cover loss by EITI implementation stage



EITI countries based on observable characteristics. Thus, the average difference in deforestation between EITI countries and the "closest" non-EITI countries should be explained by the EITI implementation. Entropy balancing has several advantages over other treatment effect estimators because it combines matching and regression analysis. It outperforms the classical regression-based approach and matching on the propensity scores methods, given that it is non-parametric (there are no concerns regarding misspecification of the model's functional form, which could bias the results). It also rules out multicollinearity issues as the reweighting mechanism makes the treatment variable orthogonal to the covariates.

Entropy balancing is more effective than other matching methods in balancing the treatment and control groups' covariates. For example, in propensity score matching methods, the control group comprises only a subset of the units not subject to treatment (Diamond and Sekhon, 2013a; Hainmueller, 2012a; Neuenkirch and Neumeier, 2016a). Each untreated unit re-

ceives a weight equal to *0* if it does not represent the best match for a treated unit or *1*if it represents the best match for one treated unit (Neuenkirch and Neumeier, 2016a). Thus, low covariate balance could bias the treatment effects estimates. However, in the case of entropy balancing, the vector of weights assigned to the units not exposed to treatment can contain any non-negative values. In this latter situation, the constructed control group adequately reflects the treated group. In sum, entropy balancing addresses the panel structure of our data by combining a reweighting scheme with regression analysis (Neuenkirch and Neumeier, 2016a). Controlling both countries- and time-fixed effects in the regression analysis is also possible. Including country-fixed effects helps account for potential unobserved heterogeneity across non-EITI and EITI countries. Indeed, EITI and non-EITI countries may differ (beyond the set of factors used to balance them) in their specific structural characteristics. Including country-fixed effects allows the accounting for country-specific time-invariant factors that explain differences in deforestation in developing countries. Our analysis is based on the idea that the EITI implementation represents a treatment and forest cover loss is the outcome variable. The units of analysis are country-year observations. The observations with EITI implementation in place comprise the treatment group, and observations without EITI implementation make up a potential control group. Our outcome is the so-called average treatment effect on the treated (ATT), which is defined as follows :

$$ATT = E[Y^1|EITI = 1] - E[Y^0|EITI = 1] \tag{2.1}$$

, where *Y* is the outcome variable measuring the forest cover loss. EITI indicates whether the observation unit is subject to EITI membership (EITI=1) or not (EITI=0). $E[Y^0|EITI = 1]$ is the level of forest loss that would have occurred for country *i* if country *i* had not adhered to the EITI standard, and $E[Y^1|EITI = 1]$ is the level of forest loss observed for country *i*. The issue is that $[Y^0|EITI = 1]$ is not observable due to the non-random nature of EITI adoption. If this were the case, the ATT could easily be identified by comparing deforestation in EITI countries with non-EITI countries. Identifying ATT then requires a good proxy for $[Y^0|EITI = 1]$. To do so, we match EITI units with non-EITI units that are as close as possible on observable characteristics that meet two criteria : correlated with EITI adoption and deforestation. Under the condition that the non-EITI units are fairly

close to the EITI units, any difference in deforestation is attributable to EITI adoption. Based on these different elements, we can rewrite Eq. (2.1) as follows :

$$ATT = E[Y^1|EITI = 1, X = x] - E[Y^0|EITI = 1, X = x] \quad (2.2)$$

, where X=x is a vector of observable covariates that may affect both the decision to adopt EITI and the deforestation, is the deforestation of EITI units, and $E[Y^1|EITI = 1, X = x]$ is the expected EITI for the synthetic control units. Estimating the ATT by entropy balancing involves two steps. The first is to compute weights for the control group. These weights may satisfy pre-specified balanced constraints involving sample moments of observable characteristics (X). Following (Neuenkirch & Neumeier, 2016), we choose balance constraints that impose equal covariates means between the treatment and control groups. In doing so, we want to ensure that the control group, on average, has non-treatment units that are as similar as possible to the treated units[4]. The second uses the weights from the first step in a regression analysis where deforestation is the dependent variable. In the second step, we control for the covariates employed in the first step. This is equivalent to including control variables in a randomized experiment and increases estimation efficiency. In addition, time- and country-specific effects are included in the second step to respectively account for time-specific effects such as country-specific heterogeneity arising from, for instance, differences with regard to control of corruption and the rule of law. Moreover, unlike other matching methods, entropy balancing ensures a high degree of covariate balance between the treatment and control groups, even in the case of small sample sizes. With "conventional" matching methods such as, for example, nearest neighbor matching or propensity score matching, each treated unit, in the simplest case, is matched with the untreated unit closest to the metric balancing score. As a result, the control group consists only of a subset of the units that are not subject to the treatment (Diamond and Sekhon, 2013a; Hainmueller, 2012a). In other words, with conventional matching methods, each untreated unit is given a weight equal to *0* in case it does not represent the best match for a treated unit or equal to *1*, in case

[4]This procedure ensures that once the weights are generated, EITI countries exhibit similar trends in their outcome variable over the pre-treatment period (see Ogrokhina & Rodriguez, 2019)

it represents the best match for a treated unit. However, when the number of untreated units is limited and the number of pre-treatment features is large, this procedure does not ensure a sufficient balance of pre-treatment features between the treatment and control groups. This is a serious problem, as poor covariate balance can lead to biased treatment effect estimates. In contrast, with entropy balancing, the vector of weights assigned to units not exposed to treatment can contain any non-negative value. Thus, a synthetic control group is designed to represent a virtually perfect image of the treatment group. Entropy balancing can thus be interpreted as a generalization of conventional matching approaches[5]. Furthermore, entropy balancing uses more flexible reweighting schemes compared to conventional matching, where control units are either eliminated or matched. It reweights units to achieve a balance between processed and unprocessed units while keeping the weights as close to the base weights as possible to avoid information loss. Despite the various advantages presented in this section, it is essential to note that this approach may have some limitations. Indeed, entropy balancing may fail to control for potential endogeneity biases resulting from unobserved temporal factors that may affect both EITI and deforestation, as well as the reverse causality problem that may exist between the treatment variable and the outcome variable on the one hand and on the other hand, to deal with the inertia of deforestation successfully. To test the robustness of our findings, we supplement entropy balancing with alternative estimation methods such as propensity score matching (PSM).

2.4 Baseline results

The estimation of the baseline model using PSM is done in two steps. The first step is to estimate the propensity scores of EITI membership using a probit model, in our case, across a set of observables. The second step is to estimate the average treatment effect on treaties (ATT) of EITI membership on forest cover loss by matching treated units (EITI members) with non-treated units (non-EITI members).

[5]Hainmueller (2012a), using Monte Carlo simulations as well as empirical applications, demonstrates that entropy balancing outperforms other matching techniques, such as propensity score matching, and nearest neighbor matching, and genetic matching, in terms of estimation bias and mean square error.

2.4.1 Descriptive statistics and covariate balancing

In Table 2.1, we show the sample means and variance of all matching variables both for EITI) and non-EITI groups. The differences in means between these two groups are shown in columns "Diff ([2]-[1])". Given these descriptive statistics, selecting an adequate control group is crucial before estimating the treatment effect using the matching approach. Otherwise, the estimated treatment effect of EITI implementation on deforestation might be biased. After weighting, we remark that the differences in means and variance between the treatment and synthetic control groups are statistically insignificant. In other words, the difference in the two groups' means is insignificant after the weighting. Entropy balancing allows for obtaining a perfect control group for our treated units.

Table 2.1 : Descriptive statistics and Covariate balancing

	Before weighting								
	EITI Commitment			EITI Candidacy			EITI Compliance		
	Treat [1]	Control [2]	Diff. [2]-[1]	Treat [1]	Control [2]	Diff. [2]-[1]	Treat [1]	Control [2]	Diff. [2]-[1]
Total_extactive rents	10.04	9.247	-0.79	10.27	9.247	-1.02	11.85	9.192	-2.66
Forest_rents	4.546	2.497	-2.05	4.385	2.497	-1.89	4.006	3.1	-0.91
GDP growth	5.005	4.514	-0.49	4.964	4.514	-0.45	5.15	4.619	-0.53
Internal Conflict	8.473	8.778	0.31	8.434	8.778	0.34	8.227	8.735	0.51
Commodity	99.67	98.11	-1.56	99.75	98.11	-1.64	98.98	98.61	-0.37
Av. Precipitation	109.7	92.58	-17.12	107.1	92.58	-14.52	91.62	99.54	7.92
FDI	6.223	3.416	-2.81	6.833	3.416	-3.42	5.925	4.179	-1.75
Population density	66.38	72.13	5.75	65.98	72.13	6.15	63.45	71.07	7.62
Industry_value added	27.59	31.5	3.91	27.79	31.5	3.71	28.87	30.32	1.45
Rule of law	-0.7048	-0.5695	0.14	-0.6956	-0.5695	0.13	-0.3483	-0.4936	-0.15
N. Obs.	342	637	-	277	637	-	122	857	-
	After weighting								
	EITI Commitment			EITI Candidacy			EITI Compliance		
	Treat [1]	Control [2]	Diff. [2]-[1]	Treat [1]	Control [2]	Diff. [2]-[1]	Treat [1]	Control [2]	Diff. [2]-[1]
Total_extactive rents	10.04	10.04	0.00	10.27	10.27	0.00	11.85	11.85	0.00
Forest_rents	4.546	4.546	0.00	4.385	4.385	0.00	4.006	4.005	0.00
GDP growth	5.005	5.005	0.00	4.964	4.964	0.00	5.15	5.15	0.00
Internal Conflict	8.473	8.473	0.00	8.434	8.434	0.00	8.227	8.227	0.00
Commodity	99.67	99.67	0.00	99.75	99.75	0.00	98.98	98.97	-0.01
Av. Precipitation	109.7	109.7	0.00	107.1	107.1	0.00	91.62	91.62	0.00
FDI	6.223	6.222	0.00	6.833	6.833	0.00	5.925	5.925	0.00
Population density	66.38	66.38	0.00	65.98	65.98	0.00	63.45	63.45	0.00
Industry_value added	27.59	27.59	0.00	27.79	27.79	0.00	28.87	28.88	0.01
Rule of law	-0.7047	-0.7047	0.00	-0.6956	-0.6956	0.00	-0.3483	-0.3484	0.00
N. Obs.	342	342	-	277	227	-	122	122	-

Notes : This Table presents the sample means matching covariates after weighting across the treated group and the synthetic control group obtained from entropy balancing in columns [2]-[1] according to each stage of EITI implementation.

2.4.2 Results from entropy balancing

Based on the synthetic control group from Table 2.1, we estimate the impact of EITI implementation on deforestation (forest cover loss) using weighted least square regressions. We provide ten sets of treatment effect estimates based on different treatment indicators, with and without the controls, according to the stages of EITI implementation (Commitment, Candidacy, and Compliance). In our primary approach, considering the year of commitment as the beginning of treatment, the control group comprises non-EITI countries. Considering the year of candidacy as the beginning of treatment, the control group comprises non-EITI countries and countries with only committed status. With the compliance year as the start of treatment, the control group comprises non-EITI countries and countries with commitment and/or candidate status. In our sample of EITI countries, there is an average two-year gap between commitment to the EITI and achieving candidate country status. This would explain the smaller effect when considering the EITI candidacy date as the start of treatment, keeping the commitment observations in the pre-treatment periods. The countries that EITI candidates and EITI compliant countries have essentially the same characteristics. This would explain the less pronounced effect when considering the date of EITI compliance as the start of treatment and keeping the commitment and candidacy observations in the pre-treatment periods. Table 2.2 presents results for a baseline model assessing the impact of EITI implementation on deforestation, using a binary variable taking the value *1* if EITI is implemented and *0* otherwise. The results indicate that deforestation is less important in EITI countries compared to non-EITI countries. For each level of treatment, we first estimate without covariates (columns [1-3-5-7-9]) and then with covariates (columns [2-4-6-8-10]) in the specification. The results show that EITI commitment, candidacy, and compliance significantly reduce deforestation. The estimated ATTs remain robust with the inclusion of covariates. With covariates, the Average Treatment Effect on Treated (ATT) is about -337 ha if treatment is started in the EITI commitment year, about -400 ha if treatment is started in the candidacy year, and about 640 if treatment is started in the compliance year. We note that if we consider the treatment at the candidacy and compliance dates by removing the observations from the previous steps (i.e., the period corresponding to the commitment on the one hand, and the other hand, the two periods corresponding to the commitment and

the candidacy, respectively), the ATTs are more important for commitment than for candidacy (see columns [5-6] and [9-10] compared to columns [3-4] and [7-8]). These results suggest that the effects of the different implementation steps add up to each other. In other words, the forest cover loss is less important in EITI-committed countries than in non-committed ones, higher in EITI candidate countries than in "only" committed countries, and higher in EITI compliant countries than in "only" candidate countries. Our results are robust and like those of the PSM method.

Table 2.2 : Impact of EITI membership on forest cover loss

Dep. Variable : Forest loss year (ha)	EITI_commitment		EITI_candidate				EITI_compliant			
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
EITI (Baseline ATT)	-352.7***	-337.1***	-333.8***	-313.7***	-426.9***	-398.9***	-332.3***	-334.3***	-690.2***	-639.5***
	(113.6)	(109.2)	(120.5)	(116.0)	(145.7)	(140.4)	(124.1)	(121.5)	(246.3)	(235.1)
N.Obs.	1,037	1,037	1,037	1,037	972	972	1,037	1,037	817	817
R-squared	0.032	0.073	0.028	0.068	0.038	0.078	0.020	0.063	0.049	0.093
Including Covariates	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Including Commitment period Obs.	Yes	Yes	0*	0*	No*	No*	0*	0*	No	No*
Including Candidate period Obs.	Yes	Yes	Yes	yes	Yes	Yes	0*	0*	No	No*
Including Compliance period Obs.	Yes	Yes	Yes	yes	Yes	Yes	Yes	Yes	yes	Yes
Country-fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1 ; 0* indicates that we keep the observations of the said period (commitment and/or candidate) in the pre-EITI adoption period. No* indicates that we delete the observations of the period prior to the considered EITI implementation stage.

Table 2.3 : Impact of EITI membership on forest cover loss

Dep. Variable : Forest loss year (ha)	EITI_commitment		EITI_candidate				EITI_compliant			
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
Inc. Control corruption (ATT)	-401.9***	-382.5***	-387.7***	-368.6***	-486.4***	-457.4***	-365.1***	-365.9***	-761.7***	-713.2***
	(131.1)	(123.7)	(139.8)	(133.9)	(167.2)	(158.6)	(135.0)	(132.8)	(272.7)	(258.0)
N.Obs.	979	979	979	979	914	914	979	979	759	759
R-squared	0.037	0.085	0.032	0.081	0.043	0.093	0.021	0.069	0.054	0.113
Including Covariates	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Including Commitment period Obs.	Yes	Yes	0*	0*	No*	No*	0*	0*	No	No*
Including Candidate period Obs.	Yes	Yes	Yes	yes	Yes	Yes	0*	0*	No	No*
Including Compliance period Obs.	Yes	Yes	Yes	yes	Yes	Yes	Yes	Yes	yes	Yes
Country-fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1 ; 0* indicates that we keep the observations of the said period (commitment and/or candidate) in the pre-EITI adoption period. No* indicates that we delete the observations of the period prior to the considered EITI implementation stage.

Table 2.4 : Impact of EITI membership on forest cover loss

Dep. Variable : Forest loss year (ha)	EITI_commitment		EITI_candidate				EITI_compliant			
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
Inc. Rule of Law (ATT)	-378.6***	-360.3***	-361.0***	-342.0***	-458.2***	-431.1***	-331.1***	-330.5***	-690.0***	-640.5***
	(123.3)	(117.8)	(131.3)	(127.1)	(158.2)	(152.2)	(121.5)	(119.3)	(244.0)	(231.5)
N.Obs.	979	979	979	979	914	914	979	979	759	759
R-squared	0.034	0.077	0.030	0.071	0.040	0.083	0.020	0.064	0.049	0.098
Including Covariates	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Including Commitment period Obs.	Yes	Yes	0*	0*	No*	No*	0*	0*	No	No*
Including Candidate period Obs.	Yes	Yes	Yes	yes	Yes	Yes	0*	0*	No	No*
Including Compliance period Obs.	Yes	Yes	Yes	yes	Yes	Yes	Yes	Yes	yes	Yes
Country-fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1 ; 0* indicates that we keep the observations of the said period (commitment and/or candidate) in the pre-EITI adoption period. No* indicates that we delete the observations of the period prior to the considered EITI implementation stage.

2.5 Robustness check by propensity score matching (PSM)

We use the propensity score matching (PSM) method to estimate the effect of EITI implementation on forest cover loss. This corrects for selection bias related to the choice of implementation of the standard for some countries. The PSM method compares EITI and non-EITI countries with similar observed characteristics so that the difference in the value of the outcome variables between the two groups can be attributed to the effect of EITI membership. In other words, to determine treatment effects, it is essential that before the experimental treatment is implemented, the two groups are as comparable as possible. The first assumption necessary to apply the PSM method is "conditional independence." It requires that conditional on the observables (X) not affected by the treatment, and the results are independent of the EITI implementation dummy variable. The equation for the estimated average treatment effect on treated individuals (ATT) is expressed as follows :

$$ATT = E[(Y^1 - Y^0)|EITI = 1] = E[Y^1|EITI = 1] - E[Y^0|EITI = 1] \quad (2.3)$$

, where EITI is the dummy variable for EITI implementation and Y is the outcome indicator (level of forest cover loss). $[Y^0|EITI = 1]$ is the level of forest loss that would have occurred for country *i*if it had not adhered to the EITI standard, and $[Y^1|EITI = 1]$ is the level of forest loss observed for country i. Equation (1) tells us that a simple comparison between the level of observed forest loss for the country *i* in the treatment group and the level of observed forest loss for the same country *i* if it had not joined EITI, would give an unbiased estimate of ATT. However, the main difficulty in estimating ATT is that the second term $E[Y^0|EITI = 1]$ is not observable. One cannot observe the level of forest loss of an EITI country if it had not joined EITI. This creates an identification problem, as is often the case in experimental studies. A commonly used approach to circumvent this difficulty is to compare the sample mean of the treatment group (EITI) with that of the control group (non-EITI) if and only if the country's choice of EITI implementation is random. This method will produce biased estimates if the decision to implement EITI is not random. However, implementing the EITI may not be random, as the choices of whether to implement EITI may be correlated with a set of observables that also affect the level of forest loss. This will lead

to the problem of "selection on observables," which makes traditional linear regression an unreliable method (see, Dehejia and Wahba, 2002a; Heckman et al., 1998a).

Matching on propensity scores.

To determine treatment effects, it is essential that before the experimental treatment is implemented, the two groups of countries (EITI and non-EITI) are as comparable as possible. The key assumption necessary to apply the matching method is "conditional independence" $(Y^0, Y^1 \perp EITI|X)$. It requires that conditional on the observables (X) not affected by the treatment, and the results are independent of the EITI implementation dummy variable. The researcher must account for all factors influencing the treatment and outcomes. Under this assumption, the original equation (2.3) can be rewritten as follows :

$$ATT = E[Y_i^1|EITI = 1, X_i] - E[Y_i^0|EITI = 0, X_i] \tag{2.4}$$

, where we replaced $E[Y_i^0|EITI_i = 1, X_i]$ with $E[Y_i^0|EITI_i = 0, X_i]$ which is observable. The PSM method would involve matching the treated units with control units with similar values of X. As the number of covariates in X increases, matching on X will be difficult to implement in practice. To overcome this important problem, we follow Rosenbaum and Rubin (1983), who propose to match treated and control units on their propensity scores. The propensity score (PS) is the probability of adhering to the EITI, conditional on the observable covariates *(X)*, and can be estimated using simple probit or logit models.

$$p(X_i) = E[EITI_i|X_i] = Pr(EITI_i = 1|X_i) \tag{2.5}$$

A second assumption necessary to apply propensity score matching is the "common support," i.e., the presence of some comparable control units for each unit treated (countries in our case). $p(X_i) < 1$, that is, the existence of some comparable control units for each unit treated (the countries in our case). This condition ensures that each country implementing the EITI standard will have a counterfactual in the non-EITI country group. The ATT estimation equation can now be as follows :

$$ATT = E[Y_i^1|EITI = 1, p(X_i)] - E[Y_i^0|EITI = 0, p(X_i)] \quad (2.6)$$

2.5.1 Estimating the Propensity score

Table 2.5 reports the probit estimates of propensity scores on the full sample, which includes only developing resource-rich countries, based on starting dates of EITI implementation (respectively, to the date of commitment and date of the candidate). Recall that EITI implementation is a binary variable. It takes the value one during the period that a given country implements EITI and 0 otherwise. Most of the coefficients are significant and have the expected signs for EITI commitment in light of the literature. Almost all explanatory variables are also significant for EITI candidates and EITI compliance. Total extractive rents, commodity prices, FDI, Population density, and the quality of governance are positively correlated with the likelihood of EITI implementation. However, GDP per capita growth, internal conflict, climate shocks, forest rents, and industry value-added are negatively associated with the likelihood of EITI implementation. After estimating the propensity score for the sample, it is essential to ensure that each EITI member has at least one non-EITI member with the same propensity score.

According to (Heckman et al., 1999a), the common support overlaps treated and untreated individuals on the set of propensity score values. It ensures that for each of the treated individuals, there is at least one individual in the control group with simulated observed characteristics (Bryson et al., 2002b). The two main techniques for determining common support are the comparison of minima and maxima between the two groups of individuals (Dehejia and Wahba, 1999a) and the comparison of trimming distributions (Dehejia, 2005). The first is to retain all treated and untreated individuals, except those with no counterfactual. The propensity score of the latter is lower than the minimum (respectively higher than the maximum) score of the individuals in the control group. A disadvantage of this method is that observations within limits will be discarded even if they are close to the limits. We use the second method, which estimates the distribution density in the two groups (trimming). We exclude the untreated individuals for whom the proportion of potential counterfactuals is lower, i.e., the treated individuals with

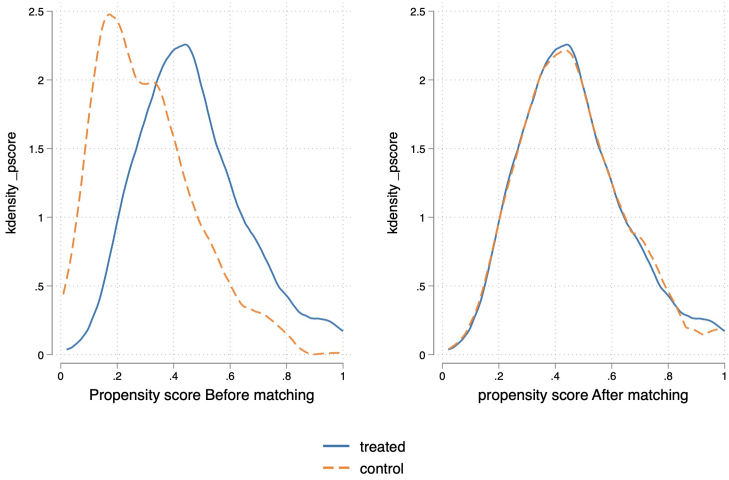
a propensity score very close to the propensity score of the untreated individuals under consideration. Figure 5 shows a fictitious situation in which the propensity score distribution supports the treatment group and the control group largely overlap, which is a good case for allowing matches. This indicates common support between EITI and non-EITI members and verifies the second assumption to apply propensity score matching.

Table 2.5 : Propensity score

VARIABLES	Treatment from 1rst year of commitment			Treatment from 1rst year of candidate		
	[1]	[2]	[3]	[4]	[5]	[6]
Total_extactive rents	0.0950***	0.0986***	0.106***	0.0728***	0.0940***	0.0840***
	(0.0228)	(0.0227)	(0.0229)	(0.0240)	(0.0262)	(0.0227)
GDP/capita growth	-0.0450**	-0.0367*	-0.0345*	-0.0503**	-0.0483**	-0.0283
	(0.0192)	(0.0188)	(0.0182)	(0.0206)	(0.0216)	(0.0190)
Internal Conflict	-0.0557	-0.0789	-0.104	-0.226**	-0.275***	-0.261***
	(0.0894)	(0.0871)	(0.0856)	(0.0965)	(0.101)	(0.0856)
Commodity prices	0.105***	0.102***	0.0935***	0.0994***	0.107***	0.0874***
	(0.0224)	(0.0224)	(0.0221)	(0.0212)	(0.0234)	(0.0201)
Climate shocks	-0.00687	-0.00913***	-0.00588*	-0.0165**	-0.0197***	-0.0122***
	(0.00434)	(0.00354)	(0.00331)	(0.00654)	(0.00525)	(0.00330)
FDI	0.0496***	0.0508***	0.0532***	0.0571***	0.0529***	0.0615***
	(0.0171)	(0.0166)	(0.0162)	(0.0168)	(0.0171)	(0.0157)
Forest_rents	-0.110*	-0.112*	-0.0891*	-0.190***	-0.131	-0.0852
	(0.0591)	(0.0581)	(0.0516)	(0.0730)	(0.0808)	(0.0626)
Population density	0.188***	0.123***	0.0960***	0.225***	0.257***	0.0971***
	(0.00781)	(0.00351)	(0.00344)	(0.0153)	(0.00863)	(0.00371)
Industry_value add	-0.0401	-0.0576**	-0.0593**	-0.0588**	-0.0905***	-0.0660***
	(0.0252)	(0.0258)	(0.0257)	(0.0279)	(0.0289)	(0.0241)
Control of corruption		0.966**			1.798***	
		(0.419)			(0.532)	
Rule of Law			1.615***			2.255***
			(0.474)			(0.484)
Constant	-28.00***	-21.62***	-15.78***	-25.98***	-23.99***	-12.98***
	(2.611)	(2.586)	(2.538)	(2.315)	(2.562)	(2.257)
N.Obs.	1,037	979	979	1,037	979	979
Countries	64	64	64	64	64	64

Standard erros in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Figure 2.5 : Common support before and after matching of treated and control units



2.5.2 Results from PS matching

Given the closeness of their propensity scores[6], we use four PSM algorithms commonly used in the literature to match each EITI member with non-EITI members. Table 2.6 reports the main results from matching, presented by the ATT (Average Treatment effect Treated). Recall that the treatment here consists of implementing the EITI. Considering that the treatment starts from the country's commitment or candidacy date, the control group includes non-ITIE countries. The first three columns show the results of n-Nearest neighbors matching (n-NNM), with n = 1,2,3 (LaLonde 1986). This technique is subject to the risk of inaccurate matching when the nearest neighbor is numerically distant. The following three columns show the

[6]While matching EITI members with non-EITI members, we limit the analyses to" common support." This restriction allows us to exclude treated countries whose propensity score is above the maximum or below the minimum of non-treaties. This is a sine qua non-condition to avoid structural confusion bias when estimating treatment effects with the propensity score (Dehejia and Wahba, 1999a; Lucotte, 2012a).

results of r-Radius matching (r-RM), which matches a treated unit to the control units with estimated propensity scores falling within a radius (or caliper) of length r (we consider a small radius r=0.005, a medium radius r=0.01, and a large radius r=0.05). In other words, each EITI member is associated only with a non-EITI member whose propensity score falls within a predefined neighborhood to that of the EITI member country (Dehejia and Wahba, 2002a). This approach has an advantage because it uses only the number of matching units available within a predefined radius. A possible drawback is that it is difficult to know a priori the reasonable radius. We also consider Kernel matching (KM), where a treated unit (EITI members) is matched to a weighted average of all control units (non-EITI members). All non-EITI members are used but weighted by their propensity score closeness to EITI members. Moreover, all control units contribute to the weights, so the variance is then reduced. The further the control unit is from the treated unit, the lower the weight (Dehejia and Wahba, 2002a). Finally, we consider the last column's regression-adjusted local linear matching (LLRM). This method developed by (Heckman et al., 1998a) is like kernel matching but includes a linear term in the weighting function instead of kernel. Each of these types of methods has advantages and disadvantages. A contrast between the most straightforward method (Nearest neighbors matching) and the most complex (Kernel matching) reflects the classic dilemma between bias and variance. In practice, it is recommended to test the sensitivity of the results according to the method used. We follow Dehejia and Wahba (2002a) and compute standard errors by bootstrapping because the matching estimator has no analytical variance. Tables 2.6, 2.7, and 2.8 indicate that the estimated ATT remains positive and statistically significant for all the matching algorithms. Regardless of the stage considered (commitment or candidate) or the date the country starts implementing EITI standards, we can notice a significant improvement in the estimated ATT. First, EITI-committed and EITI-candidate countries are more effective than non-EITI countries in reducing deforestation. According to our estimations, EITI members decrease deforestation by an average value ranging between around 300 to 600 ha compared to non-EITI members. Supposing that EITI implementation starts from the commitment date or the candidacy date, it turns out that the treatment effects are slightly identical. We also control the sensitivity of some indicators of governance, such as the control of corruption and the rule of

law. These variables alternately focus on governance in the natural resource sector (Kaufmann et al., 2010). The estimated ATTs are more significant by controlling control of corruption and the rule of law. Nevertheless, the analysis of the stylized facts suggested that the median of deforestation is less for a country at the candidate stage than at the commitment stage. Our results support the theoretical hypothesis and confirm stylized facts that EITI implementation has encouraged resource-rich developing countries to protect forest cover. In addition to the graphic evidence of common support, we also check the matching quality through the other three main diagnostic tests. First, the pseudo-R2 shows that our control variables significantly explain the probability of implementing the EITI, given that its values after matching are 'fairly low' (for instance, Caliendo and Kopeinig, 2008a; Sianesi, 2004a). Second, the diagnostic test based on the standardized bias evaluates the balancing score (see for instance, Caliendo and Kopeinig, 2008a; Lechner, 2001a; Sianesi, 2004a). According to Rosenbaum and Rubin (1985b), the p-value associated with the standardized bias should be above the critical value of 10%. The results satisfy the conditional independence assumption. This indicates no significant difference between EITI and non-EITI observable characteristics within the selected common support. Third, the Rosenbaum bounds sensitivity test shows whether unobserved variables simultaneously affect the treatment (EITI adoption) and the outcome variable (Rosenbaum, 2002a). The results suggest that there is no hidden bias[7].

[7]In order not to clutter the tables, we do not display the diagnostic tests of the control of governance indicators, but it should be noted that the results of the diagnostic tests are even better with the introduction of these indicators.

Table 2.6 : Impact of EITI membership on forest cover loss

Treatment : EITI Commitment date (EITI 1) Dependant var. : Forest loss (ha)								
	n-Nearest neighbors matching			r-Radius matching			KM	LLRM
	n=1	n=2	n=3	r=0.005	r=0.01	r=0.05		
[1] ATT basic	-267.0**	-315.4**	-261.4**	-256.5***	-268.4***	-281.0***	-274.3***	-271.6***
	(131.6)	(135.8)	(110.0)	(98.94)	(88.82)	(76.91)	(76.33)	(81.62)
N. Obs.	1037	1037	1037	1037	1037	1037	1037	1037
Treated/control	349/ 688	349/ 688	349/ 688	349/ 688	349/ 688	349/ 688	349/ 688	349/ 688
psedo R2	0.021	0.010	0.005	0.010	0.012	0.005	0.004	0.021
Standardized bias (p-value)	0.12	0.337	0.790	0.367	0.119	0.828	0.882	0.12
Rosenbaum sensitivity	1.1	1.1	1.1	2.2	3.1	4.3	4.3	5.1
[3] Control of corruption	-488.0***	-317.6**	-345.0***	-339.0***	-343.9***	-328.5***	-328.4***	-317.7***
	(160.9)	(139.0)	(130.6)	(125.0)	(102.6)	(92.91)	(90.92)	(87.87)
[5] Rule of Law	-425.6***	-387.8***	-328.2***	-342.0***	-299.2***	-313.7***	-308.7***	-312.4***
	(158.6)	(147.3)	(122.9)	(119.4)	(103.1)	(86.40)	(89.90)	(81.94)
N. Obs.	979	979	979	979	979	979	979	979

Standard errors in parentheses. * p <0.10, ** p <0.05, *** p <0.01 Bootstrap replications = 500. All the control variables estimating the propensity score are included beforehand, and then we use Governance Indicators estimate one by one to test their specific influence on the outcome.

Table 2.7 : Impact of EITI candidacy on forest cover loss

Treatment : EITI candidacy date (EITI 2) Dependant var. : Forest loss (ha)								
	n-Nearest neighbors matching			r-Radius matching			KM	LLRM
	n=1	n=2	n=3	r=0.005	r=0.01	r=0.05		
[1] ATT basic	-253.5*	-255.3*	-206.2*	-235.1**	-242.9***	-230.7***	-227.6***	-221.1***
	(149.7)	(131.5)	(123.0)	(104.1)	(86.47)	(75.81)	(73.66)	(70.90)
N. Obs.	1037	1037	1037	1037	1037	1037	1037	1037
Treated/control	287/ 750	287/ 750	287/ 750	287/ 750	287/ 750	287/ 750	287/ 750	287/ 750
psedo R2	0.009	0.006	0.008	0.010	0.010	0.007	0.008	0.009
Standardized bias (p-value)	0.559	0.789	0.634	0.526	0.512	0.714	0.669	0.559
Rosenbaum sensitivity	1.4	1.1	1.1	2.3	2.8	3.7	3.6	4.3
[2] Control of corruption	-341.4**	-457.9***	-373.0***	-306.1***	-272.6***	-269.2***	-267.2***	-252.8***
	(157.8)	(151.6)	(135.8)	(112.2)	(99.22)	(86.97)	(88.34)	(77.85)
[4] Rule of Law	-153.1	-204.5	-232.9*	-251.1**	-253.3**	-258.4***	-258.2***	-250.3***
	(165.4)	(147.9)	(127.2)	(114.9)	(99.03)	(82.83)	(86.21)	(83.08)
N.Obs.	979	979	979	979	979	979	979	979

Standard errors in parentheses. * p <0.10, ** p <0.05, *** p <0.01 Bootstrap replications = 500. All the control variables estimating the propensity score are included beforehand, and then we use Governance Indicators estimate one by one to test their specific influence on the outcome.

Table 2.8 : Impact of EITI candidacy on forest cover loss, excluding commitment times

Treatment : EITI candidacy date (EITI 2) Dependant var. : Forest loss (ha)								
	n-Nearest neighbors matching			r-Radius matching			KM	LLRM
	n=1	n=2	n=3	r=0.005	r=0.01	r=0.05		
[1] ATT basic	-338.2**	-293.9**	-228.4*	-248.8**	-251.7***	-261.7***	-257.4***	-257.8***
	(151.7)	(140.4)	(135.9)	(113.6)	(95.59)	(83.09)	(80.98)	(78.74)
N. Obs.	967	967	967	967	967	967	967	967
Treated/control	272/695	272/695	272/695	272/695	272/695	272/695	272/695	272/695
psedo R2	0.008	0.004	0.007	0.016	0.010	0.006	0.004	0.008
Standardized bias (p-value)	0.607	0.944	0.723	0.179	0.539	0.823	0.939	0.607
Rosenbaum sensitivity	1.1	1.1	1.1	2.3	2.7	4.1	3.9	5.1
[2] Control of corruption	-225.7	-423.1**	-342.7**	-342.3**	-326.3***	-309.5***	-309.1***	-305.2***
	(178.0)	(167.4)	(152.9)	(134.8)	(109.2)	(97.11)	(88.42)	(90.90)
[4] Rule of Law	-317.7*	-250.0	-226.0	-275.6**	-276.4**	-292.1***	-289.6***	-296.3***
	(173.3)	(152.4)	(143.9)	(124.2)	(108.6)	(94.39)	(91.08)	(93.65)
N.Obs.	909	909	909	909	909	909	909	909

Standard errors in parentheses. * p <0.10, ** p <0.05, *** p <0.01 Bootstrap replications = 500. All the control variables estimating the propensity score are included beforehand, and then we use Governance Indicators estimate one by one to test their specific influence on the outcome.

2.6 Conclusion

This study aimed to assess the environmental impacts of EITI implementation from a panel of 83 developing countries from 2001 to 2017. The intuition was that EITI implementation would boost the quality of governance in resource-rich countries and thus improve environmental policy and payments to prevent forest loss. Second, EITI reduces deforestation by improving the quality of institutions and improving the living standard of citizens because of the increased government revenues. Our empirical strategy focuses on the entropy balancing method. We highlight various matching algorithms, which allow us to control the self-selection of choice to implement EITI. We find that the ATT is negative and robust to EITI implementation stages. In other words, there is a significant difference between EITI members compared to non-EITI members in terms of reducing deforestation. All else being equal, EITI membership reduces deforestation by around 150 to 600 ha for a given country. In other words, EITI members are more effective than non-EITI members in reducing deforestation. The ATTs are more significant if EITI implementation starts from the candidacy date than the commitment date. Furthermore, ATTs are more significant if we account for governance indicators. Resource-rich countries could improve their environmental policy by implementing EITI according to the requirements. Most

importantly, the implementation of EITI reduces the environmental resource curse. Countries already implementing the EITI need to build good institutions. This study must guide the policymakers (EITI Board, EITI National Committees, and governments) on the vital role of the EITI in combating forest cover loss and financing sustainable development. Further studies would look at the management of property rights, the standard of living of forest communities, and the role that the EITI can play in green spending.

Chapitre 3

Does Transparency Pay? The Impact of EITI on Domestic Revenue Mobilization in RRDC

Abstract : This chapter assesses the "treatment effect" of the Extractive Industries Transparency Initiative (EITI) membership on tax revenues through two main channels. The first (direct effect) works through an equitable and transparent resource tax regime. The second is the indirect effect of EITI on non-resource revenue once transparency enhances accountability and resource allocation to productive expenditures. Using a sample of 83 resource-rich developing countries *(46 EITI and 37 non-EITI)* for the period 2001 to 2017, we use propensity score matching (PSM) and control function approach to address the self-selection bias associated with EITI membership (the dates of countries' commitment, candidacy, and compliance). Results show that EITI commitment or candidates significantly and positively affect tax revenue collection compared to non-EITI (on average, 1.06 to 1.20 percentage points). The EITI compliance generates a considerable surplus of tax revenues (on average 1.09 to 1.13 percentage points of GDP) compared to non-compliant *(using 24 compliant EITI-countries and 20 non-compliant EITI-countries)*. Besides, the magnitudes of the effects are more significant if we include governance indicators. The results are robust, with a significant increase in non-resource tax revenues, income tax, and resource tax revenue. The chapter reveals that EITI members have higher levels of tax revenue than non-members and that tax revenue is higher when countries are compliant with the initiative, even higher with quality of governance, and heterogeneous due to structural factors.

Keywords : Extractive Industries ; Governance ; Transparency ; Tax revenue mobilization.
JEL Classification : C33 ; E62 ; O19 ; H2 ; Q32

3.1 Introduction

The Addis Ababa conference on financing the Sustainable Development Goals (SDGs), held in mid-2015, placed particular emphasis on domestic tax revenue mobilization (DRM). Most governments in resource-rich developing countries struggle to mobilize substantial revenues because of a series of challenges. We note, for instance, aggressive tax planning by multinationals, weak enforcement of tax laws, overly generous tax incentives to attract foreign direct investment (FDI), ambiguous fiscal regimes (Knack, 2009), crowding out effect between Resource and Non-Resource revenues, the centrality of power. These challenges discourage establishing democratic and transparent institutions to combat corruption and misuse of public revenues (Robinson et al., 2006b).

The pioneering research (Sachs and Warner, 1995a, 2001; Van der Ploeg, 2011) suggest that the natural resources dependence hurts the economic performance of more resource-rich developing countries than lesser ones. This statement is generally known as the "resource curse." First, resource revenues hurt the traditional economic sectors by appreciating the exchange rate (often called "Dutch Disease"). Second, power is often centralized, leading regimes to authoritarianism, which hinders the establishment of democratic and transparent institutions. There is also talk of crowding out of NRTAX by resource revenues in several resource-rich developing countries (Bornhorst et al., 2009b; Crivelli and Gupta, 2014; Mawejje, 2019; Ndikumana and Abderrahim, 2010). The high natural resource rents allow governments to reduce the burden of taxation on citizens to reduce the demand for democratic accountability (McGuirk, 2013). As a result, disparate literature has focused on natural resources to understand the "resource curse" phenomenon and turn natural resource wealth into a source of economic development. These include definition and rent sharing[1], the macroeconomic effects of abundance and dependence on natural resources[2], and institutional impacts[3].

[1](Boadway and Keen, 2010; Charlet et al., 2013; Garnaut and Clunies-Ross, 1983; Laporte et al., 2022; Laporte and Rota-Graziosi, 2014; Ricardo, 1971)

[2](Benigno and Fornaro, 2014; Deacon and Rode, 2015; Gylfason et al., 1999; Gylfason and Zoega, 2006; Rose and Spiegel, 2009; Sachs and Warner, 2001; Tornell and Lane, 1999)

[3](Addison and Roe, 2018; Amiri et al., 2019; Arezki and Brückner, 2011; Badeeb et al., 2017; Berman et al., 2017; Bhattacharyya and Hodler, 2010; Brunnschweiler, 2008; Bulte et al., 2005; Collier and Hoeffler, 2009; Davis and Tilton, 2005; de Medeiros Costa and dos Santos, 2013; Desai and Jarvis, 2012; Eregha and Mesagan, 2016; Haber and Menaldo, 2011; Hodler, 2006; Knutsen

The Extractive Industries Transparency Initiative (EITI), created in 2003 at the instigation of the "Publish What You Pay" NGO, aims to promote better governance of natural resources and help address the challenges facing resource-rich developing countries' DRM collection. It is an initiative recognized as an international standard of good governance. Since then, 56 countries worldwide have implemented EITI. EITI requires extractive companies to publish all detailed payments in the government's accounts. Similarly, governments must publish all payments from extractive companies (oil, gas, and mining). Governments and companies disclose information on the main stages of the value chain : Multi-Stakeholder Group (MSG), Contracts and licenses, Exploration and production, Revenue collection, Social and economic spending, Outcomes, and impact (Corrigan, 2014; EITI, 2016). In addition to revenue collection, EITI promotes transparency and accountability in allocating resource revenues to public expenditure. Several international organizations (World Bank, International Monetary Fund, OECD) have endorsed the initiative and provided technical and financial support for implementing EITI. They aim to enhance transparency for better DRM and promote inclusive economic growth and social development in DCs (Liebenthal et al., 2005).

Generally, the EITI literature focused on the factors behind a country's joining the initiative (see Cockx and Francken, 2014; David-Barrett and Okamura, 2016; Kasekende et al., 2016; Lujala, 2018; Öge, 2016; Pitlik et al., 2010), the initiative impact on Gouvernance (Namely control of corruption, civil liberty and democracy) (see Ejiogu et al., 2019; Haufler, 2010; Magno and Gatmaytan, 2017; Papyrakis et al., 2017; Rustad et al., 2017; Sovacool and Andrews, 2015; Sovacool et al., 2016; Villar and Papyrakis, 2017), FDI flows (Sovacool and Andrews, 2015), and growth (Corrigan, 2014). A study close to ours is Mawejje (2019) which analyzes the link between natural rents and non-oil revenues using EITI membership as an interaction variable. This study focused on the linear regression model, therefore not rigorously taking into account the problem of self-selection. Lujala (2018) argues that all impact evaluations of the EITI on resource governance and societal development need to correct the selection biases in countries' decisions to commit to and implement the EITI standard. This chapter aims to provide relevant answers to the following questions : Do EITI membership improve tax revenues

et al., 2017; Kolstad and Wiig, 2009a; Papyrakis et al., 2017; Saha and Gounder, 2013; Tsui, 2011)

mobilization after controlling for self-selection ? Does the treatment effect vary with the status of EITI implementation (commitment, candidacy, and compliance) ? Is there heterogeneity in the treatment effect of EITI depending on countries' structural characteristics ? Therefore, this chapter aims to assess extractive industries' effects on tax revenue mobilization in developing countries. More specifically, we estimate the impact of EITI implementation on tax revenues compared to the situation of non-implementation. Our intuition is that EITI implementation would boost the quality of governance in resource-rich countries and improve tax revenue mobilization. We consider two main channels through which this effect occurs. The first channel is direct and works through an optimal and transparent resource tax regime ; this could improve the government's share of rents (resource revenue). The second channel is the indirect effect that EITI has on non-resource payments, as transparency enhances Accountability and resource allocation to productive expenditures ; this will have positive spillovers on government non-resource tax revenues. This study aligns with work on the effectiveness of the EITI in reducing the negative impacts of natural resources on economic development and the quality of governance (Corrigan, 2014, 2017b) and in improving tax revenue mobilization (Mawejje, 2019).

This impact assessment is motivated by the challenges faced by resource-rich developing countries to generate adequate revenues for sustainable development finance and the objective of rigorous evaluation of the EITI policy to reinforce its implementation activities. To the best of our knowledge, our study is the first study taking this self-selection problem rigorously while investigating the impact of implementing the EITI on domestic revenue. We use the propensity score matching method of Leuven and Sianesi (2018), which allows us to consider the determinants that motivated countries to implement the EITI standard. Secondly, our analysis is more comprehensive because it feels the three main stages of the EITI implementation process : commitment, candidature, and compliance. Thirdly, we consider the Total tax revenues as a dependent variable for our sensibility analysis, and then Non-resource Tax and income tax (including taxes on income, profits, and capital gains). Fourthly, we use a control function regression approach to analyze the heterogeneity of treatment effects on tax revenue mobilization based on structural factors of countries. We consider the country's temporal and fixed effects, the sensitivity of compliance with standards, and the time

elapsed since EITI implementation. The main results show that EITI implementation positively and significantly impacts tax revenue mobilization.

In the following steps of the chapter, Section 3.2 discusses the related literature, Section 3.3 presents data and highlights stylized facts, Section 3.4 describes the empirical strategy, Section 3.5 shows the main results, Section 3.6 explores the sources of heterogeneity in the treatment effects, and Section 3.7 concludes.

3.2 Literature review

3.2.1 The macroeconomic effects of natural resources and tax revenue mobilization

Natural resources have long been considered a strong pillar in economic development. The intuition is that countries rich in oil, gas, and minerals can generate significant revenues to improve their financial performance (see Rostow, 1961; Viner, 1952). However, the resource bonus seems to be a curse rather than a blessing (Auty and Warhurst, 1993; Auty, 1994; Auty and Auty, 1990; Sachs and Warner, 1995a). Causes often cited to explain the resource curse include Dutch disease, insufficient or inefficient investment (including human capital), lack of fiscal discipline, institutional decay, and macroeconomic instability (see Gylfason, 2001; Halland et al., 2015b).

In addition to other economic sectors, the tax capacity of resource-rich countries depends, on the one hand, on a fair tax regime for extractive industries that maximizes government revenue, and on the other hand, on the spillovers associated with the use of extractive resource revenues. Resource tax regimes can be evaluated quantitatively for their neutrality, revenue-raising potential, government risk (stability and timing of government revenue), effects on investor perceptions of risk, and adaptability and progressivity (Daniel and Goldsworthy, 2010). The progressivity reassures investors and guarantees the government a "fair" share of rent. This means that a tax regime will yield a rising present value of government revenue as the pre-tax rate of return on a project increases (Boadway and Keen, 2010). The rent sharing between the transnational company and the host country depends on the government's bargaining power and company operations (accounting, financial behavior, transfer pricing, and dividend repatriation). Besides, tax

competition between countries forces the implementation of incentives to attract capital. This is detrimental to tax revenues from traditional public economics and requires coordination or cooperation in tax matters. However, tax coordination is impossible under the assumption of a Nash equilibrium in the presence of tax competition (see, Rota-Graziosi, 2019).

Countries with enormous nonrenewable resources can reap substantial benefits, and many countries have done so. For example, industrialized countries such as Australia, Canada, and the United States have successfully transformed resource extraction into economic growth and development. Recently, other resource-rich countries, Botswana, Chile, Malaysia, and South Africa, have reached the highest income level (Halland et al., 2015b). However, the reliance on resource revenue poses challenges to policymakers, and governments must play an essential role in how resource revenues are used. Daniel et al. (2013) indicate that revenues from extractive industries would significantly finance productive spending with an effective fiscal policy. This condition the non-resource tax effort. Investments in immediately productive sectors would promote job creation and, consequently, expand the tax base and reduce resource dependence. According to Knebelmann (2017), the impact of oil revenue collection efforts on the taxation of the non-oil economy and investments in fiscal capacity (tax administration capacity) could contribute to a synergy between these taxes. Conversely, a reduction in control and incentives of taxing non-oil economies because of the resource revenue could lead to a crowding-out effect (Bornhorst et al., 2009a; Crivelli and Gupta, 2014; Mawejje, 2019; Ndikumana and Abderrahim, 2010).

Several empirical analyses of the effect of natural resources on non-resource revenues have led to controversial results. Bornhorst et al. (2009b) find that each additional percentage point of GDP in oil and gas revenues leads to a decline in non-oil and gas revenues of 0.23 percentage points across a sample of 30 oil countries over the period 1992-2005. Crivelli and Gupta (2014) find a reduction in domestic non-resource tax revenues of about 0.3 percentage points for each additional percentage point of GDP in resource revenues. Mohtadi et al. (2016) show a reduction in taxes on individuals of about 0.2 percentage points for each additional percentage point of GDP in resource revenues. Ossowski and Gonzáles (2012) find that the resource revenues/GDP negatively impact the non-resource taxes/non-resource GDP

on Latin American countries. Thomas and Trevino (2013) find that for every one percentage point increase in resource revenue as a proportion of GDP, non-resource revenue is lower by about 0.07 to 0.12 percent of GDP in sub-Saharan Africa. When they use GDP excluding resources, their results are not significant. However, Knebelmann (2017)'s replicas from ICTD data show that the results are sensitive to the change in the denominator (GDP by GDP excluding oil). Non-resource taxes as a percentage of total GDP seem to be biased. According to Crivelli and Gupta (2014), "if resource revenue-to-GDP increases due to a sharp increase in resource production, non-resource revenue may appear depressed relative to GDP simply because of the increased income and the coefficient estimates may be biased downwards." In contrast, Knebelmann (2017) uses gross tax revenues, i. e. not related to GDP, for a sample of 31 countries. This study concludes that oil revenues do not crowd out non-oil revenues through tax channels.

Besides, some research indexes institutional quality as the solution to reverse the "resource curse" or enhance resource blessing in resource-rich countries (see Collier and Hoeffler, 2005; Lujala et al., 2005). It is important to note that in resource-rich countries, the lower take up of non-resource taxes is correlated with higher levels of corruption in these countries, suggesting that weaker institutions affect non-resource revenue through incentives for tax evasion and overly generous tax incentives (Crivelli and Gupta, 2014). Also, natural resource abundance is the primary source of illicit financial flows (Ndikumana and Boyce, 2003). Kolstad (2009) and Mavrotas et al. (2011) show theoretical and empirical evidence that natural resources can be a blessing in countries with good institutions and a curse in bad institutions. Grigorian and Davoodi (2007) find that lower-country political risk is positively associated with the tax ratio in Romania.

Similarly, Bird et al. (2014) find that governance indicators (corruption, voice, and accountability) significantly affect tax revenues. Using a sample of 46 Sub-Saharan African countries, Botlhole et al. (2012) provide evidence that natural resources are only detrimental to tax revenue mobilization in the absence of good institutions. On the other hand, Eregha and Mesagan (2016) showed that institutional quality enhanced per-capita income growth in African countries. This is thereby questioning institutional quality in these countries that would not reverse the resource curse.

To sum up, the political economy of natural resources requires private

investment to discover and extract the resource, fiscal regimes to capture revenue, judicious spending and investment decisions, and policies to manage volatility and mitigate adverse impacts on the rest of the economy (Venables, 2016). Our analysis highlights the effects of EITI on tax revenues through the two channels mentioned above and by the spillover effects on the capacity of tax administration in general.

3.2.2 EITI Overview

Founded in 2002 at the initiative of "Publish What You Pay," an NGO, the EITI was formally launched in London in June 2003. It is a multi-stakeholder organization dedicated to promoting good management and governance of oil, gas, and mineral resources (EITI, 2016). The EITI standard has been applied in 56 countries (including 27 African countries). This standard requires extractive companies to publish all payments made in detail in government accounts. Governments must also post all payments received from extractive companies to curb corruption (Papyrakis et al., 2017). In other words, governments and companies disclose information on the main stages of the natural resource value chain, such as exploration activities, licenses and contracts, beneficial owners, production, revenue collection, and revenue use. Several international organizations (World Bank, International Monetary Fund, OECD) have endorsed the initiative and provided technical and financial support for implementing the EITI standard. Their objective is to enhance transparency for better domestic resource mobilization and promote inclusive growth and social development in developing countries (Liebenthal et al., 2005).

The EITI implementation process consists of three main steps : Commitment, Candidate, and Compliance. First, the government commits to joining the EITI and implementing the EITI standard. Following the announcement of the commitment, government, companies, and civil society must jointly commit to establishing both a national EITI secretariat and a multi-stakeholder group (MSG) to oversee the implementation process. The MSG requires all stakeholders' independent, active, and effective participation. Thus, the MSG adopts a cost work plan in line with the reporting and validation deadlines of the EITI Board. This work plan sets out the country's objectives and priorities for implementing the EITI (EITI, 2016). This step

takes time and allows the effects of accession to be examined before being accepted as a candidate country (Corrigan, 2014). Thus, this demonstrates the country's intention and implies its willingness to change transparency policies and accommodate the requirements of EITI membership.

After the requirements of Commitment Status, the government must submit a request to the EITI Board to become a candidate country. The country becomes an EITI Candidate if the Board considers that all conditions for membership have been met. The EITI Candidate countries must publish a first EITI Report within 18 months to achieve the status of EITI compliant. It must also submit the final report for approval by the Board of Directors and the MSG's support within two years and a half. Candidate countries that have not been able to comply with the requirements of the validation process and have not submitted their final validation report at the deadline risk a suspension (Anwar and Kannan, 2012). The break can also intervene if the country lives in a context of political instability. This situation is the case for the Central African Republic in 2013 and Madagascar in 2011. After compliance, the country must submit a validation report every three years as requested by the Board. Non-compliance with the latter obligation may also result in the suspension of the concerned nation. The ”resource curse” phenomenon is one of the main reasons for EITI creation. The "resource curse" phenomenon is one of the main reasons for the EITI creation. The pioneering work of Auty (1994) and Sachs and Warner (1995a) showed that resource-rich countries (oil, gas, or mining) have below-average economic activity. These countries have a higher frequency of conflicts and suffer from poor governance (Collier, 2003; Humphreys, 2005). According to international organizations (World Bank, IMF, and other multilateral cooperatives), these adverse effects could be mitigated through greater transparency in the governance of extractive industries.

Indeed, implementing the EITI would allow countries to observe a better foreign direct investment climate. This initiative would strengthen accountability and good governance and ensure excellent economic and political stability. Companies were mitigating the political risks caused by opaque management benefits investments. Investments in the extractive sector are highly capital intensive, which requires a high degree of long-term stability to generate profits. Transparency of payments to governments allows companies to demonstrate their contribution to public finances. For civil society

organizations, the benefits mainly concern the availability of information on governments' management of resource revenues. This requires more responsibility in allocating income to social and economic expenditures (EITI, 2016).

However, EITI still has several limitations. First, the fact that a country is an EITI Candidate or compliant country does not necessarily mean that its extractive sector is entirely transparent or free of corruption. This situation indicates an effective process for monitoring and improving the disclosure of information (EITI, 2016). Also, international pressure for reform and the high implementation costs of international standards push some governments to so-called fictitious or facade compliance (Öge, 2017). Civil society organizations' participation in MSG in authoritarian countries satisfies this compliance form. Global donor actors exert some form of external pressure for reforms in the management of extractive industries. They require strict compliance with good governance standards (Gillies, 2010; O'Neill et al., 2004). Since the EITI's creation, it has been strongly supported by the World Bank, the IMF, and the G-20 as an instrument of transparency in developing countries. In this logic, countries are obliged to implement EITI in order to benefit from better solvency of external financing (Simmons, 2001) and an excellent global reputation as FDI destinations (David-Barrett and Okamura, 2013; Henisz, 2002; Öge, 2017). These external incentives associated with the EITI require countries to formally accept civil society organizations as essential stakeholders in managing extractive resources. However, in practice, these groups are often marginalized and silenced. Finally, it is necessary to note that at the inception of the EITI, the responsible use of resource revenues was not a concern in implementing the EITI, making it challenging to address corruption along the value chain.

3.2.3 How can EITI implementation improve tax revenue mobilization?

The EITI literature focused on the factors behind a country's joining the initiative (see Cockx and Francken, 2014; David-Barrett and Okamura, 2016; Kasekende et al., 2016; Lujala, 2018; Öge, 2016; Pitlik et al., 2010), the initiative impact on Governance (Namely control of corruption, civil liberty and, democracy) (see Ejiogu et al., 2019; Haufler, 2010; Magno and Gatmay-

tan, 2017; Papyrakis et al., 2017; Rustad et al., 2017; Sovacool and Andrews, 2015; Sovacool et al., 2016; Villar and Papyrakis, 2017), FDI flows (Sovacool and Andrews, 2015), and growth (Corrigan, 2014). A study close to ours is Mawejje (2019), which analyzes the link between natural rents and non-oil revenues using EITI membership as an interaction variable.

The national platforms of EITI for accountability improve reforms and governance and promote more excellent economic and political stability. The effects of EITI on tax revenues would be reflected in the strengthening of the resource tax regime and linkages with the non-resource economy. The first channel is direct and works through an optimal and transparent resource tax regime. The second channel is the indirect effect that EITI has on non-resource revenue once transparency enhances accountability and resource allocation to productive expenditures (for example, infrastructure and human development to promote economic diversification). First, the EITI improves the transparency of the extractive business taxation system, improving the government's share of rents. It broadens access to detailed information on extractive sector revenues in several countries and informs citizens about the payments made by companies. For example, in Chad, the national oil company discloses detailed information about Glencore's sale of oil. Sales volumes, prices, sales amounts, public debt repayment, and the balance transferred to the treasury are presented in detail (EITI, 2018). For a long time, the identity of the beneficial owners of companies holding oil, gas, and mineral extraction rights has often been unknown. This lack of transparency in the governance of extractive industries fuels corruption, money laundering, tax evasion, and illicit financial flows, as evidenced by the Panamas Papers (Chohan, 2016). EITI requires disclosure of the absolute ownership of extractive companies (the holders of extraction rights), i.e., residence, parent company, and subsidiaries. This demonstrates that EITI leads to more efficient tax collection from companies in the extractive industries. The second channel is the indirect effect that EITI has on non-resource revenue once transparency enhances accountability and resource allocation to productive expenditures (for example, infrastructure and human development to promote economic diversification). The transparency of resource revenues' use to productive expending conditions the non-resource tax effort. This raises the complementary relationship between resource revenues and non-resource tax revenues. In general, citizens' transparency or access to

information can reduce bureaucratic corruption by making acts of corruption riskier and promoting the selection of honest and efficient agents for the public service. According to the resource curse literature, appropriate institutions can prevent the adverse impact of natural resources. It is not immediately apparent that EITI transparency reform should be the priority. It is essential to consider other indicators of institutional quality, which are crucial to the effectiveness of tax revenues.

The question of the effects of EITI on tax revenues is still little empirically addressed in the existing literature. Only Mawejje (2019) achieves to analyze a direct relationship between the EITI and non-oil tax revenues. The author considers 31 sub-Saharan African resource-rich countries over the period 2003-2015. The Fixed effects and dynamic panel models indicate a negative relationship between natural resource dependency and non-oil revenue mobilization. The effect becomes weakly positive by using the interaction between EITI membership and natural resource dependency *(Total rents in % GDP)*. The author concludes that EITI membership partially improves tax revenues since the coefficient decreases with control variables. With a panel of 186 countries from 1997 to 2014 and using the fixed-effect model, Corrigan (2017b) shows that the EITI membership positively affects significant economic development. However, the effect on the control of corruption is not significant. An ordinary least squares (OLS) analysis from 2005 to 2009 by Cockx and Francken (2014) finds no evidence for a positive effect of the EITI membership on public health spending.

However, there are several limitations to this empirical literature and EITI policy in general. The regression method is not appropriate because a country's decision to implement the EITI standard is endogenous. This work considers EITI membership as when the country publicly expresses its intention to implement the EITI standard. Demonstrating a country's intention to join the EITI implies a willingness to change transparency policies and comply with EITI requirements. By considering only this step, the analysis risks underestimating the impact of the EITI. Corrigan (2017b) points out that this variable, as defined, does not consider all policies or plans that aim to increase transparency and accountability in the governance of extractive industries. This suggests restraint in interpreting the results, as EITI implementation extends over several years. The specification with an interaction term indicates the heterogeneity of the effect of EITI via the level of depen-

dence on natural resources between countries that are already EITI Members. The result does not compare the effectiveness of non-resource tax revenues between EITI and non-EITI implementing countries. In other words, this result is much more reflective of the sensitivity in terms of extractive capacity and the value of natural resources between EITI members.

In addition to the limitations of empirical analysis, the EITI faces some challenges. Initially, EITI policy focused only on revenues from extractive industries. Other aspects of the extractive value chain, such as these revenue allocations, are not considered. Nevertheless, resource-rich countries face many corruption problems that are mainly expenditure-based (Öge, 2017). Similarly, Robinson et al. (2006b) suggest that responsible use of public resources is the way to avoid the "resource curse." Thus, the introduction of EITI seems a little late in the logic of real impact because corruption is already present at the contracting and procurement stages. As membership of the EITI is voluntary for countries and companies, countries and companies can express their intention to join the initiative and whether or not to follow up on it. This depends on the opportunity cost of complying with the standards. For example, highly corrupt governments may be interested in not promoting transparency in the extractive industries (Öge, 2017). For such governments, restrictions on access to international financial markets and development support could effectively increase their compliance costs. Also, there is a risk that supporters of the government regime may populate the multi-stakeholder group. This reduces the exposure of bad practices in EITI implementation. Members of multi-stakeholder groups also need to be able to process and act on the information conveyed.

On the other hand, we use a more appropriate methodology to assess the impact of EITI membership on tax revenues. Indeed, we consider two main stages (commitment status and candidate country status) of EITI implementation to measure EITI adherence. Besides, we believe the heterogeneity of effect (ATT) is related to Compliance with EITI standards. The primary variable of interest is the EITI Candidate country status. With this variable, we can ensure more transparency in the governance of the extractive industries, as it meets the first five (05) requirements of EITI implementation. We use the propensity score matching (PSM) method, which considers the impact of the main factors that motivate countries to join EITI. The PSM assesses the impact of EITI membership on tax revenue mobilization for a given country

compared to what it would have been like to remain a non-EITI member. In other words, this method provides the average effect of EITI membership on tax revenue mobilization. We also analyze the heterogeneity of the impact across countries related to macroeconomic variables, institutional quality, and the time elapsed since EITI membership.

3.3 Dataset and Stylized facts

3.3.1 Dataset

The empirical analysis uses an unbalanced panel of 83 resource-rich developing countries from 1995 to 2017. The choice of this large panel is based on the dependence on extractive resources and the availability of tax revenue data. Extractive-dependent countries are defined as countries that depend on minerals for at least 25% of their tangible exports (Haglund, 2011b). The panel is unbalanced because of missing observations. The sample includes 46 countries implementing the EITI standard at different accession dates (EITI members, EITI members, EITI countries, or treatment group) and 37 non-EITI members (control group). Of these 46 EITI committed countries, all have achieved Candidate status, and only 24 have achieved Compliance status as of the specific dates (see Appendices C12 for the data sources & definitions of the different variables and C13 for the list of countries & their different stages of EITI implementation).

We use the Government Revenue Dataset (GRD) developed from UNU-WIDER (McNabb, 2017; Prichard et al., 2014). It is a complete source of cross-country data available and extensively used in the studies surrounding the effects of tax policy on development. In particular, total tax revenues (% GDP) is our main dependent variable *(Log Tax_revenue-to-GDP)*[4]. It is a complete source of cross-country data available and extensively used in the studies surrounding the effects of tax policy on development. In particular, total tax revenues (% GDP) is our primary dependent variable (Log Tax revenue-to-GDP). It represents the sum of the sub-components of taxes, excluding

[4]The standard deviations of certain variables in the two groups of countries are pretty disparate (see Table C11 for the descriptive statistics). We, therefore, consider their logarithms in our econometric regressions. For example, we use the variables total tax revenues and non-resource tax revenues in logarithms

social security contributions, levied to benefit social welfare institutions. This coverage of tax revenue data is better because it is specific to taxes and consistent across countries. We test transmission channels using non-resource tax revenues and Total income taxes, including taxes on the natural resource sector, to robust our results. Non-resource tax (Log Non-Res Tax-to-GDP) is calculated as total tax revenues excluding social security contributions and resource taxes (oil, gas, and mining). Total taxes on income, Profits, and Capital Gains (Log Income Tax to GDP) represent the sum of corporate and personal income taxes (CIT + PIT).

The variable of interest is a dummy of *EITI implementation*, and it is constituted through the information available on the EITI website (EITI, 2016). The *EITI* dummy takes the value 1 to start from the year of takes the value 1 for the years that the country is an EITI member and 0 for the years that the country is not an EITI member according to the stage of implementing the EITI standard. Indeed, Candidate status is necessarily the first step for an EITI-implementing country. For a more comprehensive analysis, in this study, the interest variable is measured in three chronological levels through three main stages of EITI standard implementation, namely *Commitment, Candidate, and Compliance*. We also use it as a dependent variable for the initial probit estimation of the Propensity Score for the set of explanatory variables suspected to be endogenous to EITI membership. Propensity score estimates include EITI members and the control group (non-EITI members). In particular, the control group for commitment and candidate status includes non-EITI countries, and the control group for compliant countries is formed only by EITI commitment or candidate[5] countries that have not yet obtained compliant status.

The control variables are composed mainly of structural and institutional indicators, and their choice is justified in subsection 3.4.2. The propensity score matching method suggests that the control factors correlate simultaneously with the interest and dependent variables. Otherwise, these factors will likely explain the choice to implement EITI and tax revenues for a given country. Based on existing literature, we monitor the endogeneity of the following factors : the total rents of extractive industries (oil, gas, mineral), GDP per capita, Financial development, Inflation, Commodity prices, Trade

[5]It is essential to note that all the EITI Candidate countries are a priori committed, but the reverse is not always the case.

openness, Net official development assistance per capita (AID), Foreign direct investment (FDI), Industry value-added, Coal rents, Forest rents, Human development index (HDI), Index of institutional quality (control of corruption, government effectiveness, the rule of law), Regulatory quality, Voice and accountability. It is impossible to control for unobserved factors that may affect the likelihood of joining the EITI. However, the control variables allow us to take into account some of the known sources of bias. These data come mainly from the datasets of World Development Indicators (WDI), IMF, and The World Governance Indicators (WGI).

3.3.2 Stylized facts

Governments of resource-rich countries receive revenues from taxing extractive companies, royalties, and economic rent-sharing arrangements. The mustache box diagram in fig.3.1 visualizes the distribution of tax revenues in EITI members before and after commitment. It can be seen that for each type of tax revenue, the range is higher for EITI member periods. The same is true for the median tax revenues, i.e., the amount that divides the distribution of tax revenues into two equal shares for EITI member periods is higher than the non-EITI period. However, we can see from the mustache box diagram in figure 3.2 that the median of the tax revenues distribution increases with the stages of EITI implementation (non-EITI, commitment, candidate, and compliance). This reflects the more responsible use of revenues under the EITI standard. We explain this by creating linkages with the rest of the economy, such as job creation and allocating revenues to productive expenditures that generate other non-resource tax revenues. Therefore, implementing EITI helps mitigate the crowding out of non-resource tax revenues. In other words, the negative effect of extractive resource dependence on non-resource fiscal revenues is mitigated for EITI members. At the end of our statistical analysis, countries would mobilize more revenue by implementing EITI and achieving compliance status. Before concluding these results, we conduct an econometric verification because the stylized representation of economic variables does not consider specific endogenous factors. Likewise, the periods before and after EITI are not necessarily comparable. We begin an analysis using propensity score matching on two more comparable groups in the following.

Figure 3.1 : Distribution of taxes before and after EITI membership

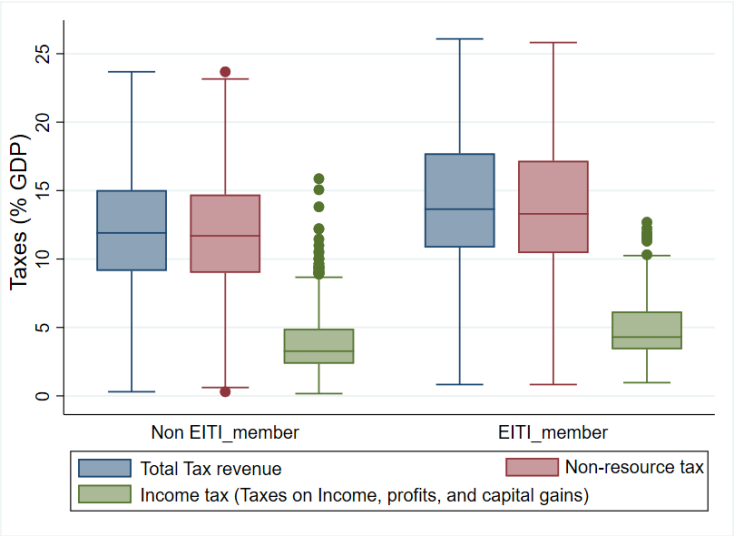
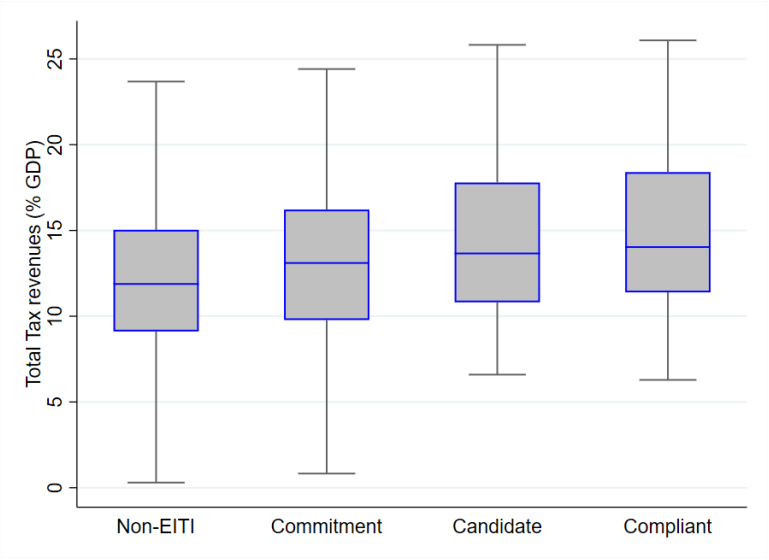


Figure 3.2 : Distribution of total tax revenues according to EITI implementing stage



3.4 Empirical strategy

Our objective is to evaluate the treatment effect of EITI implementation on tax revenue mobilization and consider the selection bias. The treatment is the EITI implementation for a given country over a given period. We refer to EITI members as the treated group and non-EITI members as the control group. The equation of the estimated average treatment effect on the treated (ATT) is expressed as follows :

$$ATT = E[(Y_{it}^{1} - Y_{it}^{0})|EITI_{it} = 1] = E[Y_{it}^{1}|EITI_{it} = 1] - E[Y_{it}^{0}|EITI_{it} = 1] \tag{3.1}$$

where *EITI* is the dummy (independent variable) corresponding to the *EITI* implementation and *Y* is the domestic tax revenues. $Y_{it}^{0}|EITI_{it} = 1$ is the value of tax revenue mobilization at time *t* that would have been observed if an EITI member *i* had not implemented the EITI and $Y_{it}^{1}|EITI_{it} = 1$ the outcome value observed in the same country. Equation (3.1) tells us that a simple comparison between tax revenue mobilization observed in the treatment group and the value of tax revenue mobilization observed for the same countries if they had not implemented the EITI, would give an unbiased estimate of ATT. However, the main difficulty in estimating the ATT is that the second term on the right-hand side ($E[Y_{it}^{0}|EITI_{it} = 1]$) is not observable. We cannot observe the value of tax revenues of an EITI member if it had not implemented the EITI standard. We face an identification problem, as is often the case with experimental studies.

A simple approach commonly used to address this difficulty and assess the causal effect would consist of comparing tax revenues of the treated (EITI-counties) with those of the control group (non-EITI countries) having similar observed characteristics (Rubin, 1974). This means that the treated group would have had tax revenues like those in the control group without EITI. The difference in outcome between the two groups can be attributed to the treatment effect. This approach is possible if and only if the decision of the country to implement EITI standards is random. It will raise selectivity bias problems if the decision to implement the EITI is not random. However, the decision to implement the EITI standards may be non-random, as choices to join or not may be correlated to a set of observables that also affect tax revenue mobilization. Then, we will have the "selection on observable" problem, which can lead to overestimating the impact of EITI implementation

on tax revenues. In this case, traditional linear regression is unreliable (for detailed discussions, see Dehejia and Wahba, 2002b; Heckman et al., 1998b). We use various propensity score matching (PSM) methods recently developed in the treatment literature to address the selection problem on observable[6] (Rosenbaum and Rubin, 1983).

3.4.1 Matching on propensity scores

The PSM method compares EITI and non-EITI members having similar observed characteristics so that the difference in tax revenue values between the two groups of countries can be attributed to the effect of treatment. In other words, to determine treatment effects, it is essential that before the experimental treatment is implemented, the two groups (EITI and non-EITI members) are as comparable as possible.

The ***first assumption*** needed to apply the PSM method is the "conditional independence" (Y^0, $Y^1 \perp EITI|X$). It requires that conditionally to observable *(X)* unaffected by the treatment, the outcomes be independent of the *EITI implementation* dummy. Under this assumption, equation (3.1) can be rewritten as follows :

$$ATT = E[Y_{it}^1|EITI_{it} = 1, X_{it}] - E[Y_{it}^0|EITI_{it} = 0, X_{it}] \tag{3.2}$$

where we have replaced $E[Y_{it}^0|EITI_{it} = 1]$ with $E[Y_{it}^0|EITI_{it} = 0, X_{it}]$, which is observable. The PSM method would consist of matching processed units to control units with similar values of X. As the number of covariates in X increases, matching on X will be difficult to implement in practice. We follow Rosenbaum and Rubin (1983), which proposes matching the treated units and control units on their propensity scores to overcome this enormous problem. The Propensity Score (PS) is the probability of implementing the EITI standard, conditional on the observable covariates *(X)*, and can be estimated using simple probit or logit models.

[6]The selectivity problem here is neither omitted variables nor a Heckman-type sample selection problem

$$p(X_{it}) = E[EITI_{it}|X_{it}] = Pr(EITI_{it} = 1|X_{it}) \tag{3.3}$$

A ***second assumption*** needed to apply propensity score matching is the "common support," i.e., the existence of some comparable control units for each treated unit. This condition ensures that each EITI country, a counterfactual in the group of Non-EITI countries. Observations with the same PS have a positive probability of being treated or untreated : $0 < p(X_{it}) < 1$. This implies that the propensity score distribution is substantially equal in the two groups of countries.

Using PSM, the estimated ATT now can be as :

$$ATT = E[Y_{it}^{1}|EITI_{it} = 1, p(X_{it})] - E[Y_{it}^{0}|EITI_{it} = 0, p(X_{it})] \tag{3.4}$$

We consider here a variety of commonly matching algorithms to assess the effect of treatment because of the difference in matching criterion (see Section 3.5.3 and 3.5.4).

3.4.2 Expected effects of independent variables

Lujala (2018) argues that examining what factors influence a country's decision to join and implement the Standard is crucial to understanding whether and how adherence to the EITI Standard can affect resource governance and development. We estimate the PS using a probit model with the binary variable *EITI* as the dependent variable. The aim is to measure the correlation of the control variables with the probability of implementing the EITI standard. Based on existing literature, our primary selection equation consists of three categories of structural factors that can influence both EITI implementation and tax revenue mobilization : internal motivation, internal capacity, and external pressure, such as development agencies and organizations (see Lujala, 2018).

Internal motivation. We assume that countries with a relatively higher level of dependence on the extractive sector are more likely than countries with a lower dependence rate to implement the EITI to prevent the curse and attract more FDI. Along the same lines, Öge (2016) argues that acceptance of the EITI by leaders of resource-rich countries was to conso-

lidate their international prestige as enthusiastic reformers, allowing them to maintain and attract foreign investment. Through cross-country and interrupted time series analyses, the author reveals that EITI members have higher FDI levels than non-members but see their FDI levels increase once countries join the initiative. The World Bank justifies the EITI's creation with the "paradox of abundance". We expect that *Extractive rents* (similarly for coal rents and forest rents) will positively affect the likelihood of implementing the EITI, as indicated in the literature (see David-Barrett and Okamura, 2016; Kasekende et al., 2016; Lujala, 2018; Öge, 2016; Pitlik et al., 2010). These studies also find that developing countries are likely to implement the EITI Standard faster than richer countries. In addition to benefiting more from the EITI, these countries may face external pressures to receive international assistance. Lujala (2018) using both GDP per capita and the squared of GDP per capita provide evidence of a curvilinear correlation between the two variables with the EITI implementation decision for a given country. In our specific case, which consists only of developing countries, we expect a positive impact of *GDP per capita* on the likelihood of implementing the EITI. This is also valid for the *Human Development Index (HDI)*. In most developing countries, multinational companies' industrial exploitation of natural resources is generally carried out (Manyika et al., 2013). The governments of these countries not equipped with adequate technology for resource exploitation should adopt incentive policies to attract foreign direct investment (FDI). Following the evidence of David-Barrett and Okamura (2016) and Lujala (2018), we assume that a higher level of *FDI flows* is positively associated with the likelihood of implementing the EITI. The resource-rich countries receive even more FDI after becoming EITI members (Öge, 2016).

Internal capacity. Most resource-rich countries are still in primary insertion into international trade. The World Bank calls on these countries to comply with EITI standards to attract FDI in the extractive sector to increase their exports. We, therefore, expect a negative relationship between the high level of past *Trade openness* and the likelihood of EITI implementation. Pitlik et al. (2010) do not find a significant effect. Although the industry remains embryonic in most developing countries, it is a crucial tax revenue source. It includes value added in mining, manufacturing, construction, electricity, water, and gas. We assume that countries with relatively high Industrial value-added will be less interested in implementing the EITI standard.

Regarding the quality of institutions, countries with good performance in the control of corruption, government effectiveness, and enforcement of Rules of law will be less interested in implementing the EITI than others. Countries that are more corrupt than others are more likely to start the EITI process (Lujala, 2018). The countries with high corruption and high dependence on extractive rents are less likely to implement the EITI quickly (David-Barrett and Okamura, 2016). Other studies suggest that the corruption in the EITI members may decrease in implementing periods (Papyrakis et al., 2017; Villar and Papyrakis, 2017). However, Regulatory quality and Voice and accountability, which refer much more to democracy, could motivate countries to join EITI. Governments that respect civil rights may tend to adopt progressive norms. At the same time, the social society can exert more significant pressure on the government to implement the EITI standard (Lujala, 2018). In authoritarian regimes, NGOs will not have some freedom to voice their concerns in this process and act as whistle-blowers (Öge, 2017).

External pressure. Dependence on development agencies and international organizations can influence a country's likelihood of implementing the EITI (Lujala and Rustad, 2012; Sovacool and Andrews, 2015). We assume that countries that receive high levels of incoming development assistance are likely to implement the EITI Standard faster than others, as David-Barrett and Okamura (2016); Lujala (2018). These countries need some guarantee of transparency to continue to receive aid. The Natural Resources Governance Institute (NRGI) indicates that, nowadays, resource-rich countries tend to turn away from multilateral loans at the detriment of private sources of finance. We capture the effects of macroeconomic fluctuations through the Inflation rate, Commodity Prices, and Financial development index. We expect the past inflation rate and financial development index to affect the EITI implementation likelihood negatively and the commodity prices to affect the EITI implementation likelihood positively

3.5 Baseline results

The estimation process of the average treatment effect of EITI implementation on tax revenue mobilization is done in two steps. The first consists of estimating the propensity scores with a binary outcome model (probit model in our case), while the second consists of matching treated (EITI mem-

bers) and untreated (Non-EITI members) observations to estimate the average treatment effect on the treated (ATT).

3.5.1 The estimation of propensity scores

Table 3.1 reports the probit estimates of propensity scores on the full sample, which includes only developing resource-rich countries, based on starting dates of EITI implementation (respectively, to the date of commitment, date of the candidate, and date of compliance). Recall that EITI implementation is a binary variable. It takes the value one during which a given country implements EITI and 0 otherwise. Most of the coefficients are significant and have the expected signs for EITI commitment. Almost all explanatory variables are also substantial for EITI candidates and EITI compliance. Total extractive rents, GDP per capita, commodity prices, AID, FDI, coal rents, forest rents, HDI, regulatory quality, and voice and accountability positively correlate with EITI implementation. However, financial development, industry value-added, institutional composite index, control of corruption, government effectiveness, and the rule of law are negatively associated with the likelihood of EITI implementation. The overall significance of the regression is reasonable, with a pseudo R2 of about 20%. After estimating the propensity score for the sample, it is essential to ensure that each EITI member has at least one non-EITI member with the same propensity score.

3.5.2 Common support of Propensity Score

According to Heckman et al. (1999b), the common support overlaps treated and untreated individuals on the set of propensity score values. It ensures that at least one individual in the control group has simulated observed characteristics (Bryson et al., 2002a). The two main techniques for determining common support are the comparison of minima and maxima between the two groups of individuals (Dehejia and Wahba, 1999b) and the comparison of trimming distributions (Smith and Todd, 2005). The first is to retain all treated and untreated individuals, except those with no counterfactual. The propensity score of the latter is lower than the minimum (respectively higher than the maximum) score of the individuals in the control group. A disad-

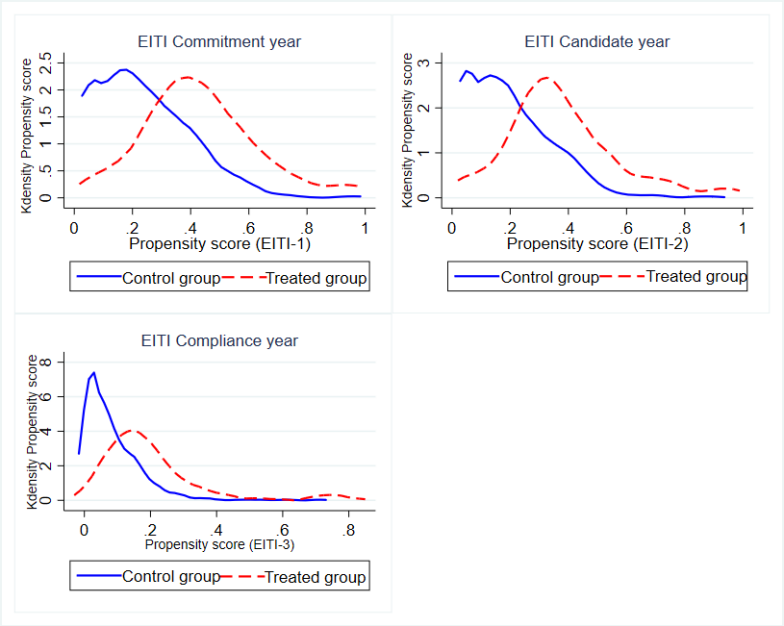
Table 3.1 : Probit estimates of the propensity score

	EITI commitment						EITI Candidate						EITI Compliance					
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Total extract. rents	0.045***	0.048***	0.045***	0.057***	0.047***	0.067***	0.045***	0.048***	0.043***	0.055***	0.047***	0.064***	0.038***	0.039***	0.037***	0.049***	0.040***	0.050***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)	(0.007)	(0.007)	(0.006)	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
LOG.GDP/CAPITA	0.045***	0.042***	0.050***	0.053***	0.045***	0.079***	0.049***	0.048***	0.053***	0.056***	0.049***	0.080***	0.045**	0.043**	0.047**	0.056**	0.046**	0.077***
	(0.016)	(0.016)	(0.016)	(0.017)	(0.016)	(0.018)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.019)	(0.022)	(0.022)	(0.022)	(0.023)	(0.022)	(0.024)
Financial Dev.	-2.499***	-2.764***	-2.454***	-3.530***	-2.649***	-4.147***	-2.608***	-2.929***	-2.405***	-3.512***	-2.764***	-4.112***	-3.309***	-3.355***	-3.191***	-4.202***	-3.488***	-4.368***
	(0.591)	(0.581)	(0.594)	(0.574)	(0.586)	(0.580)	(0.625)	(0.614)	(0.628)	(0.608)	(0.618)	(0.613)	(0.838)	(0.827)	(0.844)	(0.842)	(0.828)	(0.826)
Inflation	-0.015***	-0.015***	-0.013***	-0.012***	-0.015***	-0.011***	-0.026***	-0.026***	-0.025***	-0.023***	-0.026***	-0.023***	-0.036***	-0.036***	-0.035***	-0.034***	-0.036***	-0.034***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Commodity prices	0.048***	0.048***	0.046***	0.043***	0.049***	0.040***	0.056***	0.054***	0.054***	0.050***	0.056***	0.046***	0.025**	0.025**	0.024**	0.021**	0.024**	0.015
	(0.009)	(0.009)	(0.009)	(0.008)	(0.009)	(0.008)	(0.010)	(0.010)	(0.010)	(0.009)	(0.010)	(0.009)	(0.011)	(0.011)	(0.011)	(0.010)	(0.011)	(0.011)
Openness (Trade)	-0.002*	-0.003*	-0.003*	-0.003**	-0.002*	-0.004***	-0.004***	-0.005***	-0.004***	-0.005***	-0.004***	-0.006***	-0.002	-0.002	-0.002	-0.003	-0.002	-0.004*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
LOG.AID	0.411***	0.400***	0.401***	0.381***	0.418***	0.411***	0.385***	0.375***	0.380***	0.361***	0.390***	0.386***	0.465***	0.466***	0.463***	0.464***	0.463***	0.472***
	(0.046)	(0.046)	(0.045)	(0.045)	(0.047)	(0.046)	(0.048)	(0.047)	(0.047)	(0.047)	(0.048)	(0.048)	(0.067)	(0.067)	(0.067)	(0.069)	(0.067)	(0.070)
FDI	0.025***	0.024***	0.025***	0.022***	0.025***	0.027***	0.031***	0.030***	0.032***	0.029***	0.032***	0.033***	0.003	0.003	0.003	0.001	0.003	0.004
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.007)	(0.007)	(0.007)	(0.008)	(0.007)	(0.007)
Industry V.A	-0.026***	-0.026***	-0.026***	-0.030***	-0.027***	-0.035***	-0.024***	-0.024***	-0.023***	-0.027***	-0.024***	-0.031***	-0.018***	-0.018**	-0.018**	-0.019***	-0.019***	-0.023***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Coal rents	0.153**	0.146**	0.149**	0.142**	0.162***	0.087	0.137**	0.133**	0.133**	0.129**	0.144**	0.082	0.149**	0.148***	0.146***	0.141***	0.150***	0.107**
	(0.061)	(0.061)	(0.062)	(0.060)	(0.061)	(0.059)	(0.057)	(0.056)	(0.058)	(0.056)	(0.057)	(0.054)	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)	(0.043)
Forest rents	0.053***	0.057***	0.051***	0.064***	0.052***	0.059***	0.042***	0.047***	0.039***	0.053***	0.042***	0.049***	0.028*	0.030*	0.025	0.042**	0.029*	0.033*
	(0.012)	(0.012)	(0.012)	(0.013)	(0.012)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.016)	(0.016)	(0.016)	(0.017)	(0.016)	(0.017)
HDI	4.024***	3.897***	4.222***	3.820***	3.890***	4.053***	4.032***	3.907***	4.312***	3.846***	3.906***	4.057***	3.543***	3.493***	3.676***	3.291***	3.488***	3.764***
	(0.552)	(0.547)	(0.556)	(0.538)	(0.549)	(0.546)	(0.581)	(0.575)	(0.591)	(0.569)	(0.577)	(0.576)	(0.745)	(0.743)	(0.756)	(0.743)	(0.741)	(0.752)
Index Governance.(e)	-0.331***						-0.291***						-0.129					
	(0.071)						(0.075)						(0.095)					
Cntrl of Corruption(e)		-0.428***						-0.304***						-0.211				
		(0.111)						(0.116)						(0.148)				
Gov. Effectiveness(e)			-0.523***						-0.578***						-0.276*			
			(0.121)						(0.129)						(0.163)			
Regulatory Quality(e)				0.202**						0.166						0.461***		
				(0.100)						(0.106)						(0.146)		
Rule of Law(e)					-0.492***						-0.410***						-0.096	
					(0.108)						(0.114)						(0.145)	
Voice and Account.(e)						0.545***						0.504***						0.521***
						(0.076)						(0.079)						(0.108)
Constant	-15.886***	-15.376***	-15.586***	-13.983***	-15.964***	-14.330***	-16.112***	-15.486***	-16.172***	-14.414***	-16.074***	-14.492***	-14.697***	-14.716***	-14.719***	-13.791***	-14.425***	-13.669***
	(1.447)	(1.418)	(1.422)	(1.364)	(1.458)	(1.378)	(1.559)	(1.525)	(1.549)	(1.486)	(1.564)	(1.493)	(1.957)	(1.959)	(1.943)	(1.901)	(1.942)	(1.928)
N.Obs.	1221	1221	1221	1221	1221	1221	1221	1221	1221	1221	1221	1221	1221	1221	1221	1221	1221	1221
Pseudo R2	0.208	0.203	0.206	0.196	0.207	0.230	0.207	0.201	0.211	0.197	0.205	0.228	0.177	0.177	0.178	0.188	0.175	0.207

Standard errors in parentheses* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Dependent variable : **EITI**=1 if a country is EITI and 0 otherwise . (e) = Estimate

vantage of this method is that observations within limits will be discarded even if they are close to the limits. We use the second method, which estimates the distribution density in the two groups (trimming). We exclude the untreated individuals for whom the proportion of potential counterfactuals is lower, i.e., the treated individuals with a propensity score very close to the propensity score of the untreated individuals under consideration. Figure 3.3 shows a fictitious situation in which the propensity score distribution supports the treatment group and the control group largely overlap, which is a good case for allowing matches. This indicates common support between EITI members and non-EITI members and verifies the second assumption to apply propensity score matching.

FIGURE 3.3 : Propensity score distributions of treated and control groups



3.5.3 Results from matching the basic model

We use four PSM algorithms commonly used in the literature to match each EITI member with non-EITI members, given the closeness of their propensity scores [7]. Table 3.2 reports the results from matching concerning Total tax revenues, presented by the ATT (Average Treatment effect Treated). Recall that the treatment here consists of implementing the EITI. Considering that the treatment starts from the country's commitment or candidacy dates, the control group includes only non-EITI countries. However, considering the treatment starting from the country's compliance date to EITI standard, the control group is formed only by EITI commitment and/or candidate countries that have not yet obtained compliant status.

The first three columns show the results of n-Nearest neighbors matching (n-NNM), with n = 1,2,3 (LaLonde, 1986). This technique is subject to the risk of inaccurate matching when the nearest neighbor is numerically distant. The following three columns show the results of r-Radius matching (r-RM), which matches a treated unit to the control units with estimated propensity scores falling within a radius (or caliper) of length r (we consider a small radius r=0.005, a medium radius r=0.01, and a large radius r=0.05). In other words, each EITI member is associated only with a non-EITI member whose propensity score falls within a predefined neighborhood to that of an EITI member country (Dehejia and Wahba, 2002b). This approach has an advantage because it uses only the number of matching units available within a predefined radius. A possible drawback is that knowing a priori the reasonable radius is difficult. We also consider Kernel matching (KM), where a treated unit (EITI members) is matched to a weighted average of all control units (non-EITI members). All non-EITI members are used but weighted by their propensity score closeness to EITI members.

Moreover, all control units contribute to the weights, reducing the variance. The control units further from the treated unit, the lower the weight (Dehejia and Wahba, 2002b). Finally, we consider the last column's regression-

[7] While matching EITI members with non-EITI members, we limit the analyses to "common support." This restriction allows us to exclude treated countries whose propensity score is above the maximum or below the minimum of non-treaties. This is a sine qua non-condition to avoid structural confusion bias when estimating treatment effects with the propensity score. (Dehejia and Wahba, 1999b; Lucotte, 2012b)

adjusted local linear matching (LLRM). This method developed by (Heckman et al., 1998b) is similar to kernel matching but includes a linear term in the weighting function instead of kernel. Each of these types of methods has advantages and disadvantages. A contrast between the most straightforward approach (Nearest neighbors matching) and the most complex (Kernel matching) reflects the classic dilemma between bias and variance. In practice, it is recommended to test the sensitivity of the results according to the method used. We follow Dehejia and Wahba (2002b) and compute standard errors by bootstrapping because the matching estimator has no analytical variance.

Table 3.2 indicates that the estimated ATT remains positive and statistically significant for all the matching algorithms. Regardless of the stage considered (commitment, candidate, or compliance) or the date of implementation of the EITI, we can notice a significant improvement in the estimated ATT. Our main results are twofold.

First, EITI-committed and candidate countries are more effective than non-EITI countries in tax revenue mobilization. According to our estimations, EITI members increase total tax revenues by an average value ranging between $e^{0.0619}$ *to* $e^{0.178}$ *(1.06 to 1.20) percentage points*[8] compared to non-EITI members. Assuming that EITI implementation starts from the commitment date or the candidacy date, it turns out that the treatment effects on total tax revenues are slightly identical. This could be explained by the duration being relatively short (two years on average) between the countries' commitment date and their Candidacy date. On the other hand, the improvement of the treatment effect is pronounced between these two stages if we consider them independently, i.e., at their respective periods (see Table **??** (appendix) and Fig. 3.4 for fixed effects regression using the function control approach). Nevertheless, the analysis of the stylized facts suggested that the median tax revenues are slightly higher for a country at the candidate stage than at the commitment stage.

Second, compliance with the EITI standard allows for additional tax revenues compared to non-compliant countries. This is because the ATT estimates using EITI compliance as the treatment variable, included in the control group, only those implementing the EITI but are not yet compliant (i.e., committed or candidate countries). In this case, EITI compliance as a

[8]Note that the values of tax revenues are considered in logarithm

treatment variable estimates the additional revenue that EITI committed or Candidate countries would receive if they were Compliant. According to our estimations, EITI compliance increases total tax revenues by an average value ranging between $e^{0.0844}$ *to* $e^{0.122}$ *(1.09 to 1.13) percentage points* compared to non-compliant members (EITI committed or candidate countries).

Our results support the theoretical arguments presented in Section 3.2.3 and confirm stylized facts (Section 3.3.2) that EITI implementation has encouraged the governments of developing countries to improve tax revenue collection. We also control for the sensitivity of some indicators of governance quality by adding an index calculated by the principal component analysis, then individually. There is a clear improvement to the estimated ATT for all the governance indicators relating to commitment and EITI candidate status but mixed for compliance status. This could be explained by the fact that almost all non-compliant EITI countries have made significant and satisfactory progress and have good institutions. In other words, the institutional governance of the two groups seems quite similar.

In addition to the graphic evidence of common support (Fig.3.3), we also check the matching quality through the other three main diagnostic tests. First, the pseudo-R2 shows that our control variables significantly explain the probability of implementing the EITI, given that its values after matching are 'fairly low' (see for instance Caliendo and Kopeinig, 2008b; Sianesi, 2004b). Second, the diagnostic test based on the standardized bias evaluates the balancing score (see for instance Caliendo and Kopeinig, 2008b; Lechner, 2001b; Sianesi, 2004b). According to Rosenbaum and Rubin (1985a), the p-value associated with the standardized bias should be above the critical value of 10%. The results satisfy the conditional independence assumption. This indicates no significant difference between "EITI" and "non-EITI" observable characteristics within the selected common support. Third, the Rosenbaum bounds sensitivity test shows whether there are unobserved variables that simultaneously affect the treatment (EITI adherence) and the outcome variable (tax revenues) (Rosenbaum, 2002b). The results suggest that there is no hidden bias[9]. The matching estimators are robust. Our results are robust to alternative measures of taxes and the stages of EITI implementation.

[9]In order not to clutter the tables, we do not display the diagnostic tests of the control of governance indicators, but it should be noted that the results of the diagnostic tests are even better with the introduction of these indicators.

TABLE 3.2 : Matching estimates of treatment effect on the tax revenues

Treatment : EITI Commitment date (EITI_1)	**Dependent variable : Log Total Tax_revenue (% GDP)**							
	n-Nearest neighbors matching			r-Radius matching			Kernel	local linear
	n=1	n=2	n=3	r=0.005	r=0.01	r=0.05	matching	matching
[1] ATT without GI	0.148**	0.0952*	0.0970*	**0.0619***	0.0645*	0.106***	0.104***	0.0940**
	(0.0620)	(0.0560)	(0.0496)	(0.0341)	(0.0371)	(0.0351)	(0.0368)	(0.0425)
N. Total Obs.	1311	1311	1311	1311	1311	1311	1311	1311
N. Treated/Controls Obs.	330/991	330/991	330/991	330/991	330/991	330/991	330/991	330/991
Pseudo R2	0.009	0.006	0.007	0.005	0.007	0.008	0.007	0.009
Standardized bias (p-value)	0.676	0.882	0.817	0.940	0.862	0.758	0.785	0.676
Rosenbaum sensitivity	1.2	1.2	1.3	1.2	1.2	1.4	1.4	1.4
[2] Index of Governance	0.119*	0.115**	0.102*	0.0559	0.0759**	0.141***	0.147***	0.154***
	(0.0639)	(0.0550)	(0.0552)	(0.0389)	(0.0383)	(0.0391)	(0.0380)	(0.0444)
[3] Corruption(e)	0.167***	0.146***	0.158***	0.102***	0.0858**	0.131***	0.135***	0.131***
	(0.0604)	(0.0529)	(0.0479)	(0.0376)	(0.0353)	(0.0361)	(0.0358)	(0.0425)
[4] Gov. Effectiveness(e)	0.142**	0.115*	0.121**	0.0770**	0.0844**	0.155***	0.166***	0.157***
	(0.0714)	(0.0608)	(0.0585)	(0.0386)	(0.0379)	(0.0437)	(0.0420)	(0.0519)
[5] Rule of Law(e)	0.135**	0.136**	0.135***	0.0922**	0.0915**	0.127***	0.126***	0.134***
	(0.0629)	(0.0578)	(0.0511)	(0.0385)	(0.0362)	(0.0365)	(0.0372)	(0.0439)
Treatment : EITI Candidate date (EITI_2)	**Dependent variable : Log Total Tax_revenue (% GDP)**							
	n-Nearest neighbors matching			r-Radius matching			Kernel	local linear
	n=1	n=2	n=3	r=0.005	r=0.01	r=0.05	matching	matching
[1] ATT without GI.	0.0762	0.0683	0.0723	0.0784**	0.100***	0.105***	0.107***	0.0975***
	(0.0624)	(0.0524)	(0.0511)	(0.0367)	(0.0387)	(0.0314)	(0.0335)	(0.0372)
N. Total Obs.	1311	1311	1311	1311	1311	1311	1311	1311
N. Treated/Controls Obs.	256/1055	256/1055	256/1055	256/1055	256/1055	256/1055	256/1055	256/1055
Pseudo R2	0.011	0.010	0.009	0.004	0.001	0.006	0.005	0.011
Standardized bias (p-value)	0.694	0.728	0.825	0.991	1.000	0.995	0.964	0.694
Rosenbaum sensitivity	1	1	1.1	1.3	1.5	1.5	1.5	1.4
[2] Index of Governance	0.137**	0.120**	0.123**	0.103**	0.106***	0.140***	0.134***	0.128***
	(0.0633)	(0.0600)	(0.0510)	(0.0405)	(0.0399)	(0.0373)	(0.0388)	(0.0404)
[3] Corruption(e)	0.162***	0.127**	0.102**	0.0795**	0.0960***	0.105***	0.106***	0.108***
	(0.0569)	(0.0528)	(0.0495)	(0.0368)	(0.0365)	(0.0361)	(0.0344)	(0.0372)
[4] Gov. Effectiveness(e)	0.118	0.126*	**0.178***	0.101**	0.114***	0.130***	0.134***	0.132***
	(0.0760)	(0.0664)	(0.0643)	(0.0393)	(0.0380)	(0.0414)	(0.0455)	(0.0481)
[5] Rule of Law(e)	0.0673	0.0704	0.0727	0.0688*	0.0751**	0.106***	0.109***	0.104***
	(0.0613)	(0.0538)	(0.0461)	(0.0376)	(0.0361)	(0.0359)	(0.0352)	(0.0361)
Treatment : EITI Compliance date (EITI_3)	**Dependent variable : Log Total Tax_revenue (% GDP)**							
	n-Nearest neighbors matching			r-Radius matching			Kernel	local linear
	n=1	n=2	n=3	r=0.005	r=0.01	r=0.05	matching	matching
[1] ATT without GI.	0.0691	0.0919	0.103*	0.0945**	0.121***	0.114***	0.110***	0.116***
	(0.0687)	(0.0617)	(0.0544)	(0.0437)	(0.0386)	(0.0359)	(0.0356)	(0.0372)
N. Total Obs.	743	743	743	743	743	743	743	743
N. Treated/Controls Obs.	91/652	91/652	91/652	91/652	91/652	91/652	91/652	91/652
Pseudo R2	0.025	0.014	0.011	0.007	0.009	0.008	0.007	0.025
Standardized bias (p-value)	0.808	0.972	0.987	0.999	0.996	0.997	0.998	0.808
Rosenbaum sensitivity	1	1.2	1.4	1.5	1.9	1.7	1.7	1.8
[2] Index of Governance	0.0331	0.0822	0.0667	0.0883*	0.0809*	0.0940**	0.0943***	0.107***
	(0.0711)	(0.0667)	(0.0572)	(0.0475)	(0.0439)	(0.0398)	(0.0355)	(0.0381)
[3] Corruption(e)	0.0763	0.100	0.107**	0.122***	0.0906**	0.100***	0.0971***	0.107**
	(0.0693)	(0.0629)	(0.0508)	(0.0462)	(0.0430)	(0.0350)	(0.0369)	(0.0416)
[4] Gov. Effectiveness(e)	0.123*	0.107*	0.0909	0.0844*	0.113***	0.0850**	0.0846**	0.0980***
	(0.0712)	(0.0596)	(0.0572)	(0.0466)	(0.0418)	(0.0365)	(0.0379)	(0.0349)
[5] Rule of Law(e)	0.0918	0.0879	0.0872	0.112**	0.110***	0.0975**	0.0949**	0.105***
	(0.0735)	(0.0642)	(0.0589)	(0.0490)	(0.0404)	(0.0394)	(0.0406)	(0.0407)

Standard errors in parentheses $^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$. Bootstrap replications = 500. GI= Governance Index

All the control variables estimating the propensity score are included beforehand, and then we use Governance indicators estimate (e) one by one to test their specific influence on the outcome.

3.5.4 Robustness checks

We analyze the robustness of our empirical results in two ways. First, we check the sensitivity of two essential components of total tax revenues : the Non-resource tax-to-GDP ratio (excluding social contributions) and the Income tax-to-GDP ratio (including taxes on income, profits, and capital gains). The matching results are presented respectively in Tables 3.3 and Table 3.4. The results remain robust (with an increase in non-resource tax revenues and a more considerable increase in income tax) with the combination of control variables, treatment variables, matching algorithms, and the inclusion of governance indicators. Specifically to non-resource tax revenues, We note that the estimated ATTs are highly sensitive to governance indicators. Our estimations in Table 3.3 *(EITI_1 & EITI_2)* demonstrate that compared to non-members, EITI members increase non-resource tax revenues by an average value ranging between $e^{0.0819}$ *to* $e^{0.222}$ *(1.085 to 1.25) percentage points.* Table 3.3 *(EITI_3)* indicates that EITI compliant increases non-resource tax revenues by an average value ranging between $e^{0.100}$ *to* $e^{0.197}$ *(1.105 to 1.22) percentage points* compared to non-compliant members. Mawejje (2019) found that the coefficient on the interaction term between the EITI membership dummy variable and the natural resource dependency is positively and significantly associated with non-oil revenue mobilization but gets increasingly weaker with the addition of control variables. Our results confirm a significant and robust positive effect of EITI on the level of domestic tax revenue mobilization through a better-adapted methodology. This suggests that EITI implementation helps mitigate the crowding out of non-resource tax revenues by resource revenues, reducing resource dependence[10]. Therefore, EITI promotes complementary linkages between the extractive sector and other sectors in resource-rich economies.

Likewise, in Table 3.4 *(EITI_1 & EITI_2)*, we notice that EITI members increase income tax revenues significantly by an average value ranging between $e^{0.112}$ *to* $e^{0.447}$ *(1.13 to 1.56) p.p.* compared to non-members. Table 3.4 *(EITI_3)* indicates that EITI compliant increase significantly income tax revenues by an average value ranging between $e^{0.124}$ *to* $e^{0.234}$ *(1.132 to 1.26)*

[10]The degree to which countries do—or do not—have access to alternative sources of income other than resource extraction, at some point in time (Brunnschweiler and Bulte, 2008)

percentage points compared to non-compliant members. On the one hand, we note that the estimated ATT coefficients are more significant for income tax revenues than those for total tax revenues and non-resource tax revenues. This could be explained by the direct impact of EITI on income tax revenues through more equitable and transparent tax regimes (mining, oil, and gas regimes). The estimated ATT coefficients are smaller for total tax revenues than for income and non-resource tax revenues separately because of the negative relationship between resource dependence and non-resource tax revenues despite the EITI. Our results are consistent with Bornhorst et al. (2009b), Ndikumana and Abderrahim (2010), Crivelli and Gupta (2014), and Mawejje (2019). We also present the results of the treatment effect on resource tax revenue to GDP in Table 3.5. We remark that estimated ATTs are positive and highly significant. This confirms our first main hypothesis that implementing the EITI increases government resource revenues. To the limit of our knowledge, this evidence is the first to estimate quantitatively the impact of EITI on government resource revenue.

Second, to remove any doubt about whether the treatment effect improves with the main stages of EITI implementation, we undertake a fixed-effects estimation through the control function approach (equation 3.5), considering only the duration of each stage independently. We then include the estimated propensity score *(_pscore)* obtained after matching, considering all the control variables. The results are presented in Table **??** and graphically represented by Figure 3.4. The estimated coefficients on the propensity score are statistically significant at the 1% level, which is strong evidence for the presence of self-selection bias. This justifies the use of the PSM method a posteriori in the previous estimations of main results. The results significantly reveal that EITI members have higher levels of tax revenue mobilization than non-members, and the effects are more significant with the stage of EITI implementation. The treatment effect is more critical on income tax revenue than non-resource tax revenue, which is also greater than total tax revenue.

Table 3.3 : Matching estimates of treatment effect on the Non_resource tax_revenues

Treatment : EITI Commitment date (EITI_1)				**Dep. var. : Log Non_resource_tax_revenues (% GDP)**				
	n-Nearest neighbors matching			r-Radius matching			Kernel	local linear
	n=1	n=2	n=3	r=0.005	r=0.01	r=0.05	matching	matching
[1] ATT without GI.	0.0125	0.0214	0.0345	0.0383	0.0373	0.0961**	0.0907**	0.0819*
	(0.0655)	(0.0642)	(0.0576)	(0.0428)	(0.0420)	(0.0413)	(0.0428)	(0.0446)
N. Total Obs.	1263	1263	1263	1263	1263	1263	1263	1263
N. Treated/Controls Obs.	277/986	277/986	277/986	277/986	277/986	277/986	277/986	277/986
Pseudo R2	0.013	0.013	0.010	0.003	0.008	0.006	0.006	0.013
Standardized bias (p-value)	0.423	0.436	0.684	0.995	0.851	0.918	0.910	0.423
Rosenbaum sensitivity	1	1.1	1.3	1.1	1.2	1.4	1.4	1.4
[2] Index of Governance	0.222***	0.192***	0.191***	0.131***	0.131***	0.203***	0.203***	0.200***
	(0.0687)	(0.0650)	(0.0533)	(0.0431)	(0.0419)	(0.0402)	(0.0407)	(0.0468)
[3] Corruption(e)	0.197***	0.172***	0.165***	0.117***	0.131***	0.166***	0.168***	0.166***
	(0.0619)	(0.0542)	(0.0529)	(0.0410)	(0.0372)	(0.0372)	(0.0368)	(0.0403)
[4] Gov. Effectiveness(e)	0.121	0.131**	0.157**	0.0853**	0.121***	0.174***	0.178***	0.187***
	(0.0738)	(0.0627)	(0.0625)	(0.0432)	(0.0455)	(0.0429)	(0.0455)	(0.0498)
[5] Rule of Law(e)	0.169**	0.169***	0.165***	0.108**	0.124***	0.185***	0.187***	0.179***
	(0.0686)	(0.0627)	(0.0568)	(0.0429)	(0.0402)	(0.0418)	(0.0408)	(0.0483)
Treatment : EITI Candidate date (EITI_2)				**Dep. var. : Log Non_resource_tax_revenues (% GDP)**				
	n-Nearest neighbors matching			r-Radius matching			Kernel	local linear
	n=1	n=2	n=3	r=0.005	r=0.01	r=0.05	matching	matching
[1] ATT without GI.	0.109	0.104*	0.113**	0.0757*	0.0820*	0.108***	0.107***	0.107***
	(0.0681)	(0.0599)	(0.0560)	(0.0438)	(0.0423)	(0.0359)	(0.0402)	(0.0388)
N. Total Obs.	1263	1263	1263	1263	1263	1263	1263	1263
N. Treated/Controls Obs.	220/1043	220/1043	220/1043	220/1043	220/1043	220/1043	220/1043	220/1043
Pseudo R2	0.012	0.009	0.007	0.005	0.007	0.003	0.003	0.012
Standardized bias (p-value)	0.727	0.867	0.930	0.985	0.948	0.996	0.996	0.727
Rosenbaum sensitivity	1	1.2	1.3	1.2	1.2	1.5	1.5	1.6
[2] Index of Governance	0.147*	0.115*	0.127**	0.0947**	0.123***	0.182***	0.185***	0.196***
	(0.0756)	(0.0649)	(0.0625)	(0.0467)	(0.0470)	(0.0415)	(0.0439)	(0.0430)
[3] Corruption(e)	0.126**	0.129**	0.145***	0.101**	0.114***	0.160***	0.160***	0.166***
	(0.0597)	(0.0557)	(0.0535)	(0.0413)	(0.0388)	(0.0368)	(0.0358)	(0.0368)
[4] Gov. Effectiveness(e)	0.176**	0.170**	0.148**	0.125***	0.151***	0.193***	0.190***	0.202***
	(0.0861)	(0.0717)	(0.0675)	(0.0481)	(0.0488)	(0.0469)	(0.0500)	(0.0518)
[5] Rule of Law(e)	0.178**	0.132**	0.158***	0.125***	0.150***	0.179***	0.173***	0.169***
	(0.0726)	(0.0619)	(0.0591)	(0.0477)	(0.0431)	(0.0422)	(0.0412)	(0.0451)
Treatment : EITI Compliance date (EITI_3)				**Dep. var. : Log Non_resource_tax_revenues (% GDP)**				
	n-Nearest neighbors matching			r-Radius matching			Kernel	local linear
	n=1	n=2	n=3	r=0.005	r=0.01	r=0.05	matching	matching
[1] ATT without GI.	0.175*	0.165**	0.144*	0.151***	0.156***	0.138***	0.134***	0.154***
	(0.0903)	(0.0779)	(0.0741)	(0.0554)	(0.0548)	(0.0478)	(0.0464)	(0.0497)
N. Total Obs.	664	664	664	664	664	664	664	664
N. Treated/Controls Obs.	68/597	68/597	68/597	68/597	68/597	68/597	68/597	68/597
Pseudo R2	0.043	0.026	0.016	0.006	0.006	0.005	0.005	0.043
Standardized bias (p-value)	0.615	0.899	0.981	1.000	1.000	1.000	1.000	0.615
Rosenbaum sensitivity	1.5	1.7	1.5	1.6	1.7	1.6	1.5	1.8
[2] Index of Governance	0.130	0.146*	0.141*	0.101*	0.100*	0.155***	0.155***	0.162***
	(0.0938)	(0.0880)	(0.0773)	(0.0607)	(0.0577)	(0.0449)	(0.0477)	(0.0478)
[3] Corruption(e)	0.197**	0.158**	0.183**	0.186***	0.150***	0.136***	0.139***	0.156***
	(0.0891)	(0.0799)	(0.0775)	(0.0569)	(0.0528)	(0.0439)	(0.0449)	(0.0466)
[4] Gov. Effectiveness(e)	0.0800	0.151*	0.131*	0.123*	0.124**	0.159***	0.157***	0.162***
	(0.0951)	(0.0840)	(0.0758)	(0.0639)	(0.0545)	(0.0458)	(0.0443)	(0.0501)
[5] Rule of Law(e)	0.190**	0.137*	0.123*	0.118**	0.140***	0.130***	0.133***	0.154***
	(0.0938)	(0.0748)	(0.0745)	(0.0547)	(0.0516)	(0.0444)	(0.0440)	(0.0509)

Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Bootstrap replications = 500. GI= Governance Indicators

All the control variables estimating the propensity score are included beforehand, then we use Governance Indicators estimate one by one to test their specific influence on the outcome.

Table 3.4 : Matching estimates of treatment effect on the income tax revenues

Treatment : EITI Commitment date (EITI_1)	**Dep. var. : Log Income Tax (income, profits, and capital gains (% GDP))**							
	n-Nearest neighbors matching			r-Radius matching			Kernel	local linear
	n=1	n=2	n=3	r=0.005	r=0.01	r=0.05	matching	matching
[1] ATT without GI.	0.321***	0.286***	0.296***	0.122**	0.141**	0.242***	0.260***	0.267***
	(0.0996)	(0.0888)	(0.0822)	(0.0619)	(0.0651)	(0.0651)	(0.0687)	(0.0723)
N. Total Obs.	1096	1096	1096	1096	1096	1096	1096	1096
N. Treated/Controls Obs.	229/867	229/867	229/867	229/867	229/867	229/867	229/867	229/867
Pseudo R2	0.047	0.074	0.012	0.007	0.005	0.009	0.012	0.047
Standardized bias (p-value)	0.001	0.000	0.670	0.960	0.989	0.861	0.696	0.001
Rosenbaum sensitivity	1.5	1.7	1.9	1.3	1.5	1.8	1.8	2
[2] Index of Governance	0.447***	0.393***	0.345***	0.220***	0.256***	0.291***	0.293***	0.366***
	(0.108)	(0.100)	(0.0881)	(0.0624)	(0.0597)	(0.0692)	(0.0700)	(0.0836)
[3] Corruption(e)	0.373***	0.375***	0.368***	0.229***	0.230***	0.275***	0.278***	0.319***
	(0.104)	(0.0906)	(0.0819)	(0.0632)	(0.0593)	(0.0631)	(0.0631)	(0.0765)
[4] Gov. Effectiveness(e)	0.227*	0.295***	0.304***	0.141**	0.182***	0.324***	0.329***	0.393***
	(0.117)	(0.103)	(0.0969)	(0.0615)	(0.0619)	(0.0733)	(0.0799)	(0.0908)
[5] Rule of Law(e)	0.360***	0.303***	0.263***	0.170***	0.174***	0.248***	0.243***	0.310***
	(0.0965)	(0.0882)	(0.0850)	(0.0592)	(0.0570)	(0.0610)	(0.0639)	(0.0744)
Treatment : EITI Candidate date (EITI_2)	**Dep. var. : Log.Income Tax (income, profits, and capital gains (% GDP))**							
	n-Nearest neighbors matching			r-Radius matching			Kernel	local linear
	n=1	n=2	n=3	r=0.005	r=0.01	r=0.05	matching	matching
[1] ATT without GI.	0.234**	0.243**	0.229**	0.170**	0.167**	0.183***	0.189***	0.258***
	(0.104)	(0.0992)	(0.0906)	(0.0680)	(0.0706)	(0.0642)	(0.0664)	(0.0759)
N. Total Obs.	1096	1096	1096	1096	1096	1096	1096	1096
N. Treated/Controls Obs.	177/919	177/919	177/919	177/919	177/919	177/919	177/919	177/919
Pseudo R2	0.023	0.094	0.020	0.008	0.009	0.007	0.007	0.023
Standardized bias (p-value)	0.377	0.000	0.514	0.976	0.958	0.980	0.981	0.377
Rosenbaum sensitivity	1.3	1.4	1.4	1.4	1.5	1.8	1.8	2
[2] Index of Governance	0.262**	0.252**	0.250***	0.140**	0.168***	0.246***	0.248***	0.240***
	(0.107)	(0.100)	(0.0890)	(0.0668)	(0.0649)	(0.0703)	(0.0648)	(0.0730)
[3] Corruption(e)	0.252**	0.198**	0.188**	0.0642	0.122*	0.223***	0.224***	0.220***
	(0.108)	(0.0983)	(0.0910)	(0.0658)	(0.0637)	(0.0646)	(0.0664)	(0.0739)
[4] Gov. Effectiveness(e)	0.225*	0.232**	0.230**	0.171**	0.200***	0.308***	0.305***	0.284***
	(0.120)	(0.107)	(0.0899)	(0.0692)	(0.0633)	(0.0764)	(0.0828)	(0.0871)
[5] Rule of Law(e)	0.258**	0.241***	0.219**	0.0721	0.112*	0.228***	0.227***	0.226***
	(0.105)	(0.0890)	(0.0894)	(0.0672)	(0.0643)	(0.0670)	(0.0651)	(0.0715)
Treatment : EITI Compliance date (EITI_3)	**Dep. var. : Log.Income Tax (income, profits, and capital gains (% GDP))**							
	n-Nearest neighbors matching			r-Radius matching			Kernel	local linear
	n=1	n=2	n=3	r=0.005	r=0.01	r=0.05	matching	matching
[1] ATT without GI.	0.211*	0.186*	0.169*	0.234***	0.196***	0.173***	0.171***	0.167***
	(0.113)	(0.100)	(0.0909)	(0.0805)	(0.0700)	(0.0601)	(0.0570)	(0.0548)
N. Total Obs.	596	596	596	596	596	596	596	596
N. Treated/Controls Obs.	72/524	72/524	72/524	72/524	72/524	72/524	72/524	72/524
Pseudo R2	0.092	0.170	0.054	0.060	0.027	0.017	0.019	0.092
Standardized bias (p-value)	0.062	0.001	0.419	0.391	0.893	0.973	0.965	0.062
Rosenbaum sensitivity	1.4	1.4	1.3	2.3	2.1	2.3	2.3	2.3
[2] Index of Governance	0.0673	0.165*	0.187**	0.210***	0.178**	0.132**	0.132*	0.134**
	(0.112)	(0.0963)	(0.0916)	(0.0800)	(0.0731)	(0.0598)	(0.0690)	(0.0620)
[3] Corruption(e)	0.0958	0.0667	0.0845	0.149*	0.111	0.129**	0.124**	0.136**
	(0.110)	(0.0993)	(0.0899)	(0.0785)	(0.0753)	(0.0611)	(0.0609)	(0.0612)
[4] Gov. Effectiveness(e)	0.115	0.152	0.157*	0.169**	0.148*	0.144**	0.141**	0.141**
	(0.117)	(0.106)	(0.0912)	(0.0777)	(0.0756)	(0.0575)	(0.0630)	(0.0593)
[5] Rule of Law(0-100)	0.277**	0.200*	0.207**	0.203**	0.168**	0.133**	0.135**	0.138**
	(0.110)	(0.103)	(0.0907)	(0.0826)	(0.0749)	(0.0630)	(0.0640)	(0.0574)

Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Bootstrap replications = 500. GI= Governance Indicators

All the control variables estimating the propensity score are included beforehand, and then we use Governance Indicators estimate one by one to test their specific influence on the outcome.

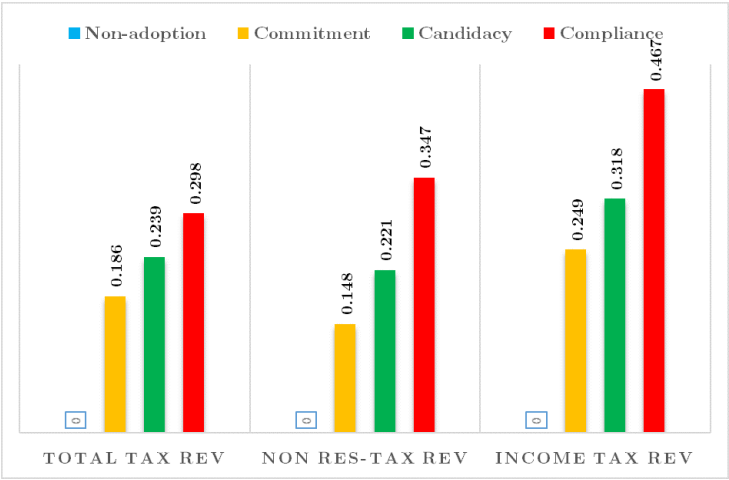
Table 3.5 : Matching estimates of treatment effect on Resource Tax revenue (% GDP)

Treatment : EITI Commitment date (EITI_1)	**Dep. var. : Log Resource Tax revenue(% GDP)**							
	n-Nearest neighbors matching			r-Radius matching			Kernel	local linear
	n=1	n=2	n=3	r=0.005	r=0.01	r=0.05	matching	matching
[1] ATT without GI.	0.0781	0.144***	0.144***	0.109***	0.123***	0.129***	0.130***	0.129***
	(0.0570)	(0.0474)	(0.0440)	(0.0332)	(0.0309)	(0.0298)	(0.0306)	(0.0295)
N. Total Obs.	1429	1429	1429	1429	1429	1429	1429	1429
N. Treated/Controls Obs.	229/867	229/867	229/867	229/867	229/867	229/867	229/867	229/867
Pseudo R2	0.047	0.074	0.012	0.007	0.005	0.009	0.012	0.047
Standardized bias (p-value)	0.001	0.000	0.670	0.960	0.989	0.861	0.696	0.001
Rosenbaum sensitivity	1.5	1.7	1.9	1.3	1.5	1.8	1.8	2
[2] Index of Governance	0.0978*	0.127**	0.131***	0.108***	0.102***	0.116***	0.121***	0.122***
	(0.0551)	(0.0502)	(0.0436)	(0.0358)	(0.0320)	(0.0319)	(0.0308)	(0.0291)
[3] Corruption(e)	0.138***	0.147***	0.149***	0.146***	0.126***	0.121***	0.121***	0.121***
	(0.0527)	(0.0475)	(0.0427)	(0.0364)	(0.0326)	(0.0287)	(0.0302)	(0.0288)
[4] Gov. Effectiveness(e)	0.105*	0.0913*	0.114**	0.0958***	0.108***	0.120***	0.120***	0.127***
	(0.0547)	(0.0503)	(0.0445)	(0.0346)	(0.0324)	(0.0325)	(0.0327)	(0.0296)
[5] Rule of Law(e) _bs_1	0.0900	0.0949*	0.121***	0.112***	0.113***	0.114***	0.116***	0.116***
	(0.0549)	(0.0486)	(0.0443)	(0.0366)	(0.0355)	(0.0319)	(0.0299)	(0.0288)
Treatment : EITI Candidate date (EITI_2)	**Dep. var. : Log.Resource Tax revenue(% GDP))**							
	n-Nearest neighbors matching			r-Radius matching			Kernel	local linear
	n=1	n=2	n=3	r=0.005	r=0.01	r=0.05	matching	matching
[1] ATT without GI.	0.191***	0.175***	0.181***	0.126***	0.133***	0.123***	0.127***	0.129***
	(0.0612)	(0.0505)	(0.0474)	(0.0317)	(0.0355)	(0.0284)	(0.0287)	(0.0291)
N. Total Obs.	1429	1429	1429	1429	1429	1429	1429	1429
N. Treated/Controls Obs.	177/919	177/919	177/919	177/919	177/919	177/919	177/919	177/919
Pseudo R2	0.023	0.094	0.020	0.008	0.009	0.007	0.007	0.023
Standardized bias (p-value)	0.377	0.000	0.514	0.976	0.958	0.980	0.981	0.377
Rosenbaum sensitivity	1.3	1.4	1.4	1.4	1.5	1.8	1.8	2
[2] Index of Governance	0.199***	0.146***	0.134***	0.123***	0.115***	0.126***	0.128***	0.130***
	(0.0594)	(0.0502)	(0.0476)	(0.0334)	(0.0327)	(0.0296)	(0.0296)	(0.0310)
[3] Corruption(e)	0.0874	0.134**	0.126***	0.115***	0.118***	0.127***	0.128***	0.122***
	(0.0565)	(0.0553)	(0.0454)	(0.0340)	(0.0325)	(0.0308)	(0.0297)	(0.0299)
[4] Gov. Effectiveness(e)	0.170***	0.135**	0.127**	0.0942***	0.117***	0.124***	0.129***	0.133***
	(0.0616)	(0.0533)	(0.0510)	(0.0337)	(0.0342)	(0.0351)	(0.0346)	(0.0343)
[5] Rule of Law(e)	0.157***	0.136***	0.157***	0.123***	0.113***	0.125***	0.125***	0.127***
	(0.0543)	(0.0480)	(0.0458)	(0.0341)	(0.0319)	(0.0302)	(0.0328)	(0.0278)
Treatment : EITI Compliance date (EITI_3)	**Dep. var. : Log.Resource Tax revenue(% GDP))**							
	n-Nearest neighbors matching			r-Radius matching			Kernel	local linear
	n=1	n=2	n=3	r=0.005	r=0.01	r=0.05	matching	matching
[1] ATT without GI.	0.180**	0.168**	0.131**	0.133***	0.151***	0.100***	0.106***	0.131***
	(0.0846)	(0.0714)	(0.0659)	(0.0406)	(0.0423)	(0.0329)	(0.0347)	(0.0341)
N. Total Obs.	596	596	596	596	596	596	596	596
N. Treated/Controls Obs.	72/524	72/524	72/524	72/524	72/524	72/524	72/524	72/524
Pseudo R2	0.092	0.170	0.054	0.060	0.027	0.017	0.019	0.092
Standardized bias (p-value)	0.062	0.001	0.419	0.391	0.893	0.973	0.965	0.062
Rosenbaum sensitivity	1.4	1.4	1.3	2.3	2.1	2.3	2.3	2.3
[2] Index of Governance	0.112	0.116*	0.120*	0.104**	0.115***	0.0884***	0.0942***	0.115***
	(0.0832)	(0.0680)	(0.0631)	(0.0423)	(0.0407)	(0.0338)	(0.0335)	(0.0368)
[3] Corruption(e)	0.160**	0.109*	0.0914	0.102**	0.116***	0.0890**	0.0952***	0.117***
	(0.0789)	(0.0660)	(0.0691)	(0.0421)	(0.0407)	(0.0352)	(0.0341)	(0.0348)
[4] Gov. Effectiveness(e)	0.103	0.117*	0.151**	0.123***	0.126***	0.0915***	0.0964***	0.119***
	(0.0778)	(0.0700)	(0.0619)	(0.0411)	(0.0402)	(0.0338)	(0.0346)	(0.0371)
[5] Rule of Law(0-100)	0.112	0.0826	0.0952	0.102***	0.113***	0.0856**	0.0898**	0.109***
	(0.0815)	(0.0710)	(0.0626)	(0.0396)	(0.0416)	(0.0366)	(0.0364)	(0.0390)

Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Bootstrap replications = 500. GI= Governance Indicators

All the control variables estimating the propensity score are included beforehand, Governance Indicators one by one to test their specific influence on the outcome.

FIGURE 3.4 : The evolution of the estimated fixed-effects coefficients



3.6 Exploring the heterogeneity in the treatment effects

Developing countries share many common characteristics, but structural factors such as economic and institutional contexts (Easterly, 2002) can magnify or mitigate the impact of EITI implementation on tax revenues. We have shown through Propensity Scoring Matching that EITI Compliant countries perform better on tax revenues than non-compliant countries. We also examine whether the time elapsed since a country joined the EITI affects tax revenues. Next, we test the influence of economic indicators in the ATT. Finally, we examine the impact of other institutional transparency indicators in the ATT. To assess the presence of potential sources of heterogeneity in the ATT related to structural factors, we use a control function regression approach, following Lin and Ye (2009) and Guerguil et al. (2017). The following OLS specification respecting the common support from matching allows exploring non-linearity in the ATT :

$$TAX\_REV_{it} = \alpha + \beta EITI_{it} + \gamma Pscore_{it} + \phi X_{it} + \theta(EITI_{it} * X_{it}) + \mu_i + \upsilon_t + \varepsilon_{it} \tag{3.5}$$

TAX_REV_{it} refers to the tax revenues (or the tax structure) ; $EITI_{it}$ to

the EITI dummy variable ; $Pscore_{it}$ which stands for the Estimated Propensity Score through the probit model is included to correct for self-selection. The X_{it} vector includes the set of macroeconomic and institutional factors that could give rise to heterogeneity in the ATT ; θ coefficient of the interactive term (between $EITI_{it}$ and X_{it}) characterizes the heterogeneity features of the treatment effect of EITI. μ_{it} and υ_{it} refer to country-fixed effects and time effects, respectively, while ε_{it} refers to stochastic disturbance terms.

Tables C2, C3, and C4 below report the estimated results on total tax revenues using EITI (commitment, Candidate, and Compliant, respectively) as the treatment variable. Column (2) shows the results of a simple OLS linking EITI implementation and total tax revenues while accounting for the previously estimated $pscore_{it}$. The estimated β coefficient (including country fixed and random effects) is the average tax revenue difference between EITI-implementing and non-EITI countries. This coefficient is positive and significantly different from zero. The magnitudes are close to the ATT from the matching algorithms in Table 3.2 above (0.096 for Commitment, 0.088 for Candidate, and 0.057 for Compliant). This shows that tax revenue growth is stronger in EITI members than in other resource-dependent countries. The time elapsed since EITI Commitment or Candidate (column 3) is positively and significantly different from zero on tax revenues. We can confirm that the time elapsed since EITI Commitment and Candidate contribute to the heterogeneity of ATT between EITI members. The following columns show the heterogeneity of treatment effects related to a given structural factor.

In EITI Candidate countries, for example, the time elapsed since the country's application date, total rents, GDP per capita, financial development, trade openness, ODA, FDI, coal rents, forest rents, HDI, industrial value-added, governance quality index, influence positively or negatively and significantly the effect of the ATT, depending on the type of tax. Our findings suggest that developing countries could improve their tax revenues by applying EITI standards rigorously and, indeed, strengthening the quality of governance.

Similarly, trade openness improves the effect of treatment on the outcome (column 10). Extractive resources in developing countries are mainly for export. Although trade openness in developing countries is still low compared to developed countries, it influences the impact of EITI membership on tax revenues. High inflation reduces tax revenue mobilization, but its in-

fluence on the effect of treatment is insignificant (column 12). This may be explained by the low inflation disparity in developing countries.

3.7 Conclusion

This study aimed to assess the impact of EITI on tax revenue mobilization using panel data from 83 developing countries from 1995-2017. The intuition was that EITI implementation would boost the quality of governance in resource-rich countries and thus improve tax revenue mobilization. Our empirical strategy focuses on the propensity score matching method and the control function approach. We highlight various matching algorithms, which allow us to control the self-selection of choice to implement EITI. We find that the ATT is positive and robust to various matching methods. In other words, there is a significant difference between EITI members compared to non-EITI members in terms of tax revenue mobilization. All else being equal, EITI membership improves tax revenues by around 1.06 to 1.20 percentage points for a given country. The matching of EITI-compliant countries with EITI non-compliant countries (commitment and candidate stage) suggests that compliance with EITI standards generates a considerable surplus of domestic tax revenues (around 1.09 to 1.13 percentage points). The magnitudes of estimated ATT are more significant if we include governance quality. Results are robust to non-resource, income tax revenues, and resource tax revenues. In other words, EITI members are more effective than non-EITI members in mobilizing domestic revenues.

Regarding heterogeneity in EITI Compliant countries, the time elapsed since the country's application date, trade openness, FDI, and forest rents positively and significantly influence the ATT effect of total tax revenues. Financial development, HDI, and governance quality index negatively and significantly influence the ATT effect. The factors of heterogeneity depend to a greater or lesser extent on the stage of EITI implementation and the type of tax revenue.

Resource-rich countries could improve their tax revenue mobilization by implementing EITI in light of the requirements. Most importantly, the implementation of EITI reduces dependence on resources and the "resource curse." Countries already implementing the EITI need to build good institutions. However, it is crucial to remember that simply EITI implementation is

not enough to guarantee transparency and better tax revenues. A series of other measures, such as compliance and responsible use of revenues, must accompany it. Another suggestion for resource-rich countries beyond this study's scope would be the need to closely monitor international tax treaties and the relationship between EITI policy and fiscal transparency.

Chapitre 4

Does Transparency Pay? Natural Resources Financial Development, and EITI in RRDC

Abstract[1] **:** It is known that natural resource revenues can impede financial development in countries with weak institutions. We hypothesize that the Extractive Industries Transparency Initiative, an international norm that aims to promote transparency in natural resources management, may mitigate this negative impact. Using the Fixed-Effects and Entropy Balancing methods, we provide empirical support for this hypothesis in a panel of 71 resource-rich countries, including 30 EITI and 41 non-EITI countries, between 1995 and 2019. Our results are robust to the use of different sets of controls and alternative measures of financial development. In addition, we provide a discussion on the transmission channels through which the financial resource curse may occur.

Keywords : Financial resource curse, Financial sector development, Transparency, Extractive industries. **JEL classification :** E3 0E44 G38

[1]This chapter was written with Edouard Mien, and one version is under revision in *World Development*

4.1 Introduction

If well managed, natural resource wealth can be critical for low- and middle-income countries to improve their economic performance. However, it is widely known that natural resources have not led to long-run sustainable economic growth in many countries. Indeed, mismanagement of natural resources can undermine the effectiveness of factors that are critical for economic development, a concept commonly referred to as the "resource curse". Most of the economic literature on the resource curse has focused on political factors (corruption, rent-seeking, political instability, etc.) or on the direct impact of resources on production and exports in other sectors (Dutch disease). However, since the early work of Beck (2011), a growing empirical literature has explored the potential negative impact of natural resources on financial development. Indeed, it has been observed that the presence of natural resources can impede the development of the financial sector through different channels, such as corruption or increasing economic instability. Yet, despite this growing literature, little is known regarding the policy that could be implemented to prevent such a "financial resource curse". In this article, we suggest that transparency in the management of natural resources can help mitigate the negative impact of resources on the financial system, either because transparency is associated with better management of these resources or because it sends a positive signal to domestic and foreign investors and banks. To test this hypothesis, we investigate the impact of the adhesion to the Extractive Industries Transparency Initiative (EITI) on financial development in a panel of 75 resource-rich countries.

Created in 2003 at the instigation of the NGO "Publish What You Pay", the EITI is an internationally recognized anti-corruption norm that aims to promote transparency, accountability, and good governance in the management of extractive resources. Despite some criticisms, the EITI has now become a major actor in the management of natural resources in the world. In addition, several analyses have shown that EITI can contribute to economic growth (Corrigan, 2014), tax revenues collection (Kinda, 2021b; Mawejje, 2019), or bureaucratic governance and institutional quality (Corrigan, 2014; Villar, 2020) in resource-rich countries. However, due to the only recent interest in the impact of resources on financial outcomes, there remains a gap in the literature regarding the impact of EITI implementation on financial

development in resource-rich countries. Due to the technical and administrative costs of EITI adhesion (due to the gathering and normalization of data from several public and private sources and the coordination of various actors involved), it is crucial for policymakers to know what will be the impact of such adhesion on different economic and social indicators, including financial development.

This article questions whether EITI membership can mitigate a financial resource curse in resource-rich countries. To test this hypothesis, we use the entropy balancing method to investigate the impact of resource rents, EITI membership, and an interaction term on domestic credit to the private sector in a panel of 75 resource-rich countries between 1995 and 2019. As robustness checks, we also use an alternative measure of financial development, namely the financial institution depth index from the IMF, and apply the fixed- and random-effect models. We also distinguish between the impacts of the three different EITI implementation steps (i.e., "commitment", "candidacy", and "compliance"). Finally, we discuss possible heterogeneity among types of resources and separately estimate the effects of minerals, natural gas, and oil on financial development. Our results suggest that EITI membership contributes to offsetting the negative impact of natural resources on financial indicators. We also conclude that both the negative impact of resources on financial development and the mitigating impact of EITI membership tend to be slightly stronger for natural gas than for mineral resources. These results call for further transparency in managing extractive resources.

The contribution of this study to the literature is twofold. First, we provide evidence that transparency in the natural resources sector can greatly contribute to avoiding a financial resource curse in resource-rich countries. Indeed, while there is abundant literature relative to the impact of natural resources on financial sector development and on the role of EITI membership in mitigating the negative effects of natural resources on different key socioeconomic indicators (in line with the resource curse theory), no study has to our knowledge tried to link these two strands of economic research. Yet, this question is a matter of interest for policymakers in resource-abundant countries because the financial sector performs critical functions for economic development through trade facilitation, economic diversification, risk management, and promotion of investment. Second, we apply a recent and robust econometric specification that allows us to compare EITI members to

comparable countries and solve most endogeneity issues faced by previous empirical analyses.

The rest of the study is structured as follows : section 4.2 details empirical literature on natural resources and financial sector development and section 4.3 provides an overview of the EITI and presents a theoretical explanation for the potential positive impact of EITI implementation on financial development. Section 4.4 describes the data and the empirical strategy of preliminary estimates. Section 4.5 presents some preliminary results. Section 4.6 details the main results and the different robustness tests. Section 4.7 explores transmission Channels. Section 4.8 concludes and discusses some key policy implications.

4.2 How Can Natural Resources Impede Financial Development?

Since the seminal work of Auty (1993b), an extensive literature has shown that natural resources can impede economic development in resource-rich countries, a phenomenon commonly denoted as the "resource curse". Among other effects, natural resources can prevent the emergence of an efficient financial system. We investigate here the existence of such "financial resource curse".

Empirical and theoretical analyses have identified several channels through which natural resources can impair financial development. First, by encouraging corruption, conflicts, and rent-seeking behaviors, natural resources might undermine the credibility of public authorities and discourage (domestic and foreign) investors. Second, large and easily available natural resource revenues tend to weaken public and private incentives to accumulate human and physical capital, which are required for the development of other sectors, including the financial sector. Third, natural resources might lead to Dutch disease effects, i.e., to the decline of non-resource tradable sectors such as manufacturing activities, which are often complementary with the financial sector (Yuxiang and Chen, 2011). Fourth, since commodity prices are often more volatile than other products, a higher concentration of exports around a few commodities is expected to increase the volatility of export earnings and, thus, the economy's vulnerability toward external shocks. To face uncertainty, financial agents can react by increasing interest rates, which will

discourage investment and impede financial development (Hattendorf, 2014; Hausmann and Rigobon, 2003). Finally, some types of natural resources, notably hydrocarbons, are often extracted by foreign international firms and appear as an enclave in the economy. Consequently, they do not depend on domestic sources of financing and do not contribute to the development of a financial sector, contrary to agriculture or manufacturing activities (Beck, 2011).

Based on these observations, an empirical literature has gradually emerged since the early 2010s to analyze the effects of natural resources on financial development. In an early study, Beck (2011) investigates the determinants of financial development, measured by seven different estimators (private credit to GDP ratio, liquid liabilities to GDP ratio, loan-deposit ratio, stock market capitalization, stock market turnover, structure size, and structure efficiency). Using cross-section OLS and panel with country-fixed effect estimators, the author concludes that natural resources exports (as a share of total exports) tend to discourage banks from engaging in trading activities and to engage in intermediation with the real economy. Similarly, Bhattacharyya and Hodler (2014) estimate the impact of natural resource rents on private credit. They, however, differ from (Beck, 2011) by investigating the impact of democracy on financial development and by including an interaction term between democracy and resource rents. Based on a panel of 133 countries, they conclude to a negative impact of resource rents on financial development, but much lower for democratic countries. Hattendorf (2014) specifically focuses on the specific channel of short-run volatility and real exchange rates, following the early model from Hausmann and Rigobon (2003). For this, the author uses export concentration (measured as a modified version of the Herfindahl-Hirschman Index) as an explanatory variable and concludes to a negative impact of this variable on private credit. Kurronen (2015) investigates the impact of mineral exports and mineral abundance on financial development in 129 countries between 1995 and 2009 using both static (pooled OLS and fixed-effects) and dynamic (Anderson-Hsiao) estimators. The author finds evidence of a lower financial sector development in resource-dependent countries and also remarks that their results support the idea that part of this negative relationship is attributable to the higher macroeconomic volatility of commodity prices. Han et al. (2022) use Granger Causality Analyses and Fully-Modified Ordinary-Least-Squares to assess the

impact of natural resource rents and export diversity on private credit in the ten most resource-dependent countries. As expected, their results suggest a significantly negative impact of natural resource rents on financial development but a positive one on export diversity. Finally, Beck and Poelhekke (2023) investigate the impact of natural resources windfalls on financial sector deposit and lending indexes. Using a large panel of 100 countries over the period 1970-2017 and based on OLS, seemingly unrelated regressions (SUR), impulse-response functions, and Generalized Methods of Moments, they conclude a positive impact of natural resources on financial development without GDP per capita as a control variable, but to a negative one when this variable is included. Interestingly, they also observe that natural resources tend to impede financial development in countries with low institutional quality but have a positive impact in countries with sound institutions.

A few authors have also investigated this impact in country case studies. For instance, Yuxiang and Chen (2011) observe that both resource dependence (resource extraction as a share of total output) and resource abundance (in constant yuan per capita) negatively impact financial development (measured as the ratio of bank loans to GDP) in Chinese provinces between 1996 and 2006. Asif et al. (2020) investigate this financial resource curse in Pakistan but with a nonlinear Autoregressive distributed lag method to account for potential heterogeneity across different types of shocks. They conclude with positive effects of negative shocks in the resource sector on financial development (in line with the financial resource curse hypothesis) but with a negative impact of positive shocks only in the short-run (the impact of natural resources on financial development being positive in the long-run).

Another strand of the literature has focused on the impact of short-run shocks in resource markets on financial instability. For instance, Kinda et al. (2018) assess the impact of commodity price shocks on financial stability in 71 (emerging and developing) commodity exporters. Their results overall suggest that commodity shocks generate more financial fragility in commodity-exporting countries. Examining various factors that may affect the results, they also conclude to a reduced effect in countries with good institutions and less corrupt governments. Similarly, Mlachila and Ouedraogo (2020) observe that commodity price shocks impair financial development in resource-exporting countries, but with a much larger effect when gover-

nance is of poor quality.

Overall, there seems to be overwhelming evidence that natural resources tend to weaken the financial sector, both in the short- and long-run, even though the channels through which this happens are not always perfectly identified. Yet, such effect is not an inescapable curse in that it is less likely to occur in countries with good political and economic institutions and efficient management of natural resources. Our study builds on this previous work by investigating if transparency in the use of resource revenues contributes to reducing the negative effects of resource revenues on financial development.

4.3 EITI and Financial Resource Curse

In this section, we introduce the Extractive Industries Transparency Initiative and the effects that are usually expected from its implementation. For this, we briefly present the history and principles of the EITI. We propose a theoretical explanation for why this could contribute to preventing a financial resource curse, and finally, we highlight the main limitations of this initiative.

4.3.1 History, Principles, and Implementation steps of EITI

The Extractive Industries Transparency Initiative (EITI) was officially created in 2003 in order to improve transparency in the collection and use of natural resources (hydrocarbons and mining) in resource-rich countries. This followed the "Publish What You Pay" campaign started in 2002 by a group of civil society organizations asking for more transparency in the resource sector.

The EITI is managed as a multi-stakeholder organization, with representatives from governments, industries, and civil society. EITI implementation process consists of three main steps : *Commitment*, *Candidacy*, and *Compliance*. First, the government publicly commits to join the EITI. Following that, government, companies, and civil society must jointly establish a national EITI secretariat and a multi-stakeholder group (MSG) to oversee the implementation process. The MSG requires all stakeholders' independent,

active, and effective participation. Thus, the MSG adopts a costed work plan to define the country's objectives and priorities for EITI implementation (EITI, 2016). This step takes time and allows the effects of accession to be examined before being accepted as a candidate country (Corrigan, 2014). Second, the country obtains the candidate status if the EITI Board considers that all conditions for membership have been met. Third, to achieve the status of EITI compliant, EITI candidates must publish a first EITI Report within 18 months, followed by a final report within two years and a half. Countries that have not met the requirements of the validation process and have not submitted the report on time risk suspension. The same applies to countries experiencing political instability (Kannan and Ravat, 2012). A few points must be emphasized here. First, EITI commitment does not imply a specific use of natural resources but only transparency in their management, although it is likely that more transparency can be associated with an improvement in resource management. Second, this initiative is not restricted to public institutions but requires the participation of private actors (firms and civil society organizations) too. Finally, the decision to join the EITI is in theory, purely voluntary, yet it might be perceived as a good signal from private investors and international organizations.

4.3.2 How EITI can prevent financial resource curse ?

In this article, we investigate how joining the EITI can prevent a financial resource curse. We can identify at least three main reasons for that. First, by increasing transparency, public authorities send a positive signal to private agents regarding their willingness to improve the management of natural resources revenues in the public sector and to fight corruption. If such a signal is considered as plausible by (foreign or domestic) investors, this will contribute to the credibility of public policy and to the development of a good business climate, encouraging investment and domestic savings, and therefore contributing to financial development. Second, if government officials and/or private firms are aware of being more closely scrutinized by citizens, they might be less prone to corruption and more likely to put more effort in resource management. It is noticeable that the first point corresponds only to a signal effect, even if it is not followed by any effective change in public policy, while this second effect is associated with an effective improvement

in public policy. The two effects are, however, related, since a positive signal (via EITI commitment, for instance) might have a positive impact on the financial sector in the short-run if perceived as plausible by private agents, but if this is not followed by any change in public policy, this impact will progressively decline as agents are lowering their expectations. However, we can expect the signal effect to start as soon as the country declares its commitment to join the EITI, while the improvement in resource management will occur during the implementation of EITI requirements. Third, by encouraging dialogue between local communities, firms, government officials, and civil society organizations, the EITI might appease social and political tensions caused by natural resources exploitation, and thus contribute to improving the investment climate and restoring the confidence of financial actors.

In particular, Le Billon et al. (2021) propose three different models to explain how EITI implementation could improve resource governance : (i) the "Name-and-Shame" model, (ii) the "Public Debate" model, and (iii) the "Technical Reform" model.

One intuition behind the EITI is that if government officials and/or private firms are aware of being closely scrutinized by citizens, they might be less prone to corruption and more likely to put more effort into resource management. Hence, by exposing corruption, transparency encourages public officials and private companies to adopt better practices through "Name-and-Shame". The EITI then contributes to reducing corruption and restoring confidence from private investors, preventing a corruption-driven financial resource curse from occurring. In addition, this "Name-and-Shame" process may also impact the second and third groups of mechanisms identified, namely the inefficient level of investment in human/physical capital and the Dutch disease effect. Indeed, as seen in section 2, the inadequate level of investment is caused by the reduced incentives from public authorities to invest in human and physical capital, while the Dutch disease can be (at least partly) countered by adequate investment in non-resource tradable activities. Sound public policy plays a major role in preventing a financial resource curse through one of these two mechanisms. Transparency can encourage public authorities to adopt better investment strategies and economic policies against Dutch disease by providing information to civil society organizations and private actors.

Second, by encouraging collective deliberation and collaboration between government officials, private sector agents, and civil society organizations, the EITI may enhance the decision process (i.e., better use of natural resources revenues). Following this "Public Debate" model, EITI implementation can reduce natural resource mismanagement and promote adequate public investment, mitigating a potential resource curse in the financial sector. In addition, this dialogue between local communities, firms, government officials, and civil society organizations might also help to appease social and political tensions caused by natural resource extraction, restoring the trust of financial and private agents.

Third, by encouraging governments to implement specific reporting and collective deliberation procedures, EITI implementation can also improve the technocratic process, leading to better economic policy in line with the "Technical Reform" model. This is an important aspect of the EITI implementation process since the EITI is also expected to provide technical recommendations and expertise regarding the reporting process. Finally, it must be noted that adhering to the EITI can be a way for public authorities to send a positive signal to private agents regarding their willingness to improve the management of natural resources and fight corruption. In that case, increasing transparency through EITI implementation is expected to be followed by public and private agents' improvement in resource governance. Let's assume that such a signal is considered plausible by investors (foreign or domestic). In that case, this will contribute to the credibility of public policy and the development of a good business climate, encouraging investment and domestic savings and therefore contributing to financial development. Reciprocally, if a country has already implemented policies aiming at improving governance and accountability, adhering to the EITI is a way to obtain a formal validation of these improvements by an international institution and to generate confidence among investors. In both cases, EITI membership reveals (past or future) improvement in governance but can have an impact on its own on the financial sector. The two effects are, however, related since a positive signal (via EITI commitment, for instance) might positively impact the financial sector in the short-run if perceived as plausible by private agents. However, if any change does not follow this in public policy, this impact will progressively decline as agents are lowering their expectations. However, we can expect the signal effect to start as soon as the country de-

clares its commitment to join the EITI, while the improvement in resource management will occur during the implementation of EITI requirements.

Therefore, EITI implementation can play a crucial role in mitigating different channels through which a financial resource curse may occur, both by encouraging a practical improvement in public policy (resource governance, investment strategy…) and restoring private agents' confidence. In this study, we do not aim to distinguish these different mechanisms but only intend to determine to what extent EITI membership can mitigate resource curse consequences on the financial sector.

4.3.3 Limits of EITI

Overall, two main groups of criticisms are leveled at the EITI. The first group of critics focuses on the nature of the information collected and made available by the EITI and argues that they are too restricted in their scope. In fact, the EITI focuses only on transparency in the collection of revenues from natural resources (through taxes and royalties) and does not consider neither the awarding of exploitation contracts nor the use of resource revenues (Corrigan, 2014; Kolstad and Wiig, 2009b). In other words, to be fully effective, the EITI should consider the entire value-added chain of natural resources exploitation and not be restricted to the "collection of revenues" step. As defined by the EITI, Transparency is thus perceived as insufficient in its current form to promote good governance and institutions.

The second group of critics question the restriction of the EITI to transparency, arguing that transparency alone is insufficient to ensure good governance or an efficient use of resource revenues. Indeed, it is known now that transparency requires pre-existing conditions to fully benefit the economy (Fung et al., 2007). In the specific case of natural resource exploitation, transparency promoted by the EITI should not be the only response but must, on the contrary, accompany a set of political and economic policies adapted to the local context. For instance, Le Billon et al. (2021) suggest that, whereas the EITI was successful in collecting data in Colombia, Ghana, and the United Kingdom, it failed to improve political accountability in these countries.

This article contributes to this overall literature relative to the impact of

the EITI. However, we consider that the transparency promoted by the EITI is not the main objective but a means of achieving other objectives by avoiding the curse of financial resources. Indeed, despite EITI's limitations, it can contribute to (at least) mitigating this curse, even if it does not completely prevent it.

4.4 Data and Empirical Strategy

4.4.1 Data description

We investigate the impact of EITI membership on financial sector development in an unbalanced panel of 75 resource-rich countries between 1995 and 2019, including 33 EITI and 42 non-EITI countries. Since the EITI mainly applies to hydrocarbons and mining resources, we focus exclusively on these resources (and thus exclude forest rents from natural resources). It is also noticeable that some countries (e.g. Chad) have started to produce natural resources during the sample period and should not be excluded from the sample even if they started as non-resource-rich countries in 1995. Therefore, resource-rich countries have been defined as countries in which the sum of oil, gas, mineral, and coal rents have represented more than 5% of GDP in at least one year between 1995 and 2019. The motivation for this threshold is twofold. First, the aim was not to restrict our sample to countries whose economy largely depends on natural resources but to countries where natural resources are large enough to be likely to enter the EITI (in order to have credible counterfactuals for EITI members). Since we restrict our study to extractive resources and do not include forest rents, a 10% threshold (as often done in the financial resource curse literature) would have been too high and led to a sizeable reduction of the sample size (excluding many EITI members too). This section presents the different dependent and explanatory variables used in this study. Descriptive statistics are provided in Table 4.1.

Dependent variables :

Domestic credit to the private sector to GDP (Credit) is the most common variable used in the literature to measure financial development. It refers to financial resources financial corporations provide to the private sector through loans, purchases of non-equity securities, trade credits, and other

accounts receivable that establish a claim for repayment. It is provided by the World Development Indicators and appears as the most common measure of financial development in the empirical literature.

Financial institution depth (FID) approximates financial development by including the standard banking sector depth measure used in the literature (bank credit to the private sector to GDP) indicators for other factors such as Pension fund assets to GDP, Mutual fund assets to GDP, and Insurance premiums, life, and non-life to GDP. In this study, the index ranges from 0 to 100, with 0 representing the lowest level of financial institution depth and 100 the highest level of financial institution depth (Svirydzenka, 2016). This variable is used here as an alternative to domestic credit.

Independent variables :

This study intends to investigate the impact of extractive resources and transparency in the use of these rents on the development of the financial sector. Therefore, we use two main explanatory variables. The first one is the value of total extractive resources rents as a share of total GDP. This variable is defined as the sum of the variables "Coal rents", "Mineral rents", "Natural gas rents" and "Oil rents" from the World Development Indicators[2]. The second variable of interest corresponds to EITI membership. More precisely, a dataset for the different steps in EITI implementation (commitment, candidacy, compliance) has been constructed solely for the purposes of this document from qualitative information available in the EITI website. A dummy variable was created for all countries, such that for each year, each country was assigned a value "1" is engaged in the specific step, and "0" otherwise. In other words, the variable for EITI commitment begins after the country has expressed its wish to become a member state ; EITI candidacy begins after the country has announced a clear statement of the government's commitment, developed a work plan describing how it intends to fulfill the EITI requirements and established a multi-stakeholder group (MSG) together with companies and civil society ; EITI compliance begins after the country's engagement has been validated by the EITI board. It is noticeable that the country

[2]This variable thus differs from the variable "Natural resources rents" which also includes forest rents. We do not include forest rents in our analysis and focus only on extractive resources (mining and hydrocarbons) because empirical evidence suggests they are more likely to generate a resource curse and because the EITI focuses mainly on these extractive resources

must then continue to provide regular progress reports to the EITI and that its adhesion can be suspended at any step if the country's obligations are not fulfilled in time. Finally, we investigate the impact of natural resources on financial development in EITI members by including an interaction term between the EITI dummy and natural resources rents. As detailed in section 4.2, we expect a negative impact of natural resources on financial development, but a positive coefficient for the EITI membership dummies and the interaction term.

In addition to our variables of interest, we include in our study a set of key control variables that have been identified in the empirical literature as explanations for the financial sector development :

- *Gross Domestic Product per capita in logarithm (GDPPC)* : Gross domestic product per capita is expressed in constant 2017 USD at Purchasing Power Parity and is included to account for the country's level of economic development. In line with the literature, this variable is expected to have a positive impact on financial development. Data come from the World Economic Outlook (IMF).

- *Domestic Inflation (Inflation)* : Domestic inflation is the average annual growth in the domestic consumer price index (CPI). A higher level of inflation is often associated with macroeconomic instability and lower confidence of investors. It is therefore expected to have a negative impact on financial sector development. Data are drawn from the World Economic Outlook (IMF).

- *Trade Openness (Trade)* : Trade openness is measured as the sum of exports and imports expressed as a share of GDP. A higher degree of openness toward international markets is traditionally assumed to have a positive impact on the development of the financial sector (see, for instance, Yuxiang and Chen, 2011). Trade openness data are provided by the World Development Indicators (World Bank).

- *Public Expenditures (Public)* : Public expenditures are defined as general government total expenditures in % of total GDP. However, the expected coefficient associated with this variable is unclear. On the one hand, public expenditures can provide support for private banks and allow the development of physical infrastructure or the accumulation

of human capital required for the development of private firms. On the other hand, excessive spending might lead to over-borrowing and rising public debt that will impair domestic financial stability. Data for this variable are provided by the World Economic Outlook (IMF).

- *Foreign Direct Investment (FDI)* : Net inflows of Foreign Direct Investment are expressed in % of GDP. FDI inflows are usually expected to be positively associated with financial development, although empirical evidence remains mixed (see for instance Kurronen (2015) and Mlachila and Ouedraogo (2020)). Data are from the World Economic Outlook (IMF).
- *International Country Risk Guide (ICRG)* : This index comes from the International Country Risk Guide, which provides 12 variables measuring political, financial and economic stability. Here, we sum all 12 variables (Government Stability ; Socioeconomic Conditions ; Investment Profile ; Internal Conflict ; External Conflict ; Corruption ; Military in Politics ; Religion in Politics ; Law and Order ; Ethnic Tensions ; Democratic Accountability ; Bureaucracy Quality) and obtain a composite index ranging from 0 to 100 (a higher value meaning better and more stable institutions). Good political, economic and financial institutions are assumed to create confidence and contribute to the development of the financial sector. We thus expect a positive effect of this variable on financial development.
- *Worldwide Governance Index (WGI)* : This variable is used as an alternative (robustness check) for the ICRG. It is drawn from the WGI database of the World Bank and is constructed as the average value of the six WGI indexes provided (Control of Corruption ; Government Effectiveness ; Political Stability and Absence of Violence/Terrorism ; Regulatory Quality ; Rule of Law ; Voice and Accountability) ranging from -2.5 to 2.5 (a higher value meaning better and more stable institutions). We also expect a positive impact of this variable.

4.4.2 Stylized facts

As mentioned above, we expect natural resources to have a negative impact on financial development, but this will be mitigated by the EITI. In

Table 4.1 : Presentation of the Data

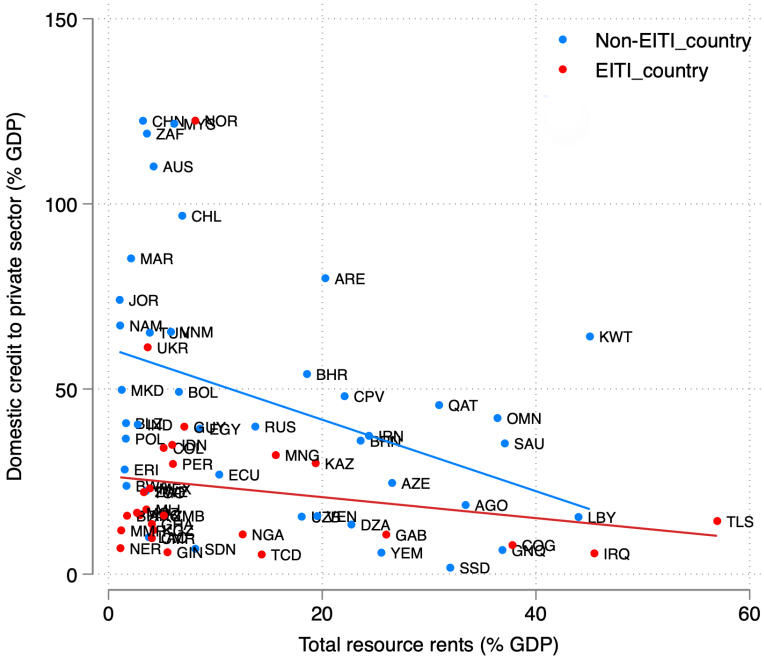
Variables	Units	Obs	Mean	Std. dev.	Min	Max	Sources
Credit	% GDP	1,514	35.1906	33.2161	0.4913	165.3904	WDI
FID	Index [0;100]	1,836	16.6776	19.5574	0	97.07381	IMF
EITI Commitment	Binary	1,886	0.2137	0.4100	0	1	EITI
EITI Candidacy	Binary	1,886	0.1792	0.3836	0	1	EITI
EITI Compliance	Binary	1,886	0.0923	0.2895	0	1	EITI
Resources	% GDP	1,842	12.9493	14.4339	0	87.5768	WDI
Oil	% GDP	1,842	9.4605	13.7306	0	66.6847	WDI
Gas	% GDP	1,842	1.3476	4.3908	0	68.6814	WDI
Mineral	% GDP	1,844	1.5291	3.1228	0	24.8341	WDI
GDPPC	USD (log)	1,835	8.9917	1.1398	6.1510	11.6655	IMF
Inflation	Rate	1,844	62.5809	1595.568	-72.729	65374.08	IMF
Trade	% GDP	1,708	76.9249	34.5427	0.0209	220.4068	WDI
Public	% GDP	1,777	28.3029	13.2759	2.1470	141.501	IMF
FDI	% GDP	1,840	4.1386	8.1805	-37.1726	161.8238	IMF
ICRG	Index [0;100]	1,564	62.1317	11.4725	27.1666	90.7083	ICRG
WGI	Index [-2.5;2.5]	1,578	-0.4668	0.7336855	-2.1031	1.8166	WGI

Figure 4.1, we present the relationship between resource dependence and the domestic credit-to-GDP ratio for EITI and non-EITI countries. As expected, the slope of the adjustment line is steeper for non-EITI countries than for EITI countries. This suggests that EITI implementation contributes to reducing the negative impact of natural resources. However, before jumping to these conclusions, we conduct more thorough econometric investigations because the stylized representation of economic variables does not consider specific endogenous factors.

4.4.3 Empirical strategy

We estimate the Average Treatment Effect of EITI implementation using the entropy balancing method developed by Hainmueller (2012b) and implemented by Neuenkirch and Neumeier (2016b). Entropy balancing mainly consists on two steps. The first requires the computation of weights assigned to the control units (non-EITI countries). In the second step, the weights obtained in the first step are used in a regression analysis with the treatment variable (EITI-countries) as the control variables. We then balance EITI countries and non-EITI countries based on observable characteristics. Thus, the average difference in financial development between EITI countries and the "closest" non-EITI countries should be explained by the EITI implemen-

Figure 4.1 : Relationship between Financial Development and Natural Resources Rents



Note : Domestic credit to the private sector and total resource rents are the average value for the period 1995-2019. EITI countries are defined as countries that have implemented the EITI standard since its launch in 2003 (see Table 4.1).

tation. Entropy balancing has several advantages over other treatment effect estimators because it combines matching and regression analysis. It outperforms the classical regression-based approach and matching on the propensity scores methods, given that it is non-parametric (there are no concerns regarding misspecification of the model's functional form, which could bias the results). It also rules out multicollinearity issues as the reweighting mechanism makes the treatment variable orthogonal to the covariates. Entropy balancing is also more effective than other matching methods in balancing the treatment and control groups' covariates. For example, in propensity score matching methods, the control group comprises only a subset of the

units not subject to treatment (Diamond and Sekhon, 2013b; Hainmueller, 2012b; Neuenkirch and Neumeier, 2016b). Each untreated unit receives a weight equal to 0 if it does not represent the best match for a treated unit or *1* if it represents the best match for one treated unit (Neuenkirch and Neumeier, 2016b). Thus, low covariate balance could bias the treatment effects estimates. However, in the case of entropy balancing, the vector of weights assigned to the units not exposed to treatment can contain any non-negative values. In this latter situation, the constructed control group adequately reflects the treated group. In sum, entropy balancing addresses the panel structure of our data by combining a reweighting scheme with regression analysis (Neuenkirch and Neumeier, 2016b). Controlling both countries- and time-fixed effects in the regression analysis is also possible. Indeed, EITI and non-EITI countries may differ (beyond the set of factors used to balance them) in their specific structural characteristics. Thus, including country-fixed effects will allow us to consider time-invariant factors and to account for potential heterogeneity across countries in access to the financial market.

Our analysis is based on the idea that the EITI implementation represents a treatment. The units of analysis are country-year observations ; observations with EITI implementation in place comprise the treatment group, and observations without EITI implementation make up a potential control group. Our outcome is the so-called average treatment effect on the treated (ATT), which is defined as follows :

$$\tau_{ATT} = E[(Y^1 - Y^0)|EITI = 1] = E[Y^1|EITI = 1] - E[Y^0|EITI = 1] \quad (4.1)$$

Y is the outcome variable, that is, financial development. EITI indicates whether a unit is exposed to treatment (EITI=1) or not (EITI=0). Accordingly, E[Y^1|EITI = 1] is the expected outcome after treatment, and E[Y^0|EITI = 1], the counterfactual outcome, that is, the outcome a unit exposed to treatment would have achieved if it had not received treatment. The counterfactual outcome is not observable, so we need a suitable proxy to identify the ATT. If the treatment is randomly assigned, then the average outcome of units not exposed to treatment, E[Y^0|EITI = 1], is a proper substitute. However, as discussed before, EITI implementation and, thus, selection into treatment could be endogenous. In general, the idea of matching estimators is to mimic ran-

domization with regard to the assignment of the treatment. The unobserved counterfactual outcome is imputed by matching the treated units with untreated units that are as similar as possible with regard to all pre-treatment characteristics that *(i)* are associated with selection into treatment (i.e., the likelihood of implementing the EITI standards) and *(ii)* influence the outcome of interest. The realization of EITI adoption for these matches is then used as an empirical proxy for the unobserved counterfactual. Formally, the estimate of the ATT based on matching is defined as follows :

$$\tau_{ATT}(x) = E[Y^1|EITI = 1, X = x] - E[Y^0|EITI = 0, X = x] \quad (4.2)$$

x is a vector of pre-treatment characteristics, $\mathrm{E}[Y^1|EITI = 1, X = x]$ is the expected outcome for the units that received treatment, and $\mathrm{E}[Y^0|EITI = 0, X = x]$ is the expected outcome for the treated units' best matches.

4.5 Preliminary Results : Direct Impact of EITI Membership on Financial Development

Before proceeding to more detailed analyses, we first investigate the average aggregate impact of EITI Membership on financial development, testing for different sets of dependent and explanatory variables.

4.5.1 Baseline results

Table 4.2 shows the sample means of all matching variables both for the EITI group, non-EITI groups and the differences in means between these two groups according to the stage of EITI implementation. Given these descriptive statistics, selecting an adequate control group is crucial before estimating the treatment effect using the matching approach. Otherwise, the estimated treatment effect of EITI implementation on financial development might be biased. After weighting, we remark that the differences in means and variance between the treatment and synthetic control groups are statistically insignificant. Entropy balancing allows for obtaining a perfect control group for our treated units.

Based on the synthetic control group from Table 4.2, we estimate the impact of EITI implementation on two measures of financial development using

Table 4.2 : Variable Means Before and After Weighting

	Before weighting								
	EITI Commitment			EITI Candidacy			EITI Compliance		
	Treat	Control	Diff.	Treat	Control	Diff.	Treat	Control	Diff.
Resources	11.17	13.24	2.07	10.86	13.24	2.38	11.32	12.95	1.63
GDPPC	8.532	9.331	0.79	8.537	9.331	0.79	8.355	9.246	0.891
Inflation	6.999	10.51	3.511	6.682	10.51	3.828	5.23	10.26	5.03
Trade	68.82	77.36	8.54	68.56	77.36	8.8	69.46	76.15	6.69
Public	24.61	28.37	3.76	24.7	28.37	3.67	23.3	28.03	4.73
ICRG	57.74	64.34	6.6	57.6	64.34	6.74	55.5	63.73	8.23
Obs.	298	1027		255	1027		141	1184	
	After weighting								
	EITI Commitment			EITI Candidacy			EITI Compliance		
	Treat	Control	Diff.	Treat	Control	Diff.	Treat	Control	Diff.
Resources	11.17	11.16	-0.00	10.86	10.85	-0.00	11.32	11.32	0.00
GDPPC	8.532	8.53	-0.00	8.537	8.536	-0.00	8.355	8.353	0.00
Inflation	6.999	7.002	0.00	6.682	6.684	0.00	5.23	5.232	-0.00
Trade	68.82	68.79	-0.02	68.56	68.55	-0.01	69.46	69.45	-0.00
Public	24.61	24.6	-0.00	24.7	24.69	-0.00	23.3	23.29	-0.01
ICRG	57.74	57.74	0.00	57.6	57.61	0.00	55.5	55.5	0.00
Obs.	298	298		255	255		141	141	

weighted least square regressions. In total, we provide ten sets of treatment effect estimates based on different treatment indicators, with and without the controls, according to the stages of EITI implementation (*Commitment, Candidacy, and Compliance*). In our primary approach, considering the year of commitment as the beginning of treatment, the control group is only constituted of non-EITI countries. Considering the year of candidacy as the beginning of treatment, the control group comprises non-EITI countries and countries with only committed status. With the compliance year as the start of treatment, the control group comprises non-EITI countries and countries with commitment and/or candidate status. In our sample of EITI countries, in average, there is a two-year gap between commitment to the EITI and achieving candidate country status. This would explain the smaller effect when considering the EITI candidacy date as the start of treatment, keeping the commitment observations in the pre-treatment periods. The countries that EITI candidates and EITI compliant countries have essentially the same characteristics. This would explain the less pronounced effect when considering the date of EITI compliance as the start of treatment and keeping the commitment and candidacy observations in the pre-treatment periods.

Table 4.3 presents results for a baseline model assessing the impact of EITI implementation on domestic credit to the private sector, using a binary variable taking the value 1 if EITI is implemented and 0 otherwise. The results indicate that the financial sector is more developed in EITI counties compared to non-EITI countries. For each level of treatment, we first estimate without covariates (columns [1-3-5-7-9]) and then with covariates (columns [2-4-6-8-10]) in the specification. All of our specifications include country-fixed effects and time-fixed effects. The results show that EITI commitment, candidacy, and compliance contribute positively and significantly to private sector credit. The estimated ATTs remain robust with the inclusion of covariates. With covariates, the Average Treatment Effect on Treated (ATT) is about 4.2 percentage points if treatment is started in the EITI commitment year, about 5.4 percentage points if treatment is started in the candidacy year, and about 6.9 percentage points if treatment is started in compliance year. we consider the treatment at the candidacy and compliance dates by removing the observations from the previous steps (i.e., the period corresponding to the commitment on the one hand, and on the other hand, the two periods corresponding to the commitment and the candidacy, respectively), the ATTs are more important for commitment than for candidacy (see columns [5-6] and [9-10] compared to columns [3-4] and [7-8]). These results suggest that the effects of the different implementation steps add up to each other. In other words, the financial sector is more developed in EITI-committed countries than in non-committed ones, higher in EITI candidate countries than in "only" committed countries, and higher in EITI compliant countries than in "only" candidate countries.

Table 4.4 reports the estimated ATTs of EITI implementation using the financial institutions' depth as the dependent variable. Results are consistent with previous findings that EITI implementation improves financial development in resource-rich countries. Considering the different implementation steps, all three contribute positively and significantly to the growing financial institutions' depth index of about 1.2 percentage points, 1.8 percentage points, and 2.1 percentage points, respectively.

Table 4.3 : Average Treatment Effect of EITI Implementation on Credit using Entropy Balancing

Dependent Var. :	EITI Commitment		EITI Candidacy				EITI Compliance			
Domestic Credit	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
EITI	4.592***	4.184***	4.525***	4.073***	5.667***	5.422***	-0.131	1.141**	3.517***	6.882***
	(1.036)	(1.034)	(0.922)	(0.900)	(1.065)	(1.058)	(0.602)	(0.566)	(1.303)	(1.232)
Including Covariates	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Including Commitment stage Obs.	Yes	Yes	0*	0*	No*	No*	0*	0*	No	No*
Including Candidacy stage Obs.	Yes	Yes	Yes	Yes	Yes	Yes	0*	0*	No	No*
Including Compliance stage Obs.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,128	1,128	1,128	1,128	1,089	1,089	1,128	1,128	985	985
R-squared	0.969	0.974	0.975	0.979	0.976	0.980	0.977	0.982	0.977	0.982
P(F-test)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Robust standard errors in parentheses ; *** p<0.01, ** p<0.05, * p<0.1 ; 0* indicates that we keep the observations of the said stage (commitment and/or candidacy) in the pre-EITI adoption period. 0* indicates that we delete the observations of the stages prior to the considered EITI implementation stage.

Table 4.4 : Average Treatment Effect of EITI Implementation on FID using Entropy Balancing

Dependent Var. :	EITI Commitment		EITI Candidacy				EITI Compliance			
Financial Institutions Depth	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
EITI	1.519***	1.246***	1.696***	1.388***	2.138***	1.794***	-0.0841	-0.0636	1.847***	2.061***
	(0.335)	(0.340)	(0.299)	(0.301)	(0.352)	(0.360)	(0.155)	(0.150)	(0.339)	(0.323)
Including Covariates	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Including Commitment stage Obs.	Yes	Yes	0	0	No	No	0	0	No	No
Including Candidacy stage Obs.	Yes	Yes	Yes	Yes	Yes	Yes	0	0	No	No
Including Compliance stage Obs.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,311	1,311	1,311	1,311	1,270	1,270	1,311	1,311	1,158	1,158
R-squared	0.986	0.987	0.989	0.990	0.989	0.990	0.993	0.994	0.993	0.994
P(F-test)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Robust standard errors in parentheses ; *** p<0.01, ** p<0.05, * p<0.1 ; 0* indicates that we keep the observations of the said stage (commitment and/or candidacy) in the pre-EITI adoption period. 0* indicates that we delete the observations of the stages prior to the considered EITI implementation stage.

4.5.2 Results with Alternative Covariates

We test the robustness of our results to alternative sets of covariates. We first include the log of GDP per capita and Foreign Direct Investment, which are often found to be key determinants of financial development. Then, we include separately the ICRG and WGI indexes to account for institutional quality and political stability. Results with the EITI Commitment step are reported in table 4.5 for both domestic credit and financial institutions' depth. In all three models, EITI membership is positively associated with financial development. It is also noticeable that the use of alternative sets of covariates does not strongly affect the average treatment effect estimated. Ove-

rall, all previous results confirm our baseline hypothesis that EITI membership contributes to the development of the financial sector in resource-rich countries.

Table 4.5 : Change in ATT of EITI Commitment with Alternative Covariates

Dependent Var. : Domestic Credit	Credit [1]	Credit [2]	Credit [3]	FINDEPTH [4]	FINDEPTH [5]	FINDEPTH [6]
EITI	3.616***	3.669***	3.716***	1.053***	1.053***	1.014***
	(0.925)	(0.920)	(0.998)	(0.286)	(0.285)	(0.311)
Incl. GDPPC and FDI	Yes	Yes	Yes	Yes	Yes	Yes
Incl. ICRG	No	Yes	No	No	Yes	No
Incl. WGI	No	No	Yes	No	No	Yes
Country-fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Time-fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,112	1,112	978	1,295	1,295	1,115
R-squared	0.975	0.975	0.975	0.989	0.989	0.989

Robust standard errors in parentheses : *** p<0.01, ** p<0.05, * p<0.1

4.6 Main Results : Does EITI Membership Mitigate the Financial Development Curse ?

Now that we have ensured that the baseline empirical model is robust to alternative specifications, we want to investigate if EITI membership has a mitigation impact on a potential financial development curse caused by natural resources. To that aim, we keep our baseline economic and econometric models but include an interaction term between EITI implementation and natural resources. This will help us to determine whether the positive impact of EITI membership increases as the level of natural resources increases. For simplicity, we consider in this section only domestic credit to the private sector (% GDP), the main indicator used to measure a country's financial development. We also consider the treatment variable starting from the date of the country's commitment to implement the EITI standard [3].

[3]This is mainly to avoid an unnecessary accumulation of results and because preliminary results reveal that the choice of the implementation step does not really affect our results. However, regressions are made for all EITI steps and remain available on demand.

4.6.1 Baseline results using Fixed-Effects and Random-Effects

We investigate the impact of EITI implementation steps on financial development using a standard Ordinary Least Square (OLS) approach with time and country-fixed effects. More precisely, we estimate the following regression :

$$Credit_{it} = \alpha + \beta_1 Res_{it} + \beta_2 (EITI_{it} \times Res_{it}) + \beta_3 EITI_{it} + \gamma X_{it} + \lambda_i + \mu_t + \epsilon_{it} \quad (4.3)$$

Where Credit$_{it}$ represents domestic credit to the private sector to GDP for country i at time t, $EITI_{it}$ is a binary variable equal to 1 if the country is a member of the EITI from a given year, Res_{it} represents natural resource rent to GDP for country i at time t, X_{it} represents the vecto of covariables, λ_i and μ_t capture country and time fixed-effects respectively. β_1 captures the presence of a resource curse (if any) while β_2 measures the mitigation effect of the EITI. We also include the EITI binary variable to account for a potential constant effect of adhering to the EITI but our main focus remains on the interaction term, as β_3 does not capture the EITI mitigation effect and can be interpreted as a constant in our regressions.

Equation (4.3) is regressed separately for each EITI adhesion step. When using EITI Commitment, we consider the first year of commitment as the beginning of treatment and use non-EITI countries as the control group. With EITI Candidacy, the treatment begins with the first year of candidacy, while the control group comprises both non-EITI units and commitment step units. Finally, taking the compliance year as the start of processing, the control group comprises non-EITI units, commitment stage units, and candidacy stage units. All results are reported in Table 4.6. As expected, the coefficient for natural resources is negative and strongly significant in every regression, suggesting that natural resources tend to generate a financial resource curse, in line with the empirical literature. However, the positive and significant values of β_2 in all regressions reveal a mitigation impact of EITI membership for every implementation step. Based on column (1) of Table 4.6, a 1 percentage point increase in natural resources is associated with a decrease in the domestic credit/GDP ratio of 0.406 percentage points for non-EITI coun-

tries and 0.152[4] percentage points for EITI members. The negative impact of natural resources on financial development in EITI countries represents, therefore, only one-third of the same impact in non-EITI countries[5]. Finally, it must be noted that the inclusion of institutional quality variables (Regulation and Democracy) does not affect our baseline results. Regarding the control variables, GDP per capita, Trade openness, and (to a lesser extent) Regulation have an expected positive impact on financial development, although inflation, FDI, and ICRG are not significant in any regressions.

However, the interpretation of our coefficients of interest suffers from several limitations. Indeed, due to the definition of our EITI membership variables, the coefficient associated with each implementation step compares countries at this stage or at a later stage of the EITI admission process to countries at any preceding stages (or non-EITI countries), implying that the coefficient for EITI compliance corresponds to the impact of being a compliant country to being a non-EITI, an EITI committed or an EITI candidate (but not compliant) country. To investigate the effect of each EITI implementation stage separately compared with the non-EITI situation, we run the same regressions but after dropping for each step the observations for countries at any other step. In that case, the coefficients indicate the impact of each specific EITI stage compared to the non-EITI situation only. Results are displayed in Table 4.7. We observe that the interaction term is positive in every regression but not significant for EITI commitment, significant at 10% or 5% for EITI candidacy, and significant at 1% for EITI compliance, with an average coefficient increasing as the level of EITI membership increases. In contrast, the negative coefficient associated with natural resources does not seem to vary across specifications. These results highlight a positive impact of EITI membership that tends to increase with each additional step, being the highest in compliance.

Based on the results in Table 4.7, we present in Figure 4.2 the effect of natural resources on domestic credit for non-EITI countries, EITI committed,

[4]Because the total effect est : $\beta_1 + \beta_2$= -0.406 + 0.254 = -0.152

[5]More precisely, EITI commitment offsets on average 0.254/0.406=63% of the financial resource curse compared with non-EITI countries, EITI candidacy offsets 0.251/0.375=67% of this effect compared with non-EITI or EITI committed countries, and EITI compliance offsets 0.227/0.352=64% of this effect compared with non-EITI, EITI committed and EITI candidates.

Table 4.6 : Impact of the EITI on Domestic Credit Using Fixed-Effects

Variables	Credit (1)	Credit (2)	Credit (3)	Credit (4)	Credit (5)	Credit (6)	Credit (7)	Credit (8)	Credit (9)
Resource	-0.406***	-0.384***	-0.502***	-0.375***	-0.353***	-0.465**	-0.352***	-0.332***	-0.439**
	(0.137)	(0.127)	(0.188)	(0.133)	(0.120)	(0.187)	(0.129)	(0.116)	(0.190)
Resource × Commitment	0.254**	0.242**	0.267*						
	(0.118)	(0.111)	(0.135)						
Resource × Candidacy				0.251**	0.243**	0.250*			
				(0.114)	(0.101)	(0.132)			
Resource × Compliance							0.227**	0.205**	0.222*
							(0.0982)	(0.0835)	(0.116)
Commitment	-6.758**	-6.326**	-6.075**						
	(2.791)	(2.617)	(2.989)						
Candidacy				-7.772**	-7.776***	-7.142**			
				(2.978)	(2.805)	(3.285)			
Compliance							-7.188***	-6.671***	-6.692***
							(2.308)	(2.135)	(2.491)
GDPPC	15.50***	12.23**	16.35***	15.69***	12.23**	16.46***	16.17***	13.11**	16.95***
	(5.140)	(5.817)	(5.589)	(5.086)	(5.692)	(5.536)	(5.102)	(5.722)	(5.550)
Inflation	-0.355	-0.395	-0.466	-0.391	-0.442	-0.521	-0.390	-0.453	-0.518
	(0.382)	(0.397)	(0.462)	(0.380)	(0.398)	(0.454)	(0.393)	(0.396)	(0.471)
Trade	0.158**	0.137***	0.192***	0.158**	0.137***	0.190***	0.144**	0.124**	0.177**
	(0.0619)	(0.0510)	(0.0692)	(0.0613)	(0.0501)	(0.0692)	(0.0632)	(0.0517)	(0.0708)
Public	0.123	0.212**	0.134	0.123	0.216**	0.134	0.114	0.206**	0.122
	(0.0885)	(0.0986)	(0.122)	(0.0867)	(0.0973)	(0.122)	(0.0864)	(0.0966)	(0.122)
FDI	-0.0467	-0.0469	-0.0829	-0.0258	-0.0264	-0.0496	-0.0232	-0.0269	-0.0501
	(0.0603)	(0.0530)	(0.0713)	(0.0569)	(0.0497)	(0.0704)	(0.0596)	(0.0536)	(0.0745)
Regulation		5.102*			5.675*			4.680	
		(2.952)			(2.876)			(2.911)	
Democracy			-0.585			-0.547			-0.590
			(0.832)			(0.817)			(0.823)
Constant	-118.8***	-88.68*	-125.2**	-120.7***	-88.87*	-126.3**	-124.0***	-96.17*	-129.9***
	(43.36)	(50.59)	(47.98)	(42.89)	(49.47)	(47.56)	(43.20)	(49.93)	(47.84)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,292	1,139	1,112	1,292	1,139	1,112	1,292	1,139	1,112
Countries	71	71	59	71	71	59	71	71	59
R2	0.465	0.473	0.467	0.470	0.481	0.471	0.463	0.472	0.465

Note : "Commitment" equals 1 for countries at the EITI commitment stage or any later stage (Candidacy or Compliance) and 0 for non-EITI countries. "Candidate" equals 1 for countries at the EITI candidacy stage or any later stage (Compliance) and 0 for non-EITI and EITI committed countries. "Compliance" equals 1 for compliant countries and 0 for non-EITI, EITI committed and EITI candidate countries. Results are estimated with OLS with Country and Time Fixed Effects. Clustered Standard errors in parentheses : *** p<0.01, ** p<0.05, * p<0.1

EITI candidates, and EITI compliant countries separately (all other variables being set at their value). In line with previous results (Corrigan, 2017a), Figure 3 reveals that while EITI membership is associated with lower financial sector development for low levels of natural resources compared to non-EITI members, this effect tends to decline as resource rents increase until it eventually becomes positive. Furthermore, each additional implementation step increases the impact on the financial sector. These benefits become evident when a typical country has around a 15% dependence on resource rents to GDP. In a typical country that is 20% dependent on resource rents, the realized financial development impact is a 3-percentage point increase in credit

to the private sector (in % GDP) compared to a non-EITI member country for any EITI implementation step. At 80% dependence (which is the extreme value of our sample reached only by Timor-Leste in 2015), the positive effect is an 8-9 ppt increase in credit to the private sector for committed countries and a 20 ppt increase for compliant countries compared to non-EITI members. Overall, these results indicate that (i) the EITI contributes to mitigating the resource curse on the financial sector and (ii) each additional EITI implementation stage reinforces this mitigation effect.

Table 4.7 : Impact of the EITI on Domestic Credit with non-EITI Countries as Reference

Variables	Credit (1)	Credit (2)	Credit (3)	Credit (4)	Credit (5)	Credit (6)	Credit (7)	Credit (8)	Credit (9)
Resource	-0.597***	-0.604***	-0.692***	-0.574***	-0.586***	-0.665***	-0.502***	-0.513***	-0.577***
	(0.0561)	(0.0584)	(0.0687)	(0.0562)	(0.0581)	(0.0685)	(0.0513)	(0.0522)	(0.0626)
Resource × Commitment	0.101	0.0979	0.131						
	(0.112)	(0.114)	(0.125)						
Resource × Candidacy				0.162*	0.170*	0.223**			
				(0.0985)	(0.102)	(0.106)			
Resource × Compliance							0.288***	0.264***	0.293***
							(0.0842)	(0.0836)	(0.0955)
EITI Commitment	-1.293	-0.719	-1.086						
	(2.176)	(2.210)	(2.406)						
EITI Candidacy				-0.204	0.275	-0.238			
				(1.652)	(1.694)	(1.775)			
EITI Compliance							-2.838*	-2.251	-2.756
							(1.577)	(1.646)	(1.789)
Controls Included	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regulation	No	Yes	No	No	Yes	No	No	Yes	No
Democracy	No	No	Yes	No	No	Yes	No	No	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,009	856	870	1,079	926	935	1,128	975	969
Countries	68	68	57	69	69	58	71	71	59
R2	0.368	0.370	0.381	0.361	0.366	0.375	0.393	0.394	0.402

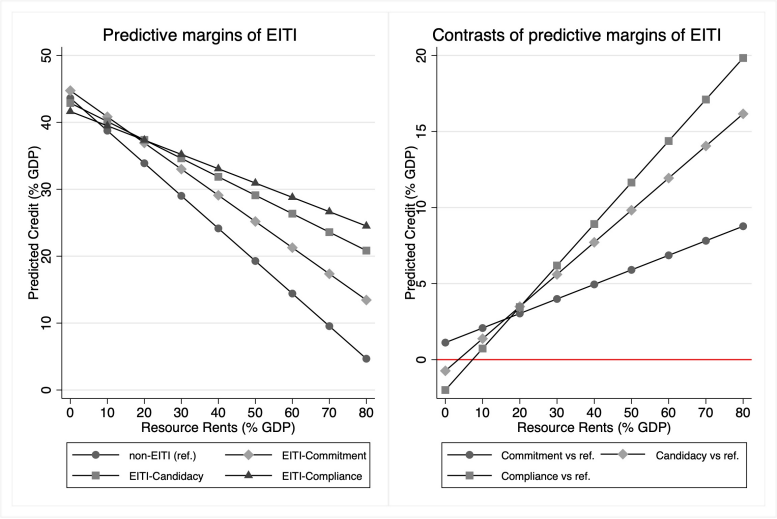
Note : In "EITI Commitment" regressions, we drop observations if the country is candidate or compliant. In "EITI Candidate" regressions, we drop observations if the country is compliant or committed but not candidate. In "EITI Compliance", we drop observations if the country if committed or candidate but not compliant. The controls included in every regression are GDPPC, Inflation, Trade openness, Public expenditures and FDI inflows. The coefficients associated with each step compares the impact of this step with the non-EITI situation. Results are estimated with OLS with Country and Time Fixed Effects. Standard errors in parentheses : *** p<0.01, ** p<0.05, * p<0.1

4.6.2 Robestness check

Using Financial Institutions Depth as an Alternative Outcome

Then, we test the robustness of our results using an alternative measure of financial development, namely the "depth of financial institutions"

Figure 4.2 : Effect of EITI Membership on Credit at Varying Levels of Natural Resource Rents



indicator (IMF). This index is defined in section 4 and ranges from 0 (lowest) to 100 (highest financial depth). We apply the same methodology as in Tables 4.6 and 4.7 with this new variable and report results in Tables 4.8 and 4.9. Overall, results support our baseline estimations, at least for EITI compliance, as the mitigating impact of EITI membership remains positive in all regressions but significant only for compliance. In addition, even if both the negative impact of natural resources and the positive impact of the interaction term decline compared to Tables 4.6 and 4.7, the ratio between them remains approximately the same, suggesting an important mitigation effect of EITI compliance.

Random-Effects Generalized Least Square Estimates

As an additional robustness test, we employ a Generalized Least Square (GLS) model with an AR(1) autocorrelation structure to account for potential autocorrelation in our data. We apply the same methodology as in baseline regressions and display results with this alternative methodology in Tables

Table 4.8 : Impact of the EITI on Financial Institutions Depth

Variables	FID FE1 (1)	FID FE2 (2)	FID FE3 (3)	FID FE4 (4)	FID FE5 (5)	FID FE6 (6)	FID FE7 (7)	FID FE8 (8)	FID FE9 (9)
Resource	-0.119***	-0.0967**	-0.152***	-0.112***	-0.0893**	-0.143**	-0.102**	-0.0798**	-0.128**
	(0.0438)	(0.0397)	(0.0559)	(0.0418)	(0.0373)	(0.0543)	(0.0404)	(0.0358)	(0.0534)
Resource × Commitment	0.0590	0.0591	0.0705						
	(0.0425)	(0.0396)	(0.0482)						
Resource × Candidacy				0.0559	0.0536	0.0610			
				(0.0404)	(0.0366)	(0.0455)			
Resource × Compliance							0.0693**	0.0566**	0.0762**
							(0.0286)	(0.0257)	(0.0327)
Commitment	-1.669	-1.443	-1.765						
	(1.206)	(1.050)	(1.328)						
Candidacy				-1.787	-1.580	-1.873			
				(1.233)	(1.063)	(1.386)			
Compliance							-3.034***	-2.507***	-3.303***
							(0.876)	(0.820)	(0.996)
Controls Included	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regulation	No	Yes	No	No	Yes	No	No	Yes	No
Democracy	No	No	Yes	No	No	Yes	No	No	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,510	1,305	1,285	1,510	1,305	1,285	1,510	1,305	1,285
Countries	69	69	57	69	69	57	69	69	57
R2	0.458	0.438	0.476	0.459	0.439	0.476	0.468	0.447	0.486

Note : "Commitment" equals 1 for countries at the EITI commitment stage or any later stage (Candidacy or Compliance) and 0 for non-EITI countries. "Candidate" equals 1 for countries at the EITI candidacy stage or any later stage (Compliance) and 0 for non-EITI and EITI committed only countries. "Compliance" equals 1 for compliant countries and 0 for non-EITI countries and countries at any preceding stage (Commitment or Candidacy). Results are estimated with OLS with Country and Time Fixed Effects. Standard errors in parentheses : *** p<0.01, ** p<0.05, * p<0.1

4.10 and 4.11. These results overall confirm our baseline estimations since the interaction term between resources and EITI membership is positive and most of the time significant but with a lower magnitude than the negative impact of natural resources, suggesting that approximately half of the financial resource curse effect might be offset by the EITI, even if the magnitude of this mitigation declines when accounting for institutional quality. However, when restricting the sample size and comparing each stage directly to the non-EITI situation, this coefficient increases at each step and becomes significant at the candidacy stage. This supports our previous claim that adhering to the EITI contributes to resource curse mitigation for the financial sector, and that effect increases with each additional step.

4.7 Transmission Channels

In this section, we aim to explore potential transmission channels for this mitigation effect of EITI membership. Our goal is not to perform a ro-

Table 4.9 : Impact of the EITI on Financial Institutions Depth with non-EITI Countries as Reference

	FE1	FE2	FE3	FE4	FE5	FE6	FE7	FE8	FE9
	FID	FID	FID	FID	FID	FID	FID	FID	FID
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Resource	-0.132***	-0.133***	-0.155***	-0.135***	-0.139***	-0.160***	-0.123***	-0.125***	-0.141***
	(0.0191)	(0.0191)	(0.0231)	(0.0199)	(0.0200)	(0.0242)	(0.0179)	(0.0177)	(0.0217)
Resource × Commitment	0.0246	0.0336	0.0461						
	(0.0467)	(0.0466)	(0.0525)						
Resource × Candidacy				0.0109	0.0187	0.0394			
				(0.0401)	(0.0412)	(0.0444)			
Resource × Compliance							0.103***	0.0888***	0.121***
							(0.0350)	(0.0342)	(0.0401)
Commitment	0.447	0.329	0.0959						
	(0.793)	(0.782)	(0.868)						
Candidacy				1.394**	1.346**	1.032			
				(0.600)	(0.607)	(0.644)			
Compliance							-1.931***	-1.410**	-2.482***
							(0.553)	(0.559)	(0.626)
Controls Included	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regulation	No	Yes	No	No	Yes	No	No	Yes	No
Democracy	No	No	Yes	No	No	Yes	No	No	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,224	1,019	1,040	1,300	1,095	1,111	1,336	1,131	1,132
Countries	68	68	57	68	68	57	69	69	57
R2	0.365	0.356	0.393	0.351	0.336	0.375	0.381	0.376	0.405

Note : In "EITI Commitment" regressions, we drop observations if the country is candidate or compliant. In "EITI Candidate" regressions, we drop observations if the country is compliant or committed but not candidate. In "EITI Compliance", we drop observations if the country is committed or candidate but not compliant. The controls included in every regression are GDPPC, Inflation, Trade openness, Public expenditures, and FDI inflows. The coefficients associated with each implementation step compares the impact of this step with the non-EITI situation. Results are estimated with OLS with Country and Time Fixed Effects. Standard errors in parentheses : *** p<0.01, ** p<0.05, * p<0.1

bust analysis of all possible channels but to briefly explore some of the most likely and propose a discussion on these channels. We select a few variables as transmission channels based on the discussion in sections 2 and 3. We use five main variables for overall institutional quality : "Control of Corruption" (WGI) as corruption is likely to impede financial development ; (ii) "Regulatory Quality" (WGI) and (iii) "Investment Profile" (ICRG) to explore the general investment and business environment as financial development depends on this environment ; (iv) "Democratic Accountability" (ICRG) and (v) "Bureaucratic Accountability" (ICRG) to determine if the EITI can increase government accountability towards citizens through transparency and/or can increase the quality of bureaucratic institutions. Corruption, the business environment, democracy, and bureaucratic quality are all expected to be negatively affected by natural resources but to benefit from EITI membership through the increase in transparency and the improvement in the technocratic process (see Section 3). In addition to these institutional variables, we also

Table 4.10 : Impact of the EITI on Domestic Credit Using RE-GLS

Variables	Credit (1)	Credit (2)	Credit (3)	Credit (4)	Credit (5)	Credit (6)	Credit (7)	Credit (8)	Credit (9)
Resource	-0.499***	-0.425***	-0.636***	-0.484***	-0.420***	-0.610***	-0.476***	-0.400***	-0.606***
	(0.0398)	(0.0394)	(0.0474)	(0.0384)	(0.0383)	(0.0457)	(0.0383)	(0.0378)	(0.0458)
Resource × Commitment	0.246***	0.216***	0.215***						
	(0.0571)	(0.0574)	(0.0688)						
Resource × Candidacy				0.244***	0.228***	0.171**			
				(0.0580)	(0.0590)	(0.0714)			
Resource × Compliance							0.216***	0.195***	0.105
							(0.0672)	(0.0671)	(0.0835)
Commitment	-3.285**	-3.587***	-2.635*						
	(1.344)	(1.368)	(1.480)						
Candidacy				-3.200**	-3.416**	-2.389*			
				(1.300)	(1.331)	(1.440)			
Compliance							-4.942***	-4.662***	-3.094*
							(1.636)	(1.643)	(1.870)
Controls Included	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regulation	No	Yes	No	No	Yes	No	No	Yes	No
Democracy	No	No	Yes	No	No	Yes	No	No	Yes
Observations	1,292	1,139	1,112	1,292	1,139	1,112	1,292	1,139	1,112
Countries	71	71	59	71	71	59	71	71	59

Note : "Commitment" equals 1 for countries at the EITI commitment stage or any later stage (Candidacy or Compliance) and 0 for non-EITI countries. "Candidate" equals 1 for countries at the EITI candidacy stage or any later stage (Compliance) and 0 for non-EITI and EITI committed countries. "Compliance" equals 1 for compliant countries and 0 for non-EITI, EITI committed and EITI candidate countries. Results are estimated with Random Effects - Generalized Least Squares. Standard errors in parentheses : *** p<0.01, ** p<0.05, * p<0.1

Table 4.11 : Impact of the EITI on Domestic Credit Using RE-GLS with non-EITI Countries as Reference

Variables	Credit (1)	Credit (2)	Credit (3)	Credit (4)	Credit (5)	Credit (6)	Credit (7)	Credit (8)	Credit (9)
Resource	-0.496***	-0.435***	-0.618***	-0.512***	-0.418***	-0.615***	-0.462***	-0.400***	-0.586***
	(0.0426)	(0.0426)	(0.0500)	(0.0437)	(0.0423)	(0.0502)	(0.0394)	(0.0387)	(0.0466)
Resource × Commitment	0.0459	0.0314	0.0923						
	(0.0856)	(0.0881)	(0.0930)						
Resource × Candidacy				0.166*	0.156*	0.194**			
				(0.0898)	(0.0884)	(0.0961)			
Resource × Compliance							0.232***	0.211***	0.143*
							(0.0652)	(0.0656)	(0.0794)
Commitment	0.559	0.136	0.595						
	(1.621)	(1.675)	(1.706)						
Candidacy				-0.398	-0.927	-0.0449			
				(1.623)	(1.608)	(1.691)			
Compliance							-2.154	-2.191	-0.0266
							(1.650)	(1.680)	(1.868)
Controls Included	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regulation	No	Yes	No	No	Yes	No	No	Yes	No
Democracy	No	No	Yes	No	No	Yes	No	No	Yes
Observations	1,008	855	869	1,078	925	934	1,127	974	968
Countries	67	67	56	68	68	57	70	70	58

Note : In "EITI Commitment" regressions, we drop observations if the country is candidate or compliant. In "EITI Candidate" regressions, we drop observations if the country is compliant or committed but not candidate. In "EITI Compliance", we drop observations if the country if committed or candidate but not compliant. The controls included in every regression are GDPPC, Inflation, Trade openness, Public expenditures and FDI inflows. The coefficients associated with each implementation step compares the impact of this step with the non-EITI situation. Results are estimated with Random Effects - Generalized Least Squares. Standard errors in parentheses : *** p<0.01, ** p<0.05, * p<0.1

estimate the impact of resources and the EITI on Foreign Direct Investment inflows (WEO), as they may contribute to the development of the financial sector and reveal the confidence of foreign investors in the domestic investment climate, and Public Debt (WEO) since excessive Public Debts suggest mismanagement of public revenues that is expected to be (at least partly) offset by the EITI implementation (through "Name and Shame", "Public Debate" and "Technical Reform" models). Finally, it has been argued in the literature that natural resources can impede financial development through "Dutch disease" effects (see Section 2) and that the EITI can contribute to better public policies against Dutch disease (see Section 3). Since a Dutch disease is expected to translate into a decline in tradable activities (traditionally associated with manufacture) and a boom in non-tradable activities (services). Thus, we investigate the possibility of potential Dutch disease by estimating the impact of the EITI and resources on the manufacture value added to Services value added ratio (WDI). To ensure that our variables are likely to be transmission channels, we display in Table D1 (Appendix) the correlation matrix between Credit to GDP ratio and all of these variables. As expected, all variables are significantly (at 5%) and positively correlated with Credit, except FDI (not significant) and Public Debt (significantly and negatively correlated with Credit). The negative impact of Public Debt with financial development is in line with the estimations, as public indebtedness may reveal inefficient management of public revenues and/or translate into an unstable financial environment. We proceed now to the estimations. All results are displayed in Table 4.12. Regarding institutional variables, we observe an expected negative impact of natural resources on corruption, democratic accountability, and bureaucratic accountability and a positive impact of at least one EITI implementation step on these variables and on regulatory quality and investment profile. These results suggest that resources tend to reduce accountability, impair democratic institutions, and encourage corruption in resource-rich countries but that the EITI can mitigate these effects. However, the insignificant effect of resources on regulatory quality and the positive one on the investment profile questions the idea that natural resources have a negative impact on the business environment. Even though the EITI has an overall positive impact on all measures of institutional variables, the mitigation effect is maximized for the effectiveness of technocratic institutions and for the fight against corruption. Additionally, natural resources

tend to discourage FDI inflows, while EITI membership encourages them. This suggests a positive impact of the EITI on the confidence of foreign investors, in line with the expectations. EITI candidacy and EITI compliance are also significantly associated with a decline in public debt, which could reveal better management of government revenues, consistent with the positive impact of the EITI on accountability. Finally, even though compliance has a positive impact on the manufacture-to-service ratio, commitment and candidacy steps are insignificant, as well as resources. This result does not support the hypothesis that the EITI could contribute to financial resource curse mitigation by preventing Dutch disease. However, more detailed analyses are required on the subject.

Table 4.12 : Impact of EITI and Resources on Potential Transmission Channels Using Fixed-Effects

Variables	Control of Corruption (1)	Regulatory Quality (2)	Investment Profile (3)	Democratic Accountability (4)	Bureaucratic Accountability (5)	FDI (6)	Public Debt (7)	Manufacture to Service (8)
Commitment	-0.0321	0.0612*	-0.272	0.186	-0.0088	0.917	-2.696	-0.0769
	(0.0305)	(0.0338)	(0.205)	(0.115)	(0.0406)	(0.737)	(3.349)	(0.0483)
Candidacy	0.0564**	0.154***	0.396**	0.221**	0.0157	2.216***	-14.16***	-0.0383
	(0.0244)	(0.0271)	(0.156)	(0.0872)	(0.0308)	(0.572)	(2.640)	(0.0382)
Compliance	0.0138	0.109***	0.214	0.175*	0.0792**	4.569***	-22.01***	0.130***
	(0.0250)	(0.0278)	(0.160)	(0.0895)	(0.0316)	(0.577)	(2.722)	(0.0390)
Resource	-0.0020*	-0.0009	0.0207***	-0.0114**	-0.0049***	-0.0645**	-0.373***	0.0007
	(0.0011)	(0.0012)	(0.0079)	(0.0044)	(0.0016)	(0.0251)	(0.122)	(0.0018)
GDPPC	0.272***	0.528***	0.850***	0.324***	0.112***	-2.243***	-10.78***	-0.426***
	(0.0340)	(0.0378)	(0.211)	(0.118)	(0.0418)	(0.740)	(3.622)	(0.0564)
Inflation	-0.0125**	-0.0088	-0.0342	0.0188	-0.0007	0.239**	2.998***	0.00925
	(0.0054)	(0.0059)	(0.0338)	(0.0189)	(0.0067)	(0.118)	(0.574)	(0.0084)
Trade	0.00034	0.0019***	-0.0085***	-0.0002	0.0006	0.0864***	0.0270	0.0010
	(0.0004)	(0.0004)	(0.0027)	(0.0015)	(0.0005)	(0.0091)	(0.0434)	(0.0006)
Public	0.0001	-0.0024**	-0.0138*	0.0086**	0.0004	0.0048	0.410***	-0.0076***
	(0.0010)	(0.0012)	(0.0074)	(0.0041)	(0.0015)	(0.0237)	(0.116)	(0.0019)
Constant	-2.721***	-4.991***	-1.541	0.163	1.053***	15.41**	136.1***	7.107***
	(0.300)	(0.333)	(1.899)	(1.064)	(0.375)	(6.514)	(31.92)	(0.495)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,335	1,335	1,315	1,315	1,315	1,540	1,427	1,408
Countries	71	71	59	59	59	71	70	70
R2	0.080	0.185	0.330	0.115	0.099	0.136	0.280	0.124

Note : "Commitment", "Candidacy," and "Compliance" capture the three EITI implementation steps. "Control of Corruption" and "Regulatory Quality" are index from the Worldwide Governance Indicators and are defined such that a higher value means better institutions. "Investment Profile", "Democratic Accountability," and "Bureaucratic Accountability" are indexes from the International Country Risk Guide and are defined such that a higher value means better institutions. FDI captures Foreign Direct Investment Inflows and is expressed as a share of GDP (WEO). Public Debt captures General Government Debt and is expressed as a share of GDP (WEO). Manufacture to Service captures the ratio of Manufacture Value Added to Services Value Added (in logarithm) (WDI). Standard errors in parentheses ; *** p<0.01, ** p<0.05, * p<0.1.

4.8 Conclusion

This chapter analyzed the effect of EITI implementation on the emergence of a financial resource curse in a panel of 71 resource-rich countries over the period 1995-2019. For this, we applied both the canonical fixed and random effects models and the entropy balancing specification, a matching approach allowing us to avoid potential endogeneity issues arising from selection bias. The results remain robust to using alternative measures of financial development and alternative sets of covariates. Based on these results, we found robust evidence that natural resources encourage the development of a "natural resource curse" on financial development, but also that committing to the EITI standards contributes to mitigating this curse. Furthermore, it appears that each additional step in EITI implementation increases its positive impact, compliance with EITI standards providing the highest mitigation effect on a financial resource curse. Finally, we investigated several potential transmission channels to better understand the causes of this mitigation effect. We conclude that the mitigation effect of the EITI could occur through improved bureaucratic institutions, reduced corruption, and better management of public revenues. From an academic perspective, these results add up to two different strands of the economic literature that are the literature on the financial resource curse and its determinants and the literature on the impact of EITI implementation on socio-economic development, which has often neglected the financial sector. Indeed, we conclude that transparency through the EITI in the use of natural resources can help mitigate their negative impact and that this transparency can be achieved through EITI implementation, which is of importance for the understanding of the channels through which a resource curse can occur. Finally, these results have also important policy implications for resource-rich countries. Indeed, they suggest that transparency and accountability in natural resources management should be promoted in resource-rich countries to promote long-term economic development, not only from public authorities but also from private actors (such as firms engaged in exploiting these resources). However, it must be noted that the mitigation impact of EITI membership is only partial (lower than the negative impact of resource rents), suggesting that transparency is a necessary but insufficient step to ensure that natural resources could benefit economic development.

General Conclusion

La volonté trouve, la liberté choisit. Trouver et choisir, c'est penser

– Victor Hugo

The 2030 Agenda has aligned all national and international resource flows, policies, and international agreements with economic, social, and environmental priorities since the 2015 UN General Assembly on Financing for Development held in Addis Ababa. Particular emphasis is placed on domestic public resources, which represent a solid and sustainable source of development financing in emerging market economies. Given the long-experienced adverse effects of natural resources, resource-rich developing countries are encouraged to focus on transparency and governance in the extractive industries in order to improve national revenues from the natural resource windfall.

This thesis explores the empirical evidence of the political economy of extractive industries in favor of sustainable development, with governance as the main control tool. It addresses the new agenda's political challenges and opportunities, which proposes "good governance of the extractive industries" to achieve sustainable development. Focusing on developing countries, both low-income countries (LICs) and middle-income countries (MICs), this thesis devotes considerable space to two main related themes, structured around four complementary political chapters.

First, the thesis makes a strong case for what can be called "resource curse and environmental sustainability" (particularly in chapter 1). In chapter 1, the thesis contributes to the literature on the relationship between man-made and natural capital in developing countries, with a specific focus on the impact of the benefits of extractive industries on deforestation. The extractive industries may contribute to forest cover loss because of the need for a large land area for industrial production and access to infrastructure. The hypothesis tested is that access to rents from extractive industries can have a non-homogenous impact on forest cover. In other words, dedicating

resource revenues to non-deforestation-related activities can reduce forest cover loss and vice-versa. Based on a sample of 52 resource-rich developing countries over a period spanning from 2001 to 2017, provide a rigorous econometric analysis comparing the effect of extractive rents on forest cover loss. The results suggest a detrimental effect of the total rent from the extractive industries on the forest cover but suggest non-homogenous impacts according to the type of rent. More specifically, mineral and gas rents contribute to accelerating forest cover loss. In contrast, oil rents and resource tax revenues contribute to reducing forest cover loss. This evidence can be analyzed as in a "polluter pays" situation, where a fair share of the profits is earmarked obligatorily to compensate for the environmental damage caused by the exploitation of extractive industries. First, the chapter suggests that environmental protection policies must overcome regulatory inefficiencies in exploration and exploitation contracts so that environmental compensation is equal to the marginal damage caused by extractive industries. In addition, public spending should target as much economic activity as possible in order to generate the least adverse environmental impacts. Finally, companies and governments must ensure that exploitation by extractive industries results in real and positive social, economic, and environmental gains for affected communities, as suggested by the Extractive Industries Transparency Initiative (EITI) standard.

Second, the thesis analyzes the environmental and economic impacts of "transparency" through three chapters (2, 3, and 4). Chapter 2 assesses the environmental impacts of EITI implementation from a panel of 83 developing countries from 2001 to 2017 by hypothesizing that EITI implementation would boost the quality of governance in resource-rich countries and thus improve environmental policy and payments to prevent forest loss. The results show that implementing the EITI standard significantly reduces the loss of forest cover by approximately 300–760 ha. Additionally, the magnitudes of the effects are larger and more significant if we include institutional indicators that are more important for EITI-compliant countries. However, we can conclude that EITI, but not a panacea, is an effective policy program for limiting the negative impacts on forests partly caused by extractive industries. In terms of policy, this study provides clear guidance to both the EITI Board and the EITI National Committees, and more generally, to the governments of extractive resource-rich developing countries on the vital

role of the EITI in combating forest cover loss and sustainable development finance. The main limit of this chapter is that requirement 6.1 of the EITI standard requires that mandatory social expenditures and significant environmental payments be disclosed and reconciled to the extent possible. The main limitation of this chapter is that requirement 6.1 of the EITI standard requiring mandatory social expenditure and significant environmental payments to be disclosed and reconciled wherever possible was only introduced very recently. This chapter, therefore, assesses the knock-on effects of transparency on deforestation but not the indirect effect of EITI on environmental protection. Chapter 1 showed that increased public revenues reduce the environmental footprint. Chapter 2 also hypothesized that the EITI could improve environmental protection through revenue mobilization and living standards. Therefore, chapter 3 assesses the impact of EITI on tax revenue mobilization using panel data from 83 developing countries from 1995-2017. The intuition was that EITI implementation would boost the quality of governance in resource-rich countries and thus improve tax revenue mobilization. The first channel works through an equitable and transparent resource tax regime. The second channel is that transparency enhances accountability and resource allocation to productive expenditures, which contribute to an increase in non-resource revenues. Results show that EITI membership significantly improves tax revenues and suggests that compliance with EITI standards generates a considerable surplus of domestic tax revenues. Results are robust to non-resource, income tax, and resource tax revenues. In other words, EITI members are more effective than non-EITI members in mobilizing domestic revenues. In terms of the policy implications of this study, resource-rich countries could improve their tax revenue mobilization by implementing EITI in light of the requirements. Most importantly, the implementation of EITI reduces dependence on resources and the "resource curse." Countries that are already implementing the EITI need to build good institutions. However, it is crucial to remember that simply EITI implementation is not enough to guarantee transparency and better tax revenues. A series of other measures, such as compliance and responsible use of revenues, must accompany it. Another suggestion for resource-rich countries beyond this study's scope would be the need to closely monitor international tax treaties and the relationship between EITI policy and fiscal transparency, and thus, the financial resource curse. Chapter 4 assesses the effect

of EITI implementation on the emergence of a financial resource curse in a panel of 71 resource-rich countries over the period 1995-2019 by hypothesizing that the EITI, through transparency and accountability, may mitigate the negative impact of natural resource on financial sector development. Although the EITI membership is not a panacea, it does contribute to improving financial development and mitigating the financial resource curse in resource-rich developing countries. It must be noted that the mitigation impact of EITI membership is only partial (lower than the negative impact of resource rents), suggesting that transparency is a necessary but insufficient step to ensure that natural resources could benefit economic development. This chapter challenges policymakers on the fundamental role of the EITI in combating the financial resource curse and, at the same time, the role it could play in financing sustainable development.

This thesis also provides and opens up avenues for possible interesting extensions and future research. The first complementary work analyzes the impact of EITI on fiscal transparency and public spending efficiency. Second, the energy transition also has economic, environmental, and social implications for resource-rich countries such as many in Africa. It would, therefore, be wiser to extend the analyses in this thesis to the challenges of the energy transition. In other words, the aim is to explore mechanisms by which countries endowed with critical minerals could take advantage of them to finance their energy transition. A third extension of this thesis concerns the issues of tax evasion, tax avoidance, and aggressive tax optimization organized by large multinational groups via transfer pricing, distorted mining valuations, excessive interest deductions, and treaty shopping, which quite simply reduce the tax base as well as the tax burden. For example, the IMF reports that 15 African countries lose between $450 and $730 million a year in corporate income tax revenues due to the transfer of profits by multinational companies (Albertin et al., 2021). More specifically, given the challenges relating to Base Erosion and Profit Shifting (BEPS), the complementary work investigates the impact of non-double tax treaties on domestic revenue mobilization.

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APPENDIX

.1 Appendix A (Chapter 1) : The Effects of Extractive Industries Rent on Deforestation in RRDC

TABLE A1 : The effects of oil rents on forest cover loss

Dependent variable : log forest loss						
	(1)	(2)	(3)	(4)	(5)	(6)
Log forest loss (-1)	0.675***	0.689***	0.674***	0.837***	0.657***	0.576***
	(0.0995)	(0.0939)	(0.0967)	(0.174)	(0.0887)	(0.0971)
Log oil rents	-0.306***	-0.282***	-0.295***	-0.459**	-0.234**	-0.0376
	(0.0917)	(0.0906)	(0.0897)	(0.197)	(0.0964)	(0.130)
GDP per capita growth		-0.00880***	-0.00819**	-0.0110**	-0.00923***	-0.0111***
		(0.00297)	(0.00370)	(0.00549)	(0.00248)	(0.00265)
Population growth			0.0162	0.113	-0.0543	-0.116
			(0.101)	(0.150)	(0.0796)	(0.253)
Log rainfall shocks				-0.0166	0.00986***	0.0097***
				(0.0164)	(0.00313)	(0.00364)
Log NET ODA per capita					-0.349***	-0.285***
					(0.109)	(0.105)
Log internal conflict						1.135**
						(0.513)
Constant	4.048***	3.827***	4.055***	3.680***	4.341***	2.769*
	(1.205)	(1.096)	(1.215)	(1.155)	(1.062)	(1.563)
Nb. of observations	535	534	534	534	502	426
Hansen (p-value)	0.244	0.37	0.278	0.552	0.336	0.122
AR (1) p-value	0.00	0.00	0.00	0.004	0.00	0.003
AR (2) p-value	0.502	0.432	0.433	0.394	0.197	0.143
Nb. of instruments	6	9	8	10	10	17
Countries	36	36	36	36	35	30

Robust standard errors in parentheses. * p <0.10, ** p <0.05, *** p <0.01. GMM-System - Generalized method of moment's estimator with country fixed effects with study period 2001-2017. Delayed forest loss is a predetermined endogenous variable ; Rents are assumed contemporaneously endogenous ; population growth, GDP per capita growth rate, NET ODA per capita, Internal Conflict, and average rainfall are assumed to be weakly exogenous.

Table A2 : The effects of gas rents on forest cover loss

Dependent variable : log forest loss (ha)						
	(1)	(2)	(3)	(4)	(5)	(6)
Log Forest loss (-1)	0.804***	0.753***	0.746***	0.675***	0.689***	0.651***
	(0.0744)	(0.0864)	(0.0651)	(0.0838)	(0.0726)	(0.0524)
Log gas rents	0.0105	0.0164	0.0260	0.113	0.154*	0.185*
	(0.0203)	(0.116)	(0.112)	(0.0776)	(0.0843)	(0.112)
GDP per capita growth		-0.126***	-0.00936**	-0.00756***	-0.00748***	-0.0104***
		(0.0263)	(0.00429)	(0.00274)	(0.00256)	(0.00319)
Population growth			-0.145**	-0.162**	-0.128*	-0.00483
			(0.0707)	(0.0738)	(0.0677)	(0.142)
Rainfall shocks				0.0115***	0.00979***	0.0122***
				(0.00391)	(0.00322)	(0.00310)
Log NET ODA per capita					-0.134	-0.114
					(0.0915)	(0.0814)
Log Internal Conflict						1.392***
						(0.513)
Constant	2.256***	3.206***	3.211***	3.202***	3.608***	0.831
	(0.847)	(1.116)	(0.894)	(0.796)	(0.897)	(1.093)
Nb. of observations	480	479	479	479	447	388
Hansen (p-value)	0.108	0.122	0.122	0.117	0.19	0.251
AR (1) p-value	0.00	0.077	0.00	0.00	0.00	0.01
AR (2) p-value	0.781	0.452	0.467	0.32	0.103	0.134
Nb. of instruments	12	11	13	9	10	13
Countries	32	32	32	32	31	27

Robust standard errors in parentheses. * p <0.10, ** p <0.05, *** p <0.01. GMM-System - Generalized method of moment's estimator with country fixed effects with study period 2001-2017. Delayed forest loss is a predetermined endogenous variable ; Rents are assumed contemporaneously endogenous ; population growth, GDP per capita growth rate, NET ODA per capita, Internal Conflict, and average rainfall are assumed to be weakly exogenous.

Table A3 : Descriptive statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max	Source	Description
Forest loss year_20	884	1469435	5040906	0	5.86E-07	Hansen et al. (2013)	Hectares of tree cover loss, by country, from 2001 to 2018, categorized by percentage of canopy cover, canopy cover >20%
Total extractive rents	876	8.890443	13.24438	0	68.7483	WDI-World Bank	Mineral rents + Oil rents + Gas rents (% GDP)
Mineral rents	880	1.889859	3.795242	0	29.82654	WDI-World Bank	Mineral rents (% GDP)
Oil rents	876	6.512433	13.02709	0	67.5278	WDI-World Bank	Oil rents (% GDP)
Natural gas rents	876	0.4796556	1.033261	0	5.704	WDI-World Bank	Natural gas rents (% GDP)
GDP per capita growth	882	3.091272	7.296149	-62.37808	121.7795	WDI-World Bank	GDP per capita growth (annual %)
Population growth	884	1.714659	1.333731	-9.080638	7.78601	WDI-World Bank	Population growth (annual %)
Net ODA received	859	57.95048	65.60888	-26.65224	819.2875	WDI-World Bank	Net ODA received per capita (current US$)
Gross fixed capital formation	846	7.38E-13	4.15E-14	1.78E-08	4.37E-15	WDI-World Bank	Gross fixed capital formation (current LCU)
Final consumption	839	1.98E-10	5.51E-10	3.22E-07	4.88E-11	WDI-World Bank	Amount of general government final consumption expenditure (in current US$)
Total resource revenues	321	13.36433	14.3983	0.0447867	72.35043	https ://www.ictd.ac/dataset/grd/	Total natural resource revenues, including natural resource revenues, reported as
Rainfall shocks	884	96.795	67.03309	1.977812	287.8786	Climatic Research Unit, University of East Anglia and CERDI https ://data.cerdi.org/	Deviation of the yearly average of rainfall levels (mm) from
Internal conflict	705	8.673499	1.443335	2.916667	11.91667	International Country Risk Guide (ICRG)	Internal Conflict index from the ICRG database. This is an assessment of political violence in the country and its actual or potential impact on governance. A score of 4 points equates to very low risk, and a score of 0 indicates very high risk.

Table A4 : List of developing countries included in the dataset.

South Asia	East Asia & Pacific	Middle East & North Africa	Europe & Central Asia	Latin America & Caribbean	Sub-Saharan Africa
3	4	7	9	10	19
Afghanistan	Indonesia	Algeria	Albania	Argentina	Angola
Bhutan	Lao PDR	Egypt	Armenia	Belize	Botswana
India	Mongolia	Iran	Azerbaijan	Brazil	Burkina Faso
	Myanmar	Iraq	Belarus	Colombia	Cameroon
		Jordan	Bosnia and Herzegovina	Cuba	Central African Republic
		Libya	Bulgaria	Ecuador	Congo, Republic of the
		Morocco	Georgia	Guatemala	Ivory Coast
			Kazakhstan	Guyana	Equatorial Guinea
			Kyrgyzstan	Honduras	Ethiopia
				Mexico	Gabon
					Gambia, The
					Ghana
					Guinea
					Guinea-Bissau
					Lesotho
					Liberia
					Madagascar
					Mali
					Mozambique

.2 Appendix B (Chapter 2) : Does Transparency matter ? The Impact of EITI on Deforestation in RRDC

TABLE B1 : List of EITI members, event dates, and status in February 2018

EITI members	Commitment	MSG	Candidate	First Report	Valid. Report	Compliant	Suspended	Status Feb. 2018	Non-EITI members
1 Afghanistan	March-09	oct-09	Feb-10	Aug-12	Feb-13		Jan-19 -	Candidate	Algeria
2 Albania	Jan-09	March-09	May-09	March-11	Aug-11	May-13		Compliant	Angola
3 Argentina	Dec-17	Dec-18	March-19					Committed	Azerbaijan
4 Armenia	Jan-17		March-17					Candidate	Belarus
5 Burkina Faso	June-07	Dec-08	May-09	Apr-11	Sept-11	Feb-13		Compliant	Belize
6 Cameroon	Feb-05	May-05	Sept-07	Oct-06	July-10	Oct-13		Compliant	Bhutan
7 Central African Republic	Sept-07	July-08	Nov-08	Feb-09	Nov-10	March-11	April-13 -	Suspended	Bosnia and Herzegovina
8 Chad	Sept-07	Feb-10	Apr-10	Oct-12	May-13	Oct-14		Compliant	Botswana
9 Colombia	May-13	Feb-14	Oct-14					Candidate	Brazil
10 Co˙te d'Ivoire	May-07	Feb-08	May-08	Jan-10	Nov-10	May-13		Compliant	Bulgaria
11 Ethiopia	July-09	June-09	March-14	May-15				Candidate	Cuba
12 Gabon	2007		2008				2013-2019	Candidate	Ecuador
13 Ghana	May-03	Jan-05	Sept-07	Sept-07	June-10	Oct-10		Compliant	Egypt
14 Guatemala	June-10	May-12	March-11	Apr-13	Nov-13	March-14	Feb - may-15	Compliant	Equatorial Guinea
15 Guinea	March-05	Apr-05	Sept-07	July-07	Aug-12	July-14	Jan-Nov-11	Compliant	Gabon
16 Guyana	May-10	Apr-10	Oct-17					Candidate	Gambia
17 Honduras	Nov-12	Dec-12	May-13	May-15				Candidate	Georgia
18 Indonesia	Dec-08	June-10	Oct-10	May-13	July-13	Oct-14	Feb - Dec-15	Compliant	Guinea-Bissau
19 Iraq	March-09	Aug-10	Feb-10	Nov-11	Aug-12	Dec-12		Compliant	India
20 Kazakhstan	June-05	Apr-05	Sept-07	Nov-07	Aug-10	Oct-13		Compliant	Iran
21 Kyrgyzstan	Apr-04	June-08	Sept-07	Nov-09	Apr-10	March-11		Compliant	Jordan
22 Liberia	May-07	Apr-07	Sept-08	Jan-09	July-09			Candidate	Lao PDR
23 Madagascar	March-07	Jan-08	Feb-08	May-11	Sept-11		Oct-12 - Jan-14	Candidate	Lesotho
24 Malawi	June-14	March-15	Oct-15					Candidate	Libya
25 Mali	Aug-06	June-07	Sept-07	Nov-09	Sept-10	Aug-11		Compliant	Malaysia
26 Mauritania	Oct-05	Dec-06	Sept-07	Feb-07	Sept-10	Feb-12	March - may-13	Compliant	Morocco
27 Mexico	Jan-15	Nov-17	Oct-18	Dec-19				Candidate	Namibia
28 Mongolia	March-06	Jan-06	Sept-07	Dec-07	Feb-10	Oct-10		Compliant	Russian Federation
29 Mozambique	May-08	Apr-09	May-09	Jan-11	May-11	Oct-12		Compliant	Rwanda
30 Myanmar	Dec-12	Jan-14	July-14	Dec-15				Candidate	South Africa
31 Niger	March-05	Jul-05	Aug-07			March-11	0ct-17-March-18	Compliant	Sudan
32 Nigeria	Nov-03	Dec-03	Sept-07	Oct-06	June-10	March-11		Compliant	Syrian Arab Republic
33 Papua New Guinea	Apr-13	Nov-13	March-14	Feb-16				Candidate	Tunisia
34 Peru	Apr-05	May-06	Sept-07	Oct-09	Sept-10	Feb-12		Compliant	Uzbekistan
35 Philippines	July-12	Jan-13	May-13	Dec-14				Candidate	Venezuela
36 Republic of the Congo	June-04	Sept-06	Sept-07	Aug-08	Sept-10	Feb-13		Compliant	Vietnam
37 Sao Tome and Principe	Dec-05	Dec-07	Feb-08	July-14	June-16		Feb - March-10	Candidate	Yemen
38 Senegal	Feb-12	Feb-13	Oct-13	Dec-15				Candidate	Zimbabwe
39 Sierra Leone	May-06	June-07	Feb-08	Feb-10	July-10	Apr-14		Compliant	
40 Suriname	Feb-16	Nov-17	Apr-18				Feb-19 -	Committed	
41 Tajikistan	Aug-12	Aug-12	Feb-13	Oct-15				Candidate	
42 Tanzania	Nov-08	Feb-09	Nov-09	Jan-11	May-11	Dec-12	Nov - Dec-15	Compliant	
43 Timor-Leste	Apr-07	Apr-07	Feb-08	Oct-09	March-10	July-10	March - June-17	Compliant	
44 Togo	Dec-09	Apr-10	Oct-10	Feb-12	Apr-13	May-13		Compliant	
45 Ukraine	Oct-09	Oct-12	Oct-13	Nov-15				Candidate	
46 Zambia	July-08	July-08	May-09	Jan-11	May-11	Sept-12		Compliant	

Table B2 : Descriptive statistics and Data sources

Variable	Obs	Mean	Std.dev.	Min	Max	Source	Description
Forest cover loss (ha)	1,411	199.8476	896.1247	0	11350.24	Hansen et al. (2013). http ://earthenginepartners. appspot.com/science-2013-global-forest	Hectares of tree cover loss, by country, from 2001 to 2018, categorized by percentage of canopy cover, canopy cover >20%
Total_extactive rents	1,385	9.442419	12.89975	0	74.03297	WDI-World Bank	Mineral rents + Oil rents + Gas rents (% GDP)
Forest_rents	1,394	3.061847	4.569089	0	36.06835		Forest rents (% GDP)
GDP growth	1,398	4.828063	6.987497	-62.07592	123.1396		GDP per capita growth (annual %)
Internal Conflict	1,113	8.625509	1.479958	2.916667	11.91667	International Country Risk Guide (ICRG)	Internal Conflict index from the ICRG database. This is an assessment of political violence in the country and its actual or potential impact on governance. A score of 4 points equates to very low risk, and a score of 0 indicates very high risk.
Commodity prices	1,394	98.70003	7.053785	56.30123	117.7615	IMF, commodity prices	Comm. Terms of Trade Index (xj-mj weighted by GDP ; defl. ; 2012m6=100)
Av, Precipitation	1,411	95.2218	70.44941	1.977812	308.7322	Climatic Research Unit, University of East Anglia and CERDI https ://data.cerdi.org/	Deviation of the yearly average of rainfall levels (mm) from its 1901 to 2019 trend
FDI	1,373	4.47441	7.503551	-37.15476	103.3374	WDI-World Bank	Foreign direct investment, net inflows (% of GDP)
Population density	1,394	69.38187	77.9308	1.557447	485.648		Population density (people per sq. km of land area)
Industry_value added	1,359	29.57727	13.63291	2.073173	87.79689		Industry (including construction), value added (% of GDP)
Control of corruption	1,328	-.63538	.5510653	-1.826361	1.568294	Kaufmann et al. (2011). Worldwide Governance Indicators. Estimate of governance in standard normal units ranging from approximately -2.5 (weak) to 2.5 (strong) governance performance. Percentile rank among all countries, ranging from 0 (lowest) to 100 (highest) rank. www.govindicators.org	capturing perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as" capture" of the state by elites and private interests."
Governance Effectiveness	1,328	-.5976349	.5652902	-1.94748	1.267115		capturing perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies."
Rule of Law	1,328	-.6928969	.5518954	-2.255286	.7305223		capturing perceptions of the extent to which agents have confidence in and abide by the rules of society and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence."
Voice and Accountability	1,328	-.5935345	.7258877	-2.233271	.8427915		capturing perceptions of the extent to which a country's citizens can participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.
Political Stability and non-Violence	1,328	-.5696404	.8255872	-3.180798	1.283388		Political Stability and Absence of Violence/Terrorism measures perceptions of the likelihood of political instability and/or politically motivated violence, including terrorism

.3 Appendix C (Chapter 3) : Does Transparency Pay ? The Impact of EITI on Domestic Revenue Mobilization in RRDC

TABLE C1 : Comparing of each EITI implementation step to non-EITI

	[Log.Total Tax rev.]	[Log.Non-Resource Tax rev.]	[Log.Income Tax rev.]
	[1]	[2]	[3]
_pscore	0.224***	0.180***	0.676***
	(0.055)	(0.059)	(0.090)
0.EITI (Non-adoption)	0.000	0.000	0.000
	(.)	(.)	(.)
1.EITI (Commitment)	0.186***	0.148***	0.249***
	(0.029)	(0.031)	(0.045)
2.EITI (Candidacy)	0.239***	0.221***	0.318***
	(0.020)	(0.021)	(0.035)
3.EITI (Compliance)	0.298***	0.347***	0.467***
	(0.027)	(0.032)	(0.043)
Constant	2.492***	2.428***	1.193***
	(0.014)	(0.014)	(0.021)
N	1311	1210	1085
F	82.532	65.380	90.962
Adjusted R-squared	0.162	0.134	0.212

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table C2 : Heterogeneity of the treatment effects (EITI_1) on outcome (Log Total tax_revenues (% GDP))

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
EITI_1	0.151***	0.096***	0.058**	0.093***	0.182***	0.251***	0.206	0.064*	0.328	0.089***	0.084***	0.100***	0.017	0.269***	0.223***	0.024
	(0.021)	(0.020)	(0.024)	(0.022)	(0.068)	(0.035)	(0.570)	(0.037)	(0.307)	(0.021)	(0.021)	(0.020)	(0.023)	(0.069)	(0.043)	(0.023)
pscore		0.108**	0.086*	0.021	0.157***	0.081*	0.202***	0.100**	0.039	0.101**	0.060	0.083*	0.160***	0.067	0.092**	0.136***
		(0.046)	(0.047)	(0.048)	(0.045)	(0.047)	(0.053)	(0.045)	(0.051)	(0.044)	(0.049)	(0.048)	(0.047)	(0.047)	(0.045)	(0.047)
Time1			0.011***													
			(0.004)													
Total_Extract.rents				0.008***												
				(0.001)												
EITI_1xTotal_Extract.rents				-0.002												
				(0.002)												
LOG.GDP/CAPITA					0.365***											
					(0.039)											
EITI_1xLOG.GDP/CAPITA					-0.008											
					(0.006)											
FINANCIAL DEV.						0.424**										
						(0.188)										
EITI_1xFINANCIAL DEV.						-0.837***										
						(0.157)										
Commodity prices							-0.005***									
							(0.001)									
EITI_1xCommodity prices							-0.001									
							(0.004)									
OPENESS								0.002***								
								(0.000)								
EITI_1xOPENESS								0.000								
								(0.000)								
LOG.AID									0.041***							
									(0.012)							
EITI_1xLOG.AID									-0.011							
									(0.015)							
Inflation										-0.001***						
										(0.000)						
EITI_1xInflation										-0.000						
										(0.001)						
FDI											0.001					
											(0.002)					
EITI_1xFDI											0.002					
											(0.002)					
Coal_rents												0.028*				
												(0.017)				
EITI_1xCoal_rents												-0.016				
												(0.016)				
Forest_rents													-0.030***			
													(0.003)			
EITI_1xForest_rents													0.014***			
													(0.003)			
HDI														1.496***		
														(0.396)		
EITI_1xHDI														-0.300**		
														(0.117)		
Industry_VA															0.010***	
															(0.001)	
EITI_1xIndustry_VA															-0.005***	
															(0.001)	
Index Governance																0.114***
																(0.019)
EITI_2xIndex Governance																-0.086***
																(0.016)
Constant	1.585***	3.256***	3.260***	3.017***	-0.584	3.220***	3.657***	3.037***	2.476***	3.299***	3.258***	3.263***	3.296***	2.630***	2.713***	3.505***
	(0.066)	(0.052)	(0.052)	(0.068)	(0.411)	(0.054)	(0.119)	(0.057)	(0.239)	(0.050)	(0.052)	(0.052)	(0.050)	(0.174)	(0.084)	(0.064)
N	1697	1111	1111	1111	1111	1111	1111	1111	1111	1110	1111	1111	1111	1111	1111	1111
F	78.671	75.627	75.002	77.039	81.333	76.291	75.051	80.734	74.855	82.265	74.708	74.275	81.453	75.813	79.310	79.449
Adjusted R-squared	0.826	0.861	0.861	0.866	0.872	0.864	0.862	0.871	0.862	0.873	0.862	0.861	0.872	0.864	0.869	0.869

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

TABLE C3 : Heterogeneity of the treatment effects (EITI_2) on outcome (Tax_revenues (% GDP))

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	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
EITI_2	0.134***	0.088***	0.055**	0.090***	0.120*	0.234***	0.036	0.015	0.467	0.081***	0.078***	0.092***	0.005	0.238***	0.148***	-0.105***
	(0.022)	(0.020)	(0.025)	(0.023)	(0.068)	(0.035)	(0.432)	(0.040)	(0.321)	(0.022)	(0.021)	(0.020)	(0.023)	(0.070)	(0.043)	(0.035)
_pscore		0.147***	0.134***	0.068	0.190***	0.129***	0.253***	0.155***	0.087	0.132***	0.089	0.123**	0.177***	0.111**	0.135***	0.173***
		(0.049)	(0.049)	(0.050)	(0.047)	(0.049)	(0.056)	(0.048)	(0.053)	(0.047)	(0.054)	(0.051)	(0.049)	(0.049)	(0.048)	(0.048)
Time2			0.010**													
			(0.005)													
Total_extract_rents				0.008***												
				(0.001)												
EITI_2xTotal_extract_rents				-0.003**												
				(0.002)												
LOG.GDP/CAPITA					0.351***											
					(0.039)											
EITI_2xLOG.GDP/CAPITA					-0.004											
					(0.006)											
FINANCIAL DEV.						0.384**										
						(0.186)										
EITI_2xFINANCIAL DEV.						-0.813***										
						(0.162)										
Commodity prices							-0.006***									
							(0.001)									
EITI_2xCommodity prices							0.000									
							(0.004)									
OPENESS								0.002***								
								(0.000)								
EITI_2xOPENESS								0.001*								
								(0.000)								
LOG.AID									0.039***							
									(0.011)							
EITI_2xLOG.AID									-0.018							
									(0.016)							
Inflation										-0.001***						
										(0.000)						
EITI_2xInflation										0.000						
										(0.001)						
FDI											0.001					
											(0.001)					
EITI_2xFDI											0.002					
											(0.002)					
Coal_rents												0.024				
												(0.016)				
EITI_2xCoal_rents												-0.014				
												(0.015)				
Forest_rents													-0.026***			
													(0.003)			
EITI_2xForest_rents													0.014***			
													(0.003)			
HDI														1.371***		
														(0.396)		
EITI_2xHDI														-0.267**		
														(0.119)		
Industry_VA															0.009***	
															(0.001)	
EITI_2xIndustry_VA															-0.003**	
															(0.001)	
Index Governance																0.118***
																(0.019)
EITI_2xIndex Governance																-0.152***
																(0.024)
Constant	1.585***	3.256***	3.267***	3.017***	-0.584	3.220***	3.657***	3.037***	2.476***	3.299***	3.258***	3.263***	3.296***	2.630***	2.713***	3.505***
	(0.066)	(0.052)	(0.052)	(0.068)	(0.411)	(0.054)	(0.119)	(0.057)	(0.239)	(0.050)	(0.052)	(0.052)	(0.050)	(0.174)	(0.084)	(0.064)
N	1697	1111	1111	1111	1111	1111	1111	1111	1111	1110	1111	1111	1111	1111	1111	1111
F	78.671	75.627	75.475	77.039	81.333	76.291	75.051	80.734	74.855	82.265	74.708	74.275	81.453	75.813	79.310	79.449
Adjusted R-squared	0.826	0.861	0.862	0.866	0.872	0.864	0.862	0.871	0.862	0.873	0.862	0.861	0.872	0.864	0.869	0.869

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The F-test refers to the global significance test (1 %) of the interaction term and the variable X.

TABLE C4 : Heterogeneity of the treatment effects (EITI_3) on outcome (Tax_revenues (% GDP))

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
EITI_3	0.095***	0.057**	0.031	0.003	0.084	0.205***	-1.223	-0.191***	0.159	0.058**	0.006	0.057**	-0.073**	0.285***	0.005	-0.056
	(0.031)	(0.026)	(0.044)	(0.037)	(0.111)	(0.050)	(0.855)	(0.065)	(0.549)	(0.028)	(0.029)	(0.026)	(0.034)	(0.106)	(0.060)	(0.050)
pscore		0.441***	0.445***	0.287***	0.492***	0.453***	0.528***	0.411***	0.350***	0.386***	0.330***	0.446***	0.467***	0.395***	0.446***	0.493***
		(0.090)	(0.090)	(0.092)	(0.087)	(0.092)	(0.096)	(0.087)	(0.101)	(0.088)	(0.093)	(0.105)	(0.088)	(0.090)	(0.089)	(0.090)
Time3			0.008													
			(0.011)													
Total_extractrentGDP				0.006***												
				(0.001)												
EITI_3xTotal_extractrentGDP				0.004												
				(0.003)												
LGDPCAPITA					0.353***											
					(0.039)											
EITI_3xLGDPCAPITA					-0.004											
					(0.009)											
FD						0.305										
						(0.188)										
EITI_3xFD						-0.933***										
						(0.268)										
xm_gdpf							-0.004***									
							(0.001)									
EITI_3xxm_gdpf							0.013									
							(0.008)									
OPENESS_Trade								0.002***								
								(0.000)								
EITI_3xOPENESS_Trade								0.003***								
								(0.001)								
LAID									0.023**							
									(0.011)							
EITI_3xLAID									-0.005							
									(0.027)							
Inflation										-0.001***						
										(0.000)						
EITI_3xInflation										-0.000						
										(0.002)						
FDI											0.002*					
											(0.001)					
EITI_3xFDI											0.007***					
											(0.002)					
Coal_rents												-0.000				
												(0.011)				
EITI_3xCoal_rents												-0.001				
												(0.010)				
Forest_rents													-0.027***			
													(0.003)			
EITI_3xForest_rents													0.026***			
													(0.005)			
HDI														1.284***		
														(0.402)		
EITI_3xHDI														-0.435**		
														(0.184)		
Industry_VA															0.008***	
															(0.001)	
EITI_3xIndustry_VA															0.002	
															(0.002)	
Index Governance																0.109***
																(0.019)
EITI_3xIndex Governance																-0.093**
																(0.036)
_cons	1.632***	3.226***	3.226***	3.043***	-0.483	3.196***	3.587***	3.017***	2.779***	3.272***	3.227***	3.226***	3.271***	2.684***	2.817***	3.458***
	(0.067)	(0.052)	(0.052)	(0.060)	(0.411)	(0.054)	(0.113)	(0.056)	(0.222)	(0.050)	(0.051)	(0.052)	(0.050)	(0.177)	(0.077)	(0.064)
N	1697	1111	1111	1111	1111	1111	1111	1111	1111	1110	1111	1111	1111	1111	1111	1111
F	76.162	75.392	74.551	76.755	80.538	74.696	74.945	80.933	74.001	81.799	75.212	73.644	81.264	74.972	78.191	76.901
Adjusted R-squared	0.822	0.860	0.860	0.865	0.871	0.862	0.862	0.871	0.861	0.873	0.863	0.860	0.872	0.862	0.867	0.865

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

TABLE C5 : Heterogeneity of the treatment effects (EITI_1) on outcome (LOG.Non-Resource tax)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
EITI_1	0.104***	0.077***	0.027	0.062***	0.151***	0.227***	0.247	0.030	-0.208	0.074***	0.074***	0.079***	-0.004	0.263***	0.045	0.238***	0.274***	0.271***
	(0.023)	(0.021)	(0.025)	(0.023)	(0.072)	(0.057)	(0.348)	(0.038)	(0.311)	(0.021)	(0.022)	(0.021)	(0.023)	(0.074)	(0.044)	(0.037)	(0.035)	(0.036)
Pscore		-0.128***	-0.156***	-0.136***	-0.099**	-0.179***	0.037	-0.126***	-0.223***	-0.135***	-0.189***	-0.149***	-0.116**	-0.173***	-0.125***	-0.122***	-0.178***	-0.145***
		(0.047)	(0.047)	(0.050)	(0.046)	(0.048)	(0.054)	(0.045)	(0.051)	(0.044)	(0.048)	(0.047)	(0.048)	(0.048)	(0.047)	(0.047)	(0.048)	(0.046)
Time1			0.014***															
			(0.004)															
Total_extract_rents				-0.001														
				(0.001)														
EITI_1xTotal_extract_rents				0.002														
				(0.002)														
LOGGDP/CAPITA					0.215***													
					(0.039)													
EITI_1xLOGGDP/CAPITA					-0.007													
					(0.006)													
FINANCIAL DEV.						0.050												
						(0.185)												
EITI_1xFINANCIAL DEV.						-0.798***												
						(0.161)												
Commodity prices_							-0.007***											
							(0.001)											
EITI_1xCommodity prices_							-0.002											
							(0.003)											
OPENESS_								0.002***										
								(0.000)										
EITI_1xOPENESS_								0.001										
								(0.000)										
LOG_AID									0.041***									
									(0.012)									
EITI_1xLOG_AID									0.015									
									(0.016)									
Inflation										-0.001***								
										(0.000)								
EITI_1xInflation										-0.001								
										(0.001)								
FDI											0.006***							
											(0.001)							
EITI_1xFDI											-0.001							
											(0.002)							
Coal_rents												0.046***						
												(0.017)						
EITI_1xCoal_rents												-0.010						
												(0.022)						
Forest_rents													-0.024***					
													(0.003)					
EITI_1xForest_rents													0.016***					
													(0.003)					
HDI														1.501***				
														(0.391)				
EITI_1xHDI														-0.315**				
														(0.123)				
Industry_VA															0.003**			
															(0.001)			
EITI_1xIndustry_VA															0.001			
															(0.002)			
Control of Corruption (0-100)																0.004***		
																(0.001)		
EITI_1xControl of Corruption (0-100)																-0.006***		
																(0.001)		
Gov. Effectiveness (0-100)																	0.003***	
																	(0.001)	
EITI_1xGov. Effectiveness (0-100)																	-0.006***	
																	(0.001)	
Rule of Law (Estimate)																		0.003***
																		(0.001)
EITI_1x Rule of Law (Estimate)																		-0.007***
																		(0.001)
_Constant	1.679***	1.727***	1.738***	1.745***	-0.542	1.726***	2.294***	1.529***	0.943***	1.773***	1.726***	1.736***	1.760***	1.097***	1.589***	1.702***	1.690***	1.706***
	(0.057)	(0.049)	(0.049)	(0.066)	(0.413)	(0.052)	(0.107)	(0.055)	(0.238)	(0.047)	(0.049)	(0.049)	(0.048)	(0.171)	(0.083)	(0.049)	(0.049)	(0.049)
N	1621	1069	1069	1069	1069	1069	1069	1069	1069	1068	1069	1069	1069	1069	1069	1069	1069	1069
F	81.016	100.217	100.431	98.109	101.364	100.692	101.899	105.749	99.909	112.926	101.899	98.782	105.976	100.574	98.819	102.641	104.013	103.093
Adjusted R-squared	0.834	0.894	0.895	0.894	0.897	0.897	0.898	0.901	0.896	0.907	0.898	0.895	0.901	0.897	0.895	0.898	0.900	0.899

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The F-test refers to the global significance test (1 %) of the interaction term and the variable X.

TABLE C6 : Heterogeneity of the treatment effects (EITI_2) on outcome (LOG.Non-Resource tax)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
EITI_2	0.095***	0.079***	0.024	0.058**	0.095	0.245***	0.124	-0.036	0.075	0.075***	0.073***	0.080***	-0.007	0.298***	0.031	0.222***	0.256***	0.261***
	(0.024)	(0.021)	(0.027)	(0.024)	(0.073)	(0.037)	(0.409)	(0.042)	(0.328)	(0.022)	(0.022)	(0.021)	(0.024)	(0.074)	(0.043)	(0.036)	(0.035)	(0.036)
Pscore		-0.087*	-0.110**	-0.083	-0.059	-0.134***	0.100*	-0.075	-0.158***	-0.104**	-0.189***	-0.108**	-0.093*	-0.133***	-0.082*	-0.071	-0.116**	-0.094*
		(0.049)	(0.050)	(0.052)	(0.049)	(0.050)	(0.057)	(0.049)	(0.053)	(0.047)	(0.053)	(0.050)	(0.050)	(0.050)	(0.050)	(0.049)	(0.050)	(0.049)
Time2			0.016***															
			(0.005)															
Total_extract_rents				-0.001														
				(0.001)														
EITI_2xTotal_extract_rents				0.003*														
				(0.002)														
LOGGDP/CAPITA					0.211***													
					(0.039)													
EITI_2xLOGGDP/CAPITA					-0.002													
					(0.006)													
FINANCIAL DEV.						0.071												
						(0.183)												
EITI_2xFINANCIAL DEV.						-0.909***												
						(0.167)												
Commodity prices_							-0.008***											
							(0.001)											
EITI_2xCommodity prices_							-0.001											
							(0.004)											
OPENESS_								0.002***										
								(0.000)										
EITI_2xOPENESS_								0.001***										
								(0.000)										
LOG_AID									0.039***									
									(0.011)									
EITI_2xLOG_AID									0.001									
									(0.016)									
Inflation										-0.001***								
										(0.000)								
EITI_2xInflation										-0.000								
										(0.002)								
FDI											0.006***							
											(0.001)							
EITI_2xFDI											-0.001							
											(0.002)							
Coal_rents												0.040**						
												(0.016)						
EITI_2xCoal_rents												0.001						
												(0.024)						
Forest_rents													-0.022***					
													(0.003)					
EITI_2xForest_rents													0.012***					
													(0.003)					
HDI														1.385***				
														(0.390)				
EITI_2xHDI														-0.381***				
														(0.124)				
Industry_VA															0.002*			
															(0.001)			
EITI_2xIndustry_VA															0.002			
															(0.001)			
Control of Corruption (0-100)																0.004***		
																(0.001)		
EITI_2xControl of Corruption (0-100)																-0.005***		
																(0.001)		
Gov. Effectiveness (0-100)																	0.003***	
																	(0.001)	
EITI_2xGov. Effectiveness (0-100)																	-0.006***	
																	(0.001)	
Rule of Law (Estimate)																		0.003***
																		(0.001)
EITI_2x Rule of Law (Estimate)																		-0.007***
																		(0.001)
_Constant	1.673***	1.719***	1.726***	1.764***	-0.509	1.713***	2.361***	1.528***	0.975***	1.766***	1.716***	1.726***	1.742***	1.135***	1.600***	1.692***	1.677***	1.694***
	(0.057)	(0.049)	(0.049)	(0.064)	(0.414)	(0.051)	(0.107)	(0.055)	(0.225)	(0.046)	(0.048)	(0.049)	(0.048)	(0.171)	(0.081)	(0.049)	(0.049)	(0.049)
N	1621	1069	1069	1069	1069	1069	1069	1069	1069	1068	1069	1069	1069	1069	1069	1069	1069	1069
F	80.669	100.020	100.015	98.073	100.931	101.019	102.708	105.371	99.111	112.679	101.709	98.468	105.528	100.438	98.563	102.053	103.236	102.649
Adjusted R-squared	0.834	0.894	0.895	0.894	0.897	0.897	0.899	0.901	0.895	0.907	0.898	0.895	0.901	0.896	0.895	0.898	0.899	0.898

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The F-test refers to the global significance test (1 %) of the interaction term and the variable X.

TABLE C7 : Heterogeneity of the treatment effects (EITI_3) on the outcome (LOG.Non-Resource tax)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
EITI_3	0.056	0.042	0.052	-0.032	-0.275*	0.201***	-0.083	-0.272***	0.059	0.052	-0.052	0.015	-0.108**	0.380***	0.033	0.186***	0.299***	0.249***
	(0.036)	(0.035)	(0.057)	(0.048)	(0.147)	(0.066)	(0.863)	(0.080)	(0.630)	(0.037)	(0.042)	(0.036)	(0.045)	(0.123)	(0.067)	(0.061)	(0.060)	(0.061)
Pscore		-0.037	-0.036	-0.130	-0.031	-0.096	0.279**	-0.047	-0.361***	-0.113	-0.049	-0.051	-0.110	-0.109	-0.094	-0.033	-0.045	-0.037
		(0.104)	(0.104)	(0.119)	(0.097)	(0.104)	(0.110)	(0.098)	(0.122)	(0.094)	(0.101)	(0.103)	(0.099)	(0.103)	(0.101)	(0.102)	(0.103)	(0.101)
Time3			-0.004															
			(0.016)															
Total_extract_rents				0.003*														
				(0.002)														
EITI_3xTotal_extract_rents				0.008**														
				(0.003)														
LOGGDP/CAPITA					0.444***													
					(0.053)													
EITI_3xLOGGDP/CAPITA					0.025**													
					(0.012)													
FINANCIAL DEV.						-0.447												
						(0.314)												
EITI_3xFINANCIAL DEV.						-1.109***												
						(0.391)												
Commodity prices_							-0.013***											
							(0.002)											
EITI_3xCommodity prices_							0.001											
							(0.009)											
OPENESS_								0.002***										
								(0.000)										
EITI_3xOPENESS_								0.003***										
								(0.001)										
LOG_AID									0.081***									
									(0.016)									
EITI_3xLOG_AID									-0.001									
									(0.031)									
Inflation										-0.001***								
										(0.000)								
EITI_3xInflation										-0.004								
										(0.004)								
FDI											0.003***							
											(0.001)							
EITI_3xFDI											0.011***							
											(0.003)							
Coal_rents												0.002						
												(0.024)						
EITI_3xCoal_rents												0.122***						
												(0.044)						
Forest_rents													-0.025***					
													(0.004)					
EITI_3xForest_rents													0.029***					
													(0.006)					
HDI														2.362***				
														(0.691)				
EITI_3xHDI														-0.689***				
														(0.215)				
Industry_VA															0.009***			
															(0.001)			
EITI_3xIndustry_VA															0.000			
															(0.002)			
Control of Corruption (0-100)																0.004***		
																(0.001)		
EITI_3xControl of Corruption (0-100)																-0.006***		
																(0.002)		
Gov. Effectiveness (0-100)																	0.003***	
																	(0.001)	
EITI_3xGov. Effectiveness (0-100)																	-0.007***	
																	(0.002)	
Rule of Law (Estimate)																		0.005***
																		(0.001)
EITI_3x Rule of Law (Estimate)																		-0.008***
																		(0.002)
_Constant	2.552***	2.665***	2.664***	2.692***	-2.908***	2.754***	3.922***	2.525***	1.133***	2.689***	2.654***	2.673***	2.735***	1.156**	2.471***	2.541***	2.580***	2.508***
	(0.055)	(0.057)	(0.057)	(0.057)	(0.670)	(0.073)	(0.183)	(0.058)	(0.314)	(0.051)	(0.055)	(0.057)	(0.054)	(0.457)	(0.062)	(0.066)	(0.075)	(0.074)
N	813	557	557	557	557	557	557	557	557	556	557	557	557	557	557	557	557	557
F	66.282	45.485	44.630	44.782	51.381	45.218	49.288	50.440	46.406	56.335	46.711	44.952	50.506	46.342	48.526	46.241	45.645	46.895
Adjusted R-squared	0.835	0.823	0.822	0.825	0.845	0.827	0.839	0.842	0.831	0.857	0.831	0.826	0.842	0.830	0.837	0.830	0.828	0.832

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The F-test refers to the global significance test (1 %) of the interaction term and the variable X.

TABLE C8 : Heterogeneity of the treatment effects (EITI_1) on outcome (Log.Income-profits-capital tax (% GDP))

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
EITI_1	0.189***	0.062**	0.007	0.083**	0.516***	0.252***	-0.384	0.007	-2.098***	0.046	0.020	0.066**	-0.039	0.366***	0.221***	0.188***	0.216***	0.223***
	(0.035)	(0.030)	(0.036)	(0.035)	(0.116)	(0.055)	(0.627)	(0.058)	(0.466)	(0.033)	(0.032)	(0.031)	(0.035)	(0.107)	(0.083)	(0.060)	(0.058)	(0.059)
Pscore		0.311***	0.278***	0.254***	0.313***	0.278***	0.366***	0.286***	0.204**	0.279***	0.175**	0.283***	0.275***	0.224***	0.259***	0.351***	0.278***	0.332***
		(0.075)	(0.075)	(0.085)	(0.074)	(0.076)	(0.083)	(0.074)	(0.080)	(0.075)	(0.081)	(0.079)	(0.075)	(0.076)	(0.076)	(0.075)	(0.078)	(0.074)
Time1			0.016***															
			(0.006)															
Total_extract_rents				0.006**														
				(0.003)														
EITI_1xTotal_extract_rents				-0.005														
				(0.003)														
LOGGDP/CAPITA					0.223***													
					(0.068)													
EITI_1xLOGGDP/CAPITA					-0.039***													
					(0.010)													
FINANCIAL DEV.						0.586**												
						(0.267)												
EITI_1xFINANCIAL DEV.						-0.997***												
						(0.246)												
Commodity prices_							-0.004*											
							(0.002)											
EITI_1xCommodity prices_							0.004											
							(0.006)											
OPENESS_								0.003***										
								(0.000)										
EITI_1xOPENESS_								0.001										
								(0.001)										
LOG_AID									0.005									
									(0.019)									
EITI_1xLOG_AID									0.108***									
									(0.023)									
Inflation										-0.000***								
										(0.000)								
EITI_1xInflation										0.001								
										(0.002)								
FDI											-0.002							
											(0.002)							
EITI_1xFDI											0.009***							
											(0.003)							
Coal_rents												0.026						
												(0.025)						
EITI_1xCoal_rents												-0.016						
												(0.023)						
Forest_rents													-0.021***					
													(0.006)					
EITI_1xForest_rents													0.021***					
													(0.004)					
HDI														1.864***				
														(0.570)				
EITI_1xHDI														-0.519***				
														(0.179)				
Industry_VA															0.007***			
															(0.002)			
EITI_1xIndustry_VA															-0.006**			
															(0.003)			
Control of Corruption (0-100)																0.005***		
																(0.001)		
EITI_1xControl of Corruption (0-100)																-0.004**		
																(0.002)		
Gov. Effectiveness (0-100)																	0.003**	
																	(0.001)	
EITI_1xGov. Effectiveness (0-100)																	-0.005***	
																	(0.002)	
Rule of Law (Estimate)																		0.004***
																		(0.001)
EITI_1x Rule of Law (Estimate)																		-0.005***
																		(0.002)
_Constant	-0.096	0.420***	0.420***	0.195	-1.915***	0.367***	0.712***	0.147	0.333	0.480***	0.439***	0.424***	0.467***	-0.306	0.015	0.373***	0.394***	0.391***
	(0.100)	(0.102)	(0.102)	(0.146)	(0.715)	(0.105)	(0.198)	(0.111)	(0.400)	(0.102)	(0.102)	(0.103)	(0.101)	(0.245)	(0.171)	(0.102)	(0.102)	(0.102)
N	1447	910	910	910	910	910	910	910	910	909	910	910	910	910	910	910	910	910
F	42.739	62.129	62.027	61.002	62.707	62.126	60.889	64.079	62.912	62.156	62.628	60.742	63.729	62.452	61.415	62.555	61.780	62.228
Adjusted R-squared	0.743	0.855	0.857	0.856	0.859	0.858	0.856	0.862	0.860	0.858	0.859	0.855	0.861	0.859	0.857	0.859	0.858	0.858

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The F-test refers to the global significance test (1 %) of the interaction term and the variable X.

TABLE C9 : Heterogeneity of the treatment effects (EITI_2) on outcome (Log.Income-profits-capital tax (% GDP))

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
EITI_2	0.188***	0.077**	-0.000	0.105***	0.514***	0.325***	-0.963	-0.031	-1.961***	0.054	0.040	0.084***	-0.033	0.495***	0.222***	0.187***	0.234***	0.242***
	(0.038)	(0.031)	(0.041)	(0.037)	(0.119)	(0.058)	(0.812)	(0.067)	(0.495)	(0.036)	(0.033)	(0.032)	(0.036)	(0.112)	(0.083)	(0.062)	(0.060)	(0.061)
Pscore		0.346***	0.325***	0.308***	0.341***	0.361***	0.405***	0.340***	0.259***	0.297***	0.189**	0.327***	0.264***	0.248***	0.295***	0.377***	0.311***	0.356***
		(0.077)	(0.077)	(0.085)	(0.076)	(0.077)	(0.086)	(0.077)	(0.081)	(0.077)	(0.089)	(0.082)	(0.077)	(0.078)	(0.078)	(0.077)	(0.079)	(0.076)
Time2			0.022***															
			(0.007)															
Total_extract_rents				0.005**														
				(0.003)														
EITI_2xTotal_extract_rents				-0.006*														
				(0.003)														
LOGGDP/CAPITA					0.209***													
					(0.067)													
EITI_2xLOGGDP/CAPITA					-0.038***													
					(0.010)													
FINANCIAL DEV.						0.645**												
						(0.262)												
EITI_2xFINANCIAL DEV.						-1.308***												
						(0.258)												
Commodity prices_							-0.005*											
							(0.002)											
EITI_2xCommodity prices_							0.010											
							(0.008)											
OPENESS_								0.003***										
								(0.000)										
EITI_2xOPENESS_								0.001										
								(0.001)										
LOG_AID									0.019									
									(0.018)									
EITI_2xLOG_AID									0.102***									
									(0.025)									
Inflation										-0.000***								
										(0.000)								
EITI_2xInflation										0.003								
										(0.002)								
FDI											-0.002							
											(0.002)							
EITI_2xFDI											0.008***							
											(0.003)							
Coal_rents												0.045*						
												(0.024)						
EITI_2xCoal_rents												-0.038*						
												(0.022)						
Forest_rents													-0.017***					
													(0.006)					
EITI_2xForest_rents													0.025***					
													(0.005)					
HDI														1.710***				
														(0.563)				
EITI_2xHDI														-0.721***				
														(0.186)				
Industry_VA															0.006***			
															(0.002)			
EITI_2xIndustry_VA															-0.006*			
															(0.003)			
Control of Corruption (0-100)																0.005***		
																(0.001)		
EITI_2xControl of Corruption (0-100)																-0.004**		
																(0.002)		
Gov. Effectiveness (0-100)																	0.003**	
																	(0.001)	
EITI_2xGov. Effectiveness (0-100)																	-0.005***	
																	(0.002)	
Rule of Law (Estimate)																		0.004***
																		(0.001)
EITI_2x Rule of Law (Estimate)																		-0.005***
																		(0.002)
_Constant	-0.097	0.425***	0.425***	0.236*	-1.768**	0.361***	0.759***	0.138	0.040	0.483***	0.437***	0.430***	0.460***	-0.246	0.070	0.383***	0.399***	0.397***
	(0.100)	(0.102)	(0.101)	(0.139)	(0.712)	(0.104)	(0.199)	(0.109)	(0.377)	(0.102)	(0.102)	(0.102)	(0.101)	(0.243)	(0.166)	(0.101)	(0.102)	(0.101)
N	1447	910	910	910	910	910	910	910	910	909	910	910	910	910	910	910	910	910
F	42.555	62.794	62.772	61.659	63.154	63.595	61.731	65.040	63.222	62.930	62.684	61.558	64.570	63.553	61.970	62.969	62.386	62.801
Adjusted R-squared	0.742	0.857	0.858	0.857	0.860	0.861	0.857	0.864	0.860	0.860	0.859	0.857	0.863	0.861	0.858	0.860	0.859	0.860

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The F-test refers to the global significance test (1 %) of the interaction term and the variable X.

TABLE C10 : Heterogeneity of the treatment effects (EITI_3) on outcome (Log.Income-profits-capital tax (% GDP))

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
EITI_3	0.101*	0.097**	0.150**	0.290***	0.918***	0.514***	-0.547	0.012	-5.414***	0.061	0.024	0.124***	-0.134***	0.966***	0.515***	0.243***	0.323***	0.372***
	(0.052)	(0.044)	(0.067)	(0.064)	(0.161)	(0.075)	(1.440)	(0.098)	(0.739)	(0.050)	(0.049)	(0.045)	(0.051)	(0.148)	(0.112)	(0.081)	(0.082)	(0.083)
Pscore		0.795***	0.784***	1.018***	0.818***	0.711***	0.893***	0.710***	0.435***	0.678***	0.597***	0.793***	0.685***	0.683***	0.716***	0.782***	0.713***	0.795***
		(0.141)	(0.141)	(0.177)	(0.137)	(0.135)	(0.155)	(0.137)	(0.152)	(0.141)	(0.142)	(0.156)	(0.133)	(0.138)	(0.142)	(0.141)	(0.141)	(0.138)
Time3			-0.018															
			(0.017)															
Total_extract_rents				-0.002														
				(0.003)														
EITI_3xTotal_extract_rents				-0.022***														
				(0.005)														
LOGGDP/CAPITA					0.167													
					(0.105)													
EITI_3xLOGGDP/CAPITA					-0.071***													
					(0.013)													
FINANCIAL DEV.						0.968**												
						(0.440)												
EITI_3xFINANCIAL DEV.						-2.564***												
						(0.388)												
Commodity prices_							-0.006*											
							(0.004)											
EITI_3xCommodity prices_							0.006											
							(0.014)											
OPENESS_								0.003***										
								(0.000)										
EITI_3xOPENESS_								0.001										
								(0.001)										
LOG_AID									0.065***									
									(0.022)									
EITI_3xLOG_AID									0.272***									
									(0.036)									
Inflation										-0.000***								
										(0.000)								
EITI_3xInflation										0.005								
										(0.003)								
FDI											0.004**							
											(0.002)							
EITI_3xFDI											0.009***							
											(0.003)							
Coal_rents												0.040**						
												(0.016)						
EITI_3xCoal_rents												-0.049***						
												(0.015)						
Forest_rents													-0.009					
													(0.006)					
EITI_3xForest_rents													0.054***					
													(0.007)					
HDI														1.571*				
														(0.886)				
EITI_3xHDI														-1.572***				
														(0.247)				
Industry_VA															0.007**			
															(0.003)			
EITI_3xIndustry_VA															-0.017***			
															(0.004)			
Control of Corruption (0-100)																0.001		
																(0.001)		
EITI_3xControl of Corruption (0-100)																-0.005**		
																(0.002)		
Gov. Effectiveness (0-100)																	-0.002	
																	(0.002)	
EITI_3xGov. Effectiveness (0-100)																	-0.007***	
																	(0.002)	
Rule of Law (Estimate)																		0.002
																		(0.002)
EITI_3x Rule of Law (Estimate)																		-0.009***
																		(0.002)
_Constant	-0.084	0.737***	0.735***	0.669***	-1.344	0.614***	1.373***	0.546***	-0.415	0.765***	0.747***	0.739***	0.826***	-0.203	0.578***	0.702***	0.872***	0.680***
	(0.094)	(0.074)	(0.074)	(0.077)	(1.314)	(0.099)	(0.376)	(0.078)	(0.432)	(0.073)	(0.073)	(0.075)	(0.072)	(0.583)	(0.097)	(0.089)	(0.105)	(0.101)
N	735	487	487	487	487	487	487	487	487	486	487	487	487	487	487	487	487	487
F	37.682	38.396	37.749	38.781	40.155	41.551	37.248	41.098	43.986	38.746	39.538	38.047	43.365	41.492	38.730	37.437	38.233	38.539
Adjusted R-squared	0.756	0.812	0.812	0.818	0.824	0.829	0.812	0.827	0.837	0.819	0.821	0.816	0.835	0.829	0.818	0.813	0.816	0.818

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The F-test refers to the global significance test (1 %) of the interaction term and the variable X.

Table C11 : Descriptive statistics

	Total of Sample					*Group of treated*					*Group of controls*				
Variable	*Obs*	Mean	Std. Dev.	Min	Max	*Obs*	Mean	Std. Dev.	Min	Max	*Obs*	Mean	Std. Dev.	Min	Max
Total_tax_revenue	*1,697*	15.097	7.428	0.301	56.916	*913*	13.012	4.704	0.301	26.082	*784*	17.525	9.097	1.193	56.916
non-resource_tax	*1,621*	13.859	6.957	0.301	56.916	*813*	12.549	4.804	0.301	25.819	*808*	15.176	8.395	0.846	56.916
Income tax	*1,449*	5.044	3.083	0.000	24.074	*735*	4.298	2.459	0.166	15.867	*714*	5.811	3.453	0.000	24.074
EITI_1	*1,909*	0.219	0.414	0.000	1.000	*1,012*	0.414	0.493	0.000	1.000	*897*	0.000	0.000	0.000	0.000
Total_rents	*1,849*	8.516	12.452	0.000	78.623	*969*	7.377	11.354	0.000	74.033	*880*	9.771	13.454	0.000	78.623
L.GDPCAPITA	*1,872*	11.109	2.719	5.453	18.304	*989*	11.533	2.579	5.453	17.439	*883*	10.633	2.794	5.899	18.304
Financial Dev.	*1,817*	0.191	0.123	0.000	0.679	*966*	0.159	0.091	0.000	0.418	*851*	0.226	0.143	0.002	0.679
Inflation	*1,867*	19.873	141.080	-36.565	4800.532	*985*	15.980	90.314	-36.565	2630.123	*882*	24.220	181.688	-31.566	4800.532
Commodity prices	*1,870*	98.001	10.130	44.630	125.776	*1,007*	99.288	8.649	44.630	122.847	*863*	96.499	11.446	45.423	125.776
Trade Openess	*1,754*	75.577	37.119	0.021	311.354	*920*	74.322	37.210	0.021	311.354	*834*	76.961	36.991	14.772	220.407
L.ODA	*1,817*	19.607	1.289	9.903	23.924	*992*	19.839	1.195	9.903	23.924	*825*	19.328	1.343	12.346	23.135
FDI	*1,821*	4.221	8.295	-37.155	161.824	*973*	4.274	7.790	-37.155	103.337	*848*	4.160	8.843	-8.589	161.824
Industry_Value Added	*1,799*	29.115	13.150	2.073	87.797	*951*	26.997	12.379	3.243	85.659	*848*	31.490	13.583	2.073	87.797
Coal_rents	*1,840*	0.232	1.059	0.000	25.316	*965*	0.257	1.344	0.000	25.316	*875*	0.205	0.607	0.000	7.850
Forest_rents	*1,859*	3.337	5.044	0.000	36.068	*975*	4.515	5.683	0.000	36.068	*884*	2.038	3.834	0.000	31.963
HDI	*1,796*	0.572	0.137	0.228	0.832	*966*	0.537	0.136	0.235	0.832	*830*	0.612	0.127	0.228	0.822
Governance Index	*1,574*	-1.106	0.918	-3.312	1.585	*833*	-1.292	0.730	-3.312	0.181	*741*	-0.898	1.053	-3.135	1.585
Control of corruption	*1,574*	-0.630	0.554	-1.826	1.568	*833*	-0.739	0.409	-1.723	0.478	*741*	-0.508	0.660	-1.826	1.568
Gov. Effectiveness	*1,574*	-0.594	0.570	-2.232	1.267	*833*	-0.708	0.491	-2.232	0.376	*741*	-0.466	0.623	-1.915	1.267
Regulatory Quality	*1,574*	-0.608	0.626	-2.344	1.053	*833*	-0.602	0.544	-2.344	0.615	*741*	-0.615	0.707	-2.274	1.053
Rule of Law	*1,577*	-0.692	0.561	-2.255	0.731	*836*	-0.791	0.468	-2.130	0.292	*741*	-0.582	0.633	-2.255	0.731
Voice and accountability	*1,577*	-0.595	0.724	-2.233	0.976	*836*	-0.467	0.621	-2.233	0.606	*741*	-0.740	0.801	-2.124	0.976

Table C12 : Definitions and Data Sources

Indicateurs	Définitions	Sources
Rentes totales (% du PIB)	The sum of oil, mining and gas rents, including the extractive industries. They correspond to the difference between the value of gross production at world prices and the total cost of production (specifically for each type of rent).	World Development Indicators. https://databank.worldbank.org/
Coal rents (% of GDP)	Coal rents are the difference between the value of both hard and soft coal production at world prices and their total costs of production.	
Forest rents (% of GDP)	Forest rents are roundwood harvest times the product of average prices and a region-specific rental rate.	
Inflation, GDP deflator (% annual)	It is measured by the annual growth rate of the implicit deflator (ratio of GDP in current local currency to GDP in constant local currency) of GDP and indicates the rate of price change in the economy as a whole.	
Trade openness (% of GDP)	It is the sum of exports and imports of goods and services relative to GDP.	
Net Official Development Assistance (ODA) received per capita (US$)	It includes loan disbursements with a grant element of at least 25% (calculated using a discount rate of 10%) and grants paid by official bodies (current US $).	
GDP per capita ($ US)	GDP per capita is the gross domestic product divided by the population at mid-year. ($ US constants 2010).	
Foreign Direct Investment (% GDP)	These are the net inflows of investments to acquire a sustainable management interest. It is the difference between new investment inflows and disinvestment divided by GDP.	
Industry value added (% of GDP)	It comprises value added in mining, manufacturing, construction, electricity, water, and gas.	
Voice and Accountability (VA)	capturing perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.	Kaufmann et al. (2011). Worldwide Governance Indicators : . Estimate of governance in standard normal units ranging from approximately -2.5 (weak) to 2.5 (strong) governance performance ; . Percentile rank among all countries, ranging from 0 (lowest) to 100 (highest) rank. www.govindicators.org
Government Effectiveness (GE)	"capturing perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies."	
Control of Corruption (CC)	"capturing perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests."	
Rule of Law (RL)	"capturing perceptions of the extent to which agents have confidence in and abide by the rules of society and in particular the quality of contract enforcement, property rights, the police , and the courts, as well as the likelihood of crime and violence."	
Regulatory Quality (RQ)	capturing perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.	
Financial Development Index	The dataset contains nine indices that summarize how developed financial institutions and financial markets are in terms of their depth, access, and efficiency.	International Monetary Fund https://data.imf.org/
Commodity Terms of Trade	Commodity-price fluctuations on countries that both export and import primary commodities, using a country-specific measure of thecommodity terms of trade	Gruss and Kebhaj (2019) International Monetary Fund https://data.imf.org/
Total tax revenues (% GDP)	It is the sum of the sub-components of tax revenues, i.e., stamp duties and taxes on the one hand, and upstream profits from the extractive resource (oil, gas, and mining), royalties and revenue from rent sharing agreements paid to the consolidated fund on the other hand, and excluding social contributions.	ICTD Government Revenue Dataset www.ictd. ac/dataset/grd
Human Development Index (HDI)	The Human Development Index (HDI) is a summary measure of average achievement in key dimensions of human development : a long and healthy life, being knowledgeable and have a decent standard of living.	UNITED NATIONS DEVELOPMENT PROGRAMME http://hdr.undp.org/en/data

TABLE C13 : List of EITI members (Group of treated), the original event dates, and status in February 2018, and Non-EITI members (Group of control)

	EITI members	Commitment	MSG	Candidate	First Report	Valid. Report	Compliant	Suspended	Status Feb. 2018	Non-EITI members
1	Afghanistan	march-09	Oct-09	Feb-10	Aug-12	Feb-13		Jan-19 -	Candidate	Algeria
2	Albania	Jan-09	march-09	May-09	march-11	Aug-11	May-13		**Compliant**	Angola
3	Argentina	Dec-17	Dec-18	march-19					Committed	Azerbaijan
4	Armenia	Jan-17		March-17					Candidate	Belarus
5	Burkina Faso	June-07	Dec-08	May-09	Apr-11	Sept-11	Feb-13		**Compliant**	Belize
6	Cameroon	Feb-05	May-05	Sept-07	Oct-06	July-10	Oct-13		**Compliant**	Bhutan
7	Central African Republic	Sept-07	July-08	Nov-08	Feb-09	Nov-10	march-11	April-13 -	Suspended	Bosnia and Herzegovina
8	Chad	Sept-07	Feb-10	Apr-10	Oct-12	May-13	Oct-14		**Compliant**	Botswana
9	Colombia	May-13	Feb-14	Oct-14					Candidate	Brazil
10	Côte d'Ivoire	May-07	Feb-08	May-08	Jan-10	Nov-10	May-13		**Compliant**	Bulgaria
11	Ethiopia	July-09	June-09	march-14	May-15				Candidate	Cuba
12	Gabon	May-04	Feb-05	march-07	Apr-07	March-08	Oct-10	Feb-13	Suspended	.
13	Ghana	May-03	Jan-05	Sept-07	Sept-07	June-10	Oct-10		**Compliant**	Ecuador
14	Guatemala	June-10	May-12	march-11	Apr-13	Nov-13	march-14	Feb - may-15	**Compliant**	Egypt
15	Guinea	march-05	Apr-05	Sept-07	July-07	Aug-12	July-14	Jan-Nov-11	**Compliant**	Equatorial Guinea
16	Guyana	May-10	Apr-10	Oct-17					Candidate	.
17	Honduras	Nov-12	Dec-12	May-13	May-15				Candidate	Gambia
18	Indonesia	Dec-08	June-10	Oct-10	May-13	July-13	Oct-14	Feb - Dec-15	**Compliant**	Georgia
19	Iraq	march-09	Aug-10	Feb-10	Nov-11	Aug-12	Dec-12		**Compliant**	Guinea-Bissau
20	Kazakhstan	June-05	Apr-05	Sept-07	Nov-07	Aug-10	Oct-13		**Compliant**	India
21	Kyrgyzstan	Apr-04	June-08	Sept-07	Nov-09	Apr-10	march-11		**Compliant**	Iran
22	Liberia	May-07	Apr-07	Sept-08	Jan-09	July-09			Candidate	Jordan
23	Madagascar	march-07	Jan-08	Feb-08	May-11	Sept-11		Oct-12 - Jan-14	Candidate	Lao PDR
24	Malawi	June-14	march-15	Oct-15					Candidate	Lesotho
25	Mali	Aug-06	June-07	Sept-07	Nov-09	Sept-10	Aug-11		**Compliant**	Libya
26	Mauritania	Oct-05	Dec-06	Sept-07	Feb-07	Sept-10	Feb-12	march - may-13	**Compliant**	Malaysia
27	Mexico	Jan-15	Nov-17	Oct-18	Dec-19				Candidate	Morocco
28	Mongolia	march-06	Jan-06	Sept-07	Dec-07	Feb-10	Oct-10		**Compliant**	Namibia
29	Mozambique	May-08	Apr-09	May-09	Jan-11	May-11	Oct-12		**Compliant**	.
30	Myanmar	Dec-12	Jan-14	July-14	Dec-15				Candidate	Russian Federation
31	Niger	march-05	July-05	Aug-07	march-10	June-10	march-11	Oct-17	Suspended	Rwanda
32	Nigeria	Nov-03	Dec-03	Sept-07	Oct-06	June-10	march-11		**Compliant**	.
33	Papua New Guinea	Apr-13	Nov-13	march-14	Feb-16				Candidate	South Africa
34	Peru	Apr-05	May-06	Sept-07	Oct-09	Sept-10	Feb-12		**Compliant**	Sudan
35	Philippines	July-12	Jan-13	May-13	Dec-14				Candidate	Syrian Arab Republic
36	Republic of the Congo	June-04	Sept-06	Sept-07	Aug-08	Sept-10	Feb-13		**Compliant**	Tunisia
37	Sao Tome and Principe	Dec-05	Dec-07	Feb-08	July-14	June-16		Feb - march-10	Candidate	Uzbekistan
38	Senegal	Feb-12	Feb-13	Oct-13	Dec-15				Candidate	Venezuela
39	Sierra Leone	May-06	June-07	Feb-08	Feb-10	July-10	Apr-14		**Compliant**	Vietnam
40	Suriname	Feb-16	Nov-17	Apr-18				Feb-19 -	Committed	Yemen
41	Tajikistan	Aug-12	Aug-12	Feb-13	Oct-15				Candidate	Zimbabwe
42	Tanzania	Nov-08	Feb-09	Nov-09	Jan-11	May-11	Dec-12	Nov - Dec-15	**Compliant**	
43	Timor-Leste	Apr-07	Apr-07	Feb-08	Oct-09	march-10	July-10	march - June-17	**Compliant**	
44	Togo	Dec-09	Apr-10	Oct-10	Feb-12	Apr-13	May-13		**Compliant**	
45	Ukraine	Oct-09	Oct-12	Oct-13	Nov-15				Candidate	
46	Zambia	July-08	July-08	May-09	Jan-11	May-11	Sept-12		**Compliant**	

Niger was previously suspended by the EITI Board on the basis of inadequate progress in implementing the EITI Standard on 26 October 2017, and rejoined the EITI in February 2020. Gabon was suspended in February 2013 after failing to submit a Validation report by the agreed deadline, and re-joined the EITI on 21 October 2021. The EITI Board has decided to temporarily suspend Central African Republic's status as EITI Compliant, effective 10 April 2013, due to political instability.

.4 Appendix D (Chapter 4) : Does Transparency Pay ? Natural Resources Financial Development, and EITI in RRDC

TABLE D1 : List of EITI Members, Event Dates, and Status in 2018

EITI Members	Commitment	MSG	Candidacy	First Report	Valid. Report	Compliance	Suspended	Status 2018	Non-EITI Members
1 Argentina	Dec-17	Dec-18	Feb-19	Dec-20	Nov-21			Candidate	1 Algeria
2 Burkina Faso	June-07	Dec-08	May-09	Apr-11	sept-11	Feb-13		Compliant	2 Angola
3 Cameroon	Feb-05	May-05	sept-07	oct-06	july-10	oct-13		Compliant	3 Australia
4 Chad	sept-07	Feb-10	Apr-10	oct-12	May-13	oct-14		Compliant	4 Azerbaijan
5 Colombia	May-13	Feb-14	oct-14	Apr-16	Dec-17			Candidate	5 Bahrain
6 Congo, Dem. Rep.	jan-05	Nov-05	sept-07	Nov-09	sept-10	Jul-15	Apr-Jul-13	Compliant	6 Belize
7 Congo, Rep.	june-04	sept-06	sept-07	Aug-08	sept-10	Feb-13		Compliant	7 Bolivia
8 Gabon	2007		2008				2013-2019	Candidate	Botswana
9 Ghana	May-03	jan-05	sept-07	sept-07	june-10	oct-10		Compliant	9 Brunei Darussalam
10 Guinea	march-05	Apr-05	sept-07	july-07	Aug-12	july-14	jan-nov-11	Compliant	10 Cabo Verde
11 Guyana	May-10	Apr-10	oct-17					Candidate	11 Chile
12 Indonesia	Dec-08	june-10	oct-10	May-13	july-13	oct-14	feb - Dec-15	Compliant	12 China
13 Iraq	march-09	Aug-10	Feb-10	nov-11	Aug-12	Dec-12		Compliant	13 Ecuador
14 Kazakhstan	june-05	Apr-05	sept-07	nov-07	Aug-10	oct-13		Compliant	14 Egypt, Arab Rep.
15 Kyrgyz Republic	Apr-04	june-08	sept-07	nov-09	Apr-10	march-11		Compliant	15 Equatorial Guinea
16 Liberia	May-07	Apr-07	sept-08	jan-09	july-09			Candidate	16 Eritrea
17 Mali	Aug-06	june-07	sept-07	nov-09	sept-10	Aug-11		Compliant	17 India
18 Mauritania	oct-05	Dec-06	sept-07	Feb-07	sept-10	Feb-12	march - may-13	Compliant	18 Iran, Islamic Rep.
19 Mexico	jan-15	nov-17	oct-18	Dec-19				Candidate	19 Jordan
20 Mongolia	march-06	jan-06	sept-07	Dec-07	Feb-10	oct-10		Compliant	20 Kuwait
21 Mozambique	May-08	Apr-09	May-09	jan-11	May-11	oct-12		Compliant	21 Lao PDR
22 Myanmar	Dec-12	jan-14	july-14	Dec-15	march-18	march-19		Candidate	22 Libya
23 Niger	March-05	Jul-05	Aug-07			march-11	0ct-17-march-18	Compliant	23 Malaysia
24 Nigeria	nov-03	Dec-03	sept-07	oct-06	june-10	march-11		Compliant	24 Morocco
25 Norway	sept-07	Nov-09	June-09	march-09		march-10		Compliant	25 Namibia
26 Papua New Guinea	Apr-13	nov-13	march-14	Feb-16	march-17			Candidate	26 North Macedonia
27 Peru	Apr-05	May-06	sept-07	oct-09	sept-10	Feb-12		Compliant	27 Oman
28 Suriname	Feb-16	Dec-16	May-17	Apr-19	Dec-19			Candidate	28 Poland
29 Timor-Leste	Apr-07	May-07	Feb-08	oct-09	feb-11	july-11		Compliant	29 Qatar
30 Togo	Dec-09	Apr-10	oct-10	Feb-12	Apr-13	May-13		Compliant	30 Russian Federation
31 Trinidad and Tobago	Dec-10	Sep-10	march-11	sept-13	sept-14			Candidate	31 Saudi Arabia
32 Ukraine	oct-09	oct-12	oct-13	Dec-15	May-18			Candidate	32 South Sudan
33 Zambia	july-08	july-08	May-09	jan-11	May-11	sept-12		Compliant	33 Sudan
									34 Syrian Arab Republic
									35 South Africa
									36 Tunisia
									37 United Arab Emirates
									38 Uzbekistan
									39 Venezuela, RB
									40 Vietnam
									41 Yemen, Rep.
									42 Zimbabwe