

Governance in extractive industries and resource revenue mobilization in developing countries: Evaluating the treatment effects of the EITI

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Abstract

The need for developing countries to increase their domestic revenue has always been relevant, especially after the Covid-19 pandemic which has weakened their public finances. While natural resource exploitation is expected to generate significant revenues, their inefficient management led to the creation of the Extractive Industries Transparency Initiative (EITI) in 2003, providing a standard for transparent and accountable resource management. This paper analyzes the dynamic treatment effects of implementing the EITI on resource revenue mobilization. Using a sample of 67 developing countries from 1995 to 2020, our empirical strategy relies on the recent heterogeneous and dynamic two-way fixed effects difference-in-difference estimator. This event study approach allows us to address the self-selection in the EITI membership and the heterogeneous and dynamic treatment effects over the EITI implementation process, thus providing an overview of the dynamics of pre-treatment and post-treatment effects in member countries. The results show that implementing the EITI significantly increases resource revenue mobilization in member countries compared to non-member countries. These results are supported by several robustness checks. Moreover, we find that the EITI increases non-tax revenue more than tax revenue, and has no adverse effects on other types of domestic revenue. Finally, we highlight the improvement of investment climate and the increase in foreign direct investment and resources exports as the main transmission channels. This study highlights the contribution of the EITI to better domestic revenue mobilization for sustainable development financing.

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1 Introduction

Domestic revenue mobilization has always constituted a vital challenge for developing countries. At the International Conference on Financing for Development in June 2015, the need to increase domestic revenue collection to finance the Sustainable Development Goals (SDGs) was highlighted (Chauvet and Ferry, 2021). The first target of Goal 17 of the SDGs also emphasizes the necessity to improve revenue collection. This is particularly relevant given the Covid-19 pandemic, which, due to the increase in spending to alleviate the burden on populations, has led to an economic and social crisis, contracting economic activity and exacerbating income inequalities and poverty (Buheji et al., 2020; Decerf et al., 2021; Deaton, 2021).

Despite the importance of domestic revenue mobilization, the literature shows that it remains weak in developing countries (Knack, 2009; Gordon and Li, 2009; McGuirk, 2013; Besley and Persson, 2014; Mascagni and Nell, 2022). Nevertheless, many developing countries are endowed with natural resources, and these resource exploitation revenues could be used to increase national income for development financing. However, developing countries fail to use these revenues to finance their development, leading to the "resource curse" theory. Three main determinants have been highlighted in the literature, namely the "Dutch disease" (Corden and Neary, 1982), conflicts (Collier and Hoeffler, 1998; Van der Ploeg and Rohner, 2012; Caselli and Coleman, 2013), and most importantly, institutional and governance matters (Bhattacharyya and Hodler, 2010; Arezki and Brückner, 2011, Sala-i Martin and Subramanian, 2013). In countries with low institutional quality, rent-seeking diverts agents from productive activities like entrepreneurship (Mehlum et al., 2006), and political elites practice patronage, using resource rents to inefficiently allocate administrative posts to gain political support (Robinson et al., 2006). This could lead to several consequences, like the allocation of exploration and extraction rights to extractive companies at prices below international standards, the use of bribes by corrupt politicians to capture wealth, and an under-estimation of taxes owed by extractive companies due to possible under-reporting of production volumes. This appropriation of resource revenue by political elites and corrupt agents prevents resource revenue from effectively contributing to the national income needed to support productive public spending in order to achieve economic growth and reduce income inequality and poverty. An additional consequence of the resource curse is that natural resource endowments decrease domestic non-resource revenue mobilization (Bornhorst et al., 2009; Crivelli and Gupta, 2014).

Due to all these consequences, and as mining and oil resources are non-renewable, it is important for developing countries to maximize their benefits from the extraction of these resources. Policies

that promote transparency and accountability increase the cost of corruption episodes and are a tool for tackling bad governance (Kolstad and Wiig, 2009). They also increase the accountability of governments to their citizens in managing extractive industries' revenues (Mejía Acosta, 2013). As mentioned by Bornhorst et al. (2009) and Kolstad and Wiig (2009), widespread concern about the inefficient use of natural resources, the resulting institutional and governance problems, and other dysfunctions of resource-rich developing countries have led to the creation of initiatives aimed at promoting transparency and accountability in resource management in order to reduce corruption and conflict, and channel revenues into sectors promoting economic growth and reducing poverty.

The Extractive Industries Transparency Initiative (EITI) was first publicly announced at the World Summit on Sustainable Development in Johannesburg in 2002 before formally launched in London in June 2003 (Lujala, 2018), and is considered the most broadly implemented and supported transparency initiative in natural resource governance. The EITI standard provides a global standard which aims to improve national governance in developing countries by enhancing transparency and accountability in resource revenue collection.

The EITI defines the process for countries seeking to join the institution and implement the EITI standard (EITI, 2016). Firstly, the government of a country seeking to implement the EITI standard must publicly announce its commitment to joining the EITI. It must then appoint a government official to lead the membership process, establish a national EITI secretariat and form an independent and active multi-stakeholder group (MSG). The MSG must include representatives from government, civil society and extractive companies, with the task of monitoring the implementation of the standard and drawing up a work plan detailing the country's objectives with national reforms and development priorities. Sovacool et al. (2016) precise that the key to the EITI is its multi-stakeholder transparency approach. Then comes the candidate stage, in which the country submits a formal application to the EITI Board (EITI, 2019). If the EITI Board determines that the standard's implementation requirements have been satisfied, the country's application is validated. In order to become a fully compliant country, the EITI multi-stakeholder group and national secretariat must prepare the required documents and data on the extractive sector. After this, an independent consultant prepares a validation report, which is submitted to the EITI board within two and a half years. The EITI board, after reviewing the documents, decides whether the country is compliant or not. When the country is declared compliant, it will have to publish regular reports according to the deadlines fixed by the EITI Board. In practice, however, the deadline for achieving compliance status is not always met. Most countries achieve

Compliance late in the engagement process but publish their EITI reports annually and comply with the standard's requirements. Sanctions can be taken against countries that can be suspended from the organization for four main reasons¹. However, the suspension can be lifted when the conditions for lifting the suspension are met, depending on the suspension type.

The EITI standard emphasizes the necessity for payments and revenues from extractive resources (oil, gas and mining) from extractive sector companies (public and private) to be published on regularly, for a wide audience, in an accessible, comprehensive and understandable manner, after reconciliation and a "credible independent audit" in line with international auditing standards, carried out by an independent and trusted external auditor. The main objective is to promote better resource revenue collection, which can be used to finance productive public spending with the aim of promoting sustainable economic growth, reducing poverty and income inequality, and increasing the well-being of populations in developing countries.

This study provides the first rigorous quantitative analysis of the dynamic treatment effects of the EITI implementation on resource revenue in developing countries and its contribution to domestic revenue mobilization. We want to assess the effectiveness of the EITI in achieving its primary objective of improving resource revenue collection. Concretely, this paper aims to answer the following questions: Does the EITI implementation increase resource revenue mobilization in developing member countries? If so, what are its dynamic effects? What are the transmission channels through which EITI implementation increases resource revenue? The conceptual framework developed in Section 2 suggests that implementing the EITI should increase resource revenue through three possible channels: (1) the investment climate, (2) foreign direct investment, and (3) extractive resources exports.

Considering a sample of 67 developing countries over the period 1995-2020, we evaluate the causal impact of implementing the EITI on resource revenue mobilization. We use, as dependent variable, resource revenue from the UNU-WIDER Government Revenue Dataset (GRD), which provides the most comprehensive, reliable, and comparative (across countries and time) data on resource revenue to date (Prichard et al., 2014). Our analysis exploits a difference-in-differences (DID) setup that compares countries implementing the EITI and those that do not implement the EITI. However, this analysis faces some analytical challenges. First, the EITI is a global organization that any country can join voluntarily. Second, member countries adhere to the EITI at different dates. Third, and most importantly, some treatment units are going in and out of treatment status due to suspension, creating breakdowns in the implementation process. Consequently,

¹More details on these suspension episodes and their impact on the analysis are discussed in Section 4.

the EITI implementation effects may vary across countries and years. As a result, the ordinary difference-in-differences (ordinary DID) estimation method could be biased, as highlighted by several recent studies (De Chaisemartin and D’Haultfoeuille (2020; 2022); Sun and Abraham, 2021; Goodman-Bacon, 2021; Callaway and Sant’Anna, 2021). In order to ensure the validity of the results and estimate the dynamic treatment effects of the EITI implementation, we apply the recent heterogeneous and dynamic two-way fixed effects difference-in-differences estimator (the DID_M estimator) proposed by De Chaisemartin and D’Haultfoeuille (2020; 2022). We also provide the ordinary DID estimation results for robustness. The results indicate positive, statistically and economically significant effects of the EITI implementation on resource revenue. More concretely, implementing the EITI increases, on average, the share of natural resource revenue in the GDP of developing member countries compared to non-members by 1.84 percentage points. In addition, implementing the EITI increases the government’s total domestic revenue by around 2.03 percentage points. These findings are robust to several robustness checks, such as using alternative estimation samples, including additional control variables, exploiting the exogenous variation in extractive resources world prices, exploring alternative dependent variables, conducting placebo tests, and employing alternative estimations methods like ordinary difference-in-differences (ordinary DID) method, and an instrumental variables (IV) identification. Furthermore, we provide evidence that the EITI’s effects on resource revenue are driven by a higher increase in non-tax revenue relative to tax revenue, and that the EITI implementation does not negatively affect other sources of revenue. Finally, we analyze three transmission channels through which the EITI implementation may affect resource revenue. We provide evidence that the improvement of the investment climate and the increase in foreign direct investment and extractive resource exports are the main transmission channels through which the EITI implementation increases resource revenue mobilization in developing countries.

This study contributes primarily to three strands of literature. The first is the literature on the EITI’s impact evaluation and the methodological challenges present in the EITI literature (Kasekende et al., 2016; Sovacool et al., 2016; Lujala, 2018). We apply a new analysis method that addresses, for the first time and all at once, the self-selection in the EITI membership, the heterogeneous treatment effects over the EITI implementation process and between countries and, more interestingly, which provides the evaluation of dynamic treatment effects. The second strand of the literature to which this paper contributes is the literature on strategies for enhancing domestic revenue mobilization, which remains relatively weak in developing countries (Knack, 2009; Gordon

and Li, 2009; McGuirk, 2013; Besley and Persson, 2014; Mascagni and Nell, 2022). Increased domestic revenues are all the more crucial to provide these countries with the capacity to mitigate the negative economic effects of the recent Covid-19 crisis and better cope with future economic shocks. By increasing the resource revenue collection, this study shows that the EITI implementation allows the extractive sector to participate in better domestic revenue mobilization. The third and final strand of the literature this paper contributes is that on the resource curse, specially the rent-seeking and resource misappropriation (Bhattacharyya and Hodler, 2010; Mehlum et al., 2006; Arezki and Brückner, 2011; Okada and Shinkuma, 2022). Indeed, this study highlights the EITI's ability to reduce the capacity for misappropriation of resource revenue by corrupt agents.

The rest of this paper proceeds as follows. Section 2 provides a conceptual framework for the EITI implementation and highlights several channels through which the EITI can affect resource revenue mobilization. Section 3 presents data and descriptive statistics. In Section 4, we develop the empirical strategy. The main results are presented in Section 5, followed by a robustness analysis in Section 6. Sections 7 and 8 provide evidence on the composition effects and the transmission channels, respectively. Finally, Section 9 concludes.

2 Conceptual framework

Referring to the literature, we explain how implementing the EITI may affect resource revenue collection and thus increase domestic revenue mobilization. The literature has revealed that the political elite rent-seeking and patronage are important factors leading to the resource curse (Mehlum et al., 2006; Robinson et al., 2006). On the one hand, rent-seeking diverts agents from productive activities, which leads the economy to a grabber equilibrium when the quality of institutions is low (Mehlum et al., 2006). On the other hand, the liberty of political elites to dispose of resource rents and their lack of accountability leads them to patronage, in the sense that they use these rents to obtain political support in order to limit the public's ability to demand accountability (Robinson et al., 2006). Acemoglu et al. (2004) have shown that corruption is a widespread evil in most developing countries, where leaders appropriate extractive rents and use them to "influence" opponents, applying the "divide and rule" strategy. Moreover, resource rents can be used to enforce corruption when the quality of democratic institutions is relatively low (Bhattacharyya and Hodler, 2010; Arezki and Brückner, 2011), at the detriment of social and equitable redistribution of these revenues. All these resource-rent appropriation activities by political elites and corrupt agents limit the collection of resource revenue by public administration and negatively affect the invest-

ment climate and foreign investment in an extractive sector which requires significant investments and specific advanced technologies. Transparency is a key factor for better resource revenue collection. Indeed, transparency is an important component of good governance, as lack of transparency makes corruption less risky and more attractive, while reducing trust between the population and its leaders on the one hand and even between financial institutions, foreign investors and governments on the other. By developing a model based on a public agent collecting revenues from extractive resources, [Kolstad and Wiig \(2009\)](#) argue that this agent has the choice of being honest or corrupt (in this case, receiving bribes from extractive companies) and that corruption decreases when these bribes decrease or when the costs of corruption (i.e., the probability of being caught) increase. Corruption between extractive companies and corrupt agents or politicians can lead to over-reporting extractive companies' costs and under-reporting their production, all of which leads to reduced payment of taxes and royalties owed by these extractive companies. Transparency in natural resources management can increase the mobilization of resource revenue by making public the awarding of contracts and licenses, improving the accountability of political elites, making corruption more costly and limiting rent-seeking and patronage, and improving the investment climate, which will lead to facilitating and regulating the activities of foreign investments ([Kolstad and Wiig, 2009](#); [Bhattacharyya and Hodler, 2010](#); [Mejía Acosta, 2013](#)). Implementing the EITI can thus increase resource revenue collection by improving the investment climate to attract more foreign investment, limiting rent-seeking and patronage, and increasing the production and exports of natural resources. For example, the EITI implementation, through its incentive and enforcement mechanism, could help to reduce the misappropriation of extractive rents and improve governance and accountability in public management, leading to a healthy investment climate. By improving trust in politicians and their accountability in extractive resources governance ([Villar, 2020](#)), enhancing the mining investment climate ([Malden, 2017](#)) and sending a signal to international investors about member countries' commitment to promoting transparency and combat corruption in the extractive sector ([Öge, 2016a](#); [Lujala, 2018](#)), the EITI implementation should enhance the attractiveness of foreign direct investment ([Sovacool et al., 2016](#); [Öge, 2016a](#); [Sovacool, 2020](#)). [Öge \(2016b\)](#) also found that the EITI is associated with better transparency by improving overall aggregate data disclosure in member countries. In addition, the EITI implementation should improve disclosure of real production of extractive companies, leading to more exports and more revenue collection. Moreover, the EITI implementation can allow an increase in resource revenue (both tax and non-tax revenue) in developing countries. Indeed, since resource revenue is

a growing function of production and a decreasing function of prices, implementing the EITI will increase the level of enforcement of laws imposed on extractive companies and political elites (thus increasing the concealment costs of companies' real production and costs), which will reduce cost inflation and under-reporting of production (Okada and Shinkuma, 2022).

In summary, the conceptual framework suggests that the EITI implementation affects resource revenue mobilization through three potential channels: (1) improving the investment climate, (2) increasing foreign direct investment, and (3) increasing export revenues from extractive resources. In Section 8, we provide evidence of the validity of these channels.

3 Data and descriptive statistics

3.1 Data

To evaluate the treatment effects of implementing the EITI on resource revenue mobilization, we use available data for a panel of 67 developing countries from 1995 to 2020. We focus on developing countries because the EITI implementation is more specific to developing countries. The treatment variable (*EITI*) is from the information available on the EITI website² (World Bank Group, 2016) and Lujala (2018). *EITI* is defined as equal to 1 for each year t in which country i is a member of the EITI and 0 otherwise. The study sample includes 33 countries that joined the EITI during the study period and 34 non-member countries. The complete list of countries in the sample is available in Table B1 in the Appendix B, and details on important dates in the EITI implementation process of the sample EITI countries are provided in Table B2.

Our main dependent variable (outcome) is resource revenue, the share of total revenue collected in the extractive sector in percentage of GDP. This variable is from the UNU-WIDER Government Revenue Dataset (GRD). The main advantage of the GRD is that it provides data on government domestic revenues, distinguishing between resource and non-resource revenues.³ This dataset provides the most comprehensive, reliable, and comparative (across countries and time) data on natural resource revenue to date (Prichard et al., 2014; Prichard, 2016). As described in Fig. B1, resource revenue includes resource tax revenue (extractive industries' corporate income taxes and indirect resource taxes) and resource non-tax revenue (royalties, export taxes, profit sharing, and the profits of state-owned enterprises). We use resource revenue as our main dependent variable

²EITI website: <https://eiti.org/countries>.

³This disaggregation is based on data available in existing databases, including among others the IMF Government Financial Statistics (GFS), the OECD Tax Statistics, and available IMF Article IV reports Prichard (2016).

since the EITI standard promotes transparency in collecting and disclosing all types of resource revenue, and its requirements cover all extractive sector revenue.

In line with the literature on the determinants of EITI membership and resource revenue, we use the following group of control variables: constant GDP per capita, net official development assistance, net foreign direct investment inflows, mineral and fuel dependence, corruption level, *polity2* score, law and order index, and commodity price index. Details on the choice of these control variables are available in Appendix [A.1](#).

In line with the literature on the EITI determinants ([Lujala, 2018](#)) and also in order to mitigate problems of reverse causality, we lag all control variables by one year. Data on constant GDP per capita, official development assistance, and foreign direct investment come from the World Development Indicators (WDI) database. Mineral dependence and fuel dependence represents, respectively, the share of mineral and fuel exports in total exports ([Haglund, 2011](#)). These data come from the United Nations Conference on Trade and Development dataset (UNCTADstat).⁴ Our corruption index and law and order index are from the International Country Risk Guide (ICRG) dataset, and the democracy index comes from the Polity IV dataset. The commodity price index is drawn from the International Monetary Fund (IMF) Commodity Terms of Trade database. Tables [C4](#), and [C5](#) describe the complete list of data and their sources, and additional descriptive statistics for these variables are provided in Table [B3](#) in Appendix [B](#).

3.2 Descriptive statistics

In this subsection, we present some statistics between the EITI implementation and the average resource revenue in our sample countries over the study period (1995-2020).

Figs. [1](#) and [2](#) provide some interesting stylized facts about the relationship between the EITI implementation and resource revenue. Indeed, Fig. [1](#) shows the average evolution of resource revenue in the group of EITI member countries, compared to the group of non-EITI member countries. It can be seen that while non-EITI countries had higher resource revenue than EITI countries prior to the creation of the EITI, resource revenue in EITI countries increased from 2003 and became significantly higher than resource revenue in non-EITI countries. Moreover, Fig. [2](#) presents the average resource revenue in country-year observations in which EITI is implemented and in country-year observations without EITI implementation. The results reveal higher resource revenue in treated units (7.38%) compared to non-treated units (4.76%). Furthermore, the dif-

⁴More details are provided in Table [B6](#) in Appendix [B](#).

ference between the two groups is statistically significant ($t\text{-test} = 3.6802$; $p\text{-value} = 0.000$). Even if these stylized facts indicate a positive relationship between EITI implementation and resource revenue, these statistics are only correlations and not causal effects. This does not allow us to draw a conclusion about a causal relationship between the EITI implementation and resource revenue. To do so, we conduct an impact evaluation analysis described in Section 4.

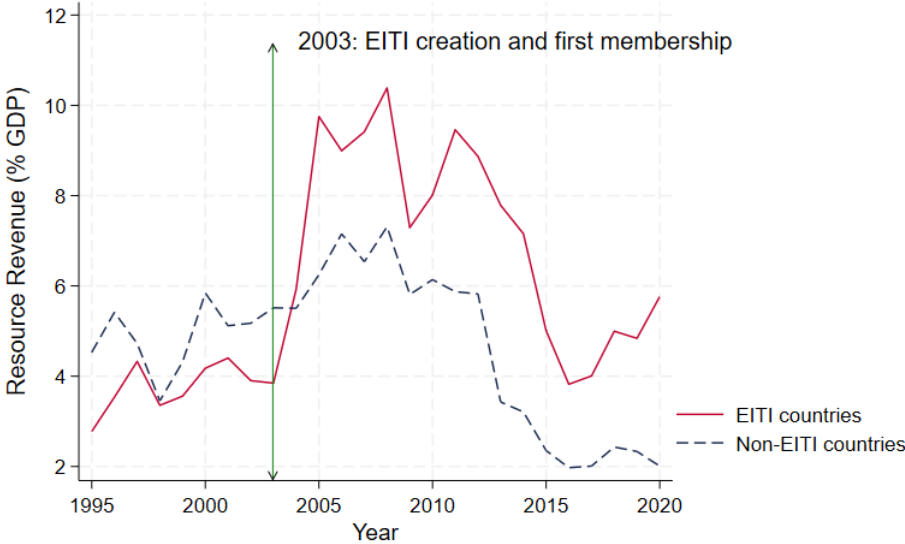


Fig. 1: Average evolution of resource revenue in EITI member and non-member countries. Source: Author’s construction based on data from UNU-WIDER GRD.

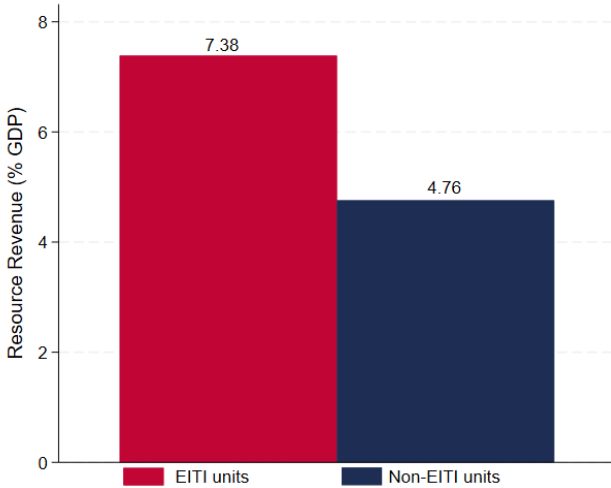


Fig. 2: Average resource revenue (% GDP) in EITI units and non-EITI units. Source: Author’s construction based on data from UNU-WIDER GRD.

4 Empirical strategy

This study aims to evaluate the EITI dynamic treatment effects on resource revenue mobilization in developing countries. We exploit variations in EITI adherence and implementation timing across countries, resulting in the following equation:

$$RR_{it} = \beta EITI_{it} + \alpha_i + \mu_t + \delta X_{it} + \epsilon_{it} \quad (1)$$

Where RR_{it} is the share of resource revenue in GDP of country i in year t ; $EITI_{it}$ is a dummy variable representing the treatment and indicates whether country i implements the EITI in year t (it is equal to 1) or not (it is equal to 0); α_i represents country-fixed effects that capture time-invariant country-specific effects; μ_t represents year-fixed effects that capture time-specific factors affecting sample countries. X_{it} is a set of control variables, and ϵ_{it} is the random error term.

Equation 1 represents an ordinary difference-in-differences (ordinary DID) specification with additional controls, a method generally used in the literature to analyze treatment effects. However, our analysis faces some analytical challenges that must be addressed to ensure the validity of the results. Firstly, the EITI is a global organization that any country can join voluntarily. Secondly, member countries adhere to the EITI at different dates. Therefore, a country’s decision to implement the EITI standard may be influenced by its economic and institutional characteristics. Thirdly, and most importantly, some treatment units go in and out of treatment status. Indeed, Table B7 describes the timeline in the EITI implementation process for all EITI countries in our sample and shows that some countries were suspended at different times before rejoining the EITI.⁵ This last threat to identification has not yet been considered in any studies evaluating the effects of the EITI but represents a major threat that can significantly bias the results.

Several recent studies have shown that the existence of heterogeneous treatment effects (meaning that the same treatment has different effects on different samples or at different times) may induce bias in traditional DID estimation if treatments are phased in at different times over a long panel and, in some extreme scenarios, even reversing the sign of the effect due to the fact that it may give negative weights to some of the underlying treatment effects (De Chaisemartin and d’Haultfoeuille (2020; 2022); Sun and Abraham, 2021; Goodman-Bacon, 2021; Callaway and Sant’Anna, 2021; Borusyak et al., 2021). However, one of the consequences of the interruptions in EITI implementation in some countries is that a unit treated at one period can serve as a control for a unit treated at a later period, and past treatments may influence the treatment outcome at time t . More concretely, a unit not treated in $t-1$ and t may have been treated in $t-2$ or $t-3$, and these treatments can influence the estimate of the treatment effect in t . It is legitimate to

⁵Countries can be suspended from the EITI for four reasons: First, when the country does not meet the deadline for the publication of EITI reports (For example, Gabon, which left the organization from February 2012 to October 2021). Second, when the country does not demonstrate significant progress, such as Niger, which left the organization in October 2017 following its suspension before rejoining in January 2019. Third, when the country does not comply with the EITI principles. Fourth, when the country faces political instability that prevents it from implementing the EITI standard, this was the case for Guinea from December 2009 to March 2011.

think that the EITI treatment effects could be heterogeneous over time and between countries. The ordinary DID method considers the earlier treated observations as a comparison group for the later treated observations, assuming that the treatment effect is stable (Lu et al., 2023).⁶ If the treatment effect increases over the years, the ordinary DID method takes a part of the increasing effect as the year fixed effect and then generates an underestimation of the treatment effect. Equally, a decreasing treatment effect generates an overestimate.

To take into account these identification threats and address such bias, we implement the very recently heterogeneous and dynamic two-way fixed effects difference-in-differences estimator (denoted by " DID_M estimator" in the rest of the analysis), developed by De Chaisemartin and d'Haultfoeuille (2020; 2022). Indeed, only their estimator provides a methodology for difference-in-differences specifications that address heterogeneity and dynamic treatment effects in a non-staggered design, with units that move in and out of treatment status (Bertoli et al., 2022). The intuition behind this estimator is that it compares units treated at the time they are first treated to units that have not yet been exposed to treatment. We then estimate the following equation:

$$RR_{it} = \sum_{j \geq -K, j \neq -1}^L \beta_j EITI_{it}^j + \alpha_i + \mu_t + \delta X_{it} + \epsilon_{it} \quad (2)$$

As precised earlier, RR_{it} is the share of resource revenue in GDP of country i in year t ; α_i represents country-fixed effects; μ_t represents year-fixed effects; X_{it} is a set of control variables; and ϵ_{it} is the random error term. Let consider u_i as the year when country i adhere to the EITI, K the largest numbers of years tested before u_i , and L the largest numbers of years tested after u_i . Thus, as mentioned earlier, $EITI_{it}$ is equal to 1 if $t-u_i=j$, and zero otherwise for $-K \leq j \leq L$ and $j \neq -1$. In other words, the year immediately before the membership to the EITI ($t - u_i = -1$) is taken as the reference and we calculate the coefficients for all other years relative to this base. So, the " DID_M estimator provide not only a test of the validity of the parallel trends assumption (β_j for $j < -1$), but also an evaluation of the EITI's treatment effect over time (β_j for $j \geq -0$). Therefore, the average effects of the EITI can be determined by averaging the yearly treatment effects. Finally, we set $K = 5$ and $L = 14$.⁷

We use the DID_M estimator in our analysis for its various advantages. This estimator allows controlling for heterogeneity and dynamic effects in the EITI implementation. Indeed, this estimator is able to use all the information in our full sample both to test for parallel trends as-

⁶Indeed, this method relies on two major assumptions: the parallel trends assumption and the assumption that the treatment effect is constant between groups and over time.

⁷The maximum numbers that be computed with the current STATA package.

sumption validity through their placebo analysis and to compute treatment effects a number of periods after the establishment of the policy. It also allows us to test for anticipation effect and to address potential self-selection bias in the EITI membership. Given its numerous advantages, this estimator enables us to properly evaluate the dynamic treatment effects of implementing the EITI on resource revenue in developing countries. Nevertheless, we provide the ordinary DID estimation results and test their validity by applying the test proposed by [De Chaisemartin and d’Haultfoeuille \(2020\)](#), which consists in calculating the number of estimated ATTs attached to negative weights.⁸ The higher the percentage of ATTs attached to estimated negative weights in the total number of ATTs estimated by the ordinary DID method, the higher the probability of these results being biased. In addition in the robustness analysis, we provide results based on an Instrumental Variables (IV) identification.

5 Main results

Employing the heterogeneous and dynamic DID_M estimator developed in Section 4, we estimate the treatment effects of implementing the EITI on resource revenue mobilization in developing countries over the period 1995-2020.

First, in column (1) of Table C3 in Appendix C, we present the estimation results of the EITI implementation treatment effects on resource revenue using the ordinary DID estimation. The result indicates that the EITI implementation increases the resource revenue rate in GDP by 1.17 percentage points, statistically significant at the 5% threshold.. As explained previously, the results obtained using the ordinary DID method may not be robust to the heterogeneous effects of the EITI implementation. Applying the validity test of ordinary DID estimation proposed by [De Chaisemartin and d’Haultfoeuille \(2020\)](#), the result indicates that, under the assumption of common trends, β estimates a weighted sum of 283 ATTs, 33 of which receive a negative weight, i.e. 11,66 % of total estimated ATTs. This result means that the ordinary DID estimates are not completely robust to the heterogeneous treatment effects of the EITI.

Second, Table 2 presents our main results of the EITI implementation treatment effects on resource revenue, based on the heterogeneous and dynamic TWFE difference-in-differences estimation (DID_M estimator). Column (1) of Panel A reports the results for the post-average treatment effect of the EITI implementation on resource revenue. DID_M is the estimated post-average im-

⁸This test can be performed in Stata using the command "twowayfeweights" ([De Chaisemartin et al., 2019](#); [De Chaisemartin and d’Haultfoeuille, 2020](#)).

Table 1: EITI and Resource Revenue

	Baseline main results	Excluding recent member countries	Excluding long -term suspended countries	Excluding the pre-EITI period	Resource-rich countries sample
Dependent variable: Resource Revenue	(1)	(2)	(3)	(4)	(5)
Panel A					
Post average treatment effects					
DID_M	1.8450*** (0.7121)	2.0042*** (0.7531)	2.0828*** (0.7188)	2.1579*** (0.7414)	0.2.7175*** (0.9856)
Control variables	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Mean in control group	4.7581	4.83	4.55	4.97	7.12
Placebo joint-test p-value	0.3624	0.2772	0.6404	0.4958	0.2949
Panel B					
Annual post-treatment effects					
T 0	0.6269** (0.2907)	0.6391 (0.3945)	0.8516** (0.3598)	0.5746* (0.3325)	0.6882 (0.4955)
T+1 year	1.5902** (0.6280)	1.6397** (0.7883)	1.8541** (0.7750)	1.4592** (0.6901)	0.1.9159** (0.8594)
T+2 years	1.7866** (0.7768)	1.9268** (0.9694)	2.0398** (0.9498)	1.6048* (0.8214)	2.1223* (1.1141)
T+3 years	1.7693*** (0.6353)	1.8606** (0.7721)	2.0844*** (0.6932)	1.7611*** (0.6640)	2.0481** (0.8643)
T+4 years	2.1769** (0.9966)	2.4148** (1.1689)	2.3194** (1.1661)	2.4758** (1.0381)	0.2.6178** (1.3261)
T+5 years	1.0840* (0.6326)	1.3098** (0.5465)	1.3477** (0.5670)	1.1694* (0.6399)	1.4068 (0.8657)
Pre-treatment (placebo) estimators					
$DID_M^{plb,1}$	0.5150 (0.4455)	0.4528 (0.4551)	0.5379 (0.4914)	0.2337 (0.2928)	0.6189 (0.5625)
$DID_M^{plb,2}$	0.9079 (0.5923)	0.8047 (0.6158)	0.8447 (0.6830)	0.3354 (0.5230)	1.1375 (0.7113)
$DID_M^{plb,3}$	0.5020 (0.4584)	0.3805 (0.5034)	0.3566 (0.5502)	0.7119 (0.6708)	0.6631 (0.6546)
$DID_M^{plb,4}$	-0.6510 (0.5557)	-0.8839 (0.5495)	-0.4018 (0.7445)	-0.0593 (1.0257)	-0.8487 (0.8348)
$DID_M^{plb,5}$	-0.3735 (0.6649)	-0.3484 (0.7769)	-0.6546 (0.7544)	-0.4626 (1.1581)	-0.1142 (0.9976)

Results are obtained using the heterogeneous and dynamic TWFE-DID estimator of [De Chaisemartin and D'Haultfoeuille \(2020; 2022\)](#), as well as 100 bootstrap replications and 5 placebo years. Robust standard errors are in parentheses. EITI membership is the treatment variable, and unreported constant is included. Control variables: natural resources rents (log), corruption index, trade openness (log), foreign direct investment (log), commodity price index, constant GDP per capita (log), and inflation. All of these variables are lagged by one year. * Significant at the 10% level; ** Significant at the 5% level; *** Significant at the 1% level.

part of implementing the EITI, based on the effects over the first fourteen years ($t + 14$) following the membership to the EITI. The results show that implementing the EITI, on average and over the study period, increases resource revenue by 1.84 percentage points in developing country members compared to non-members, with a statistically significant effect at the 1% threshold. With an average resource revenue in the control group of 4.75%, this coefficient represents 38% of the control sample average and indicates an economically significant effect of the EITI implementation on resource revenue. Moreover, the placebo joint-test performed by this estimator (which are the p-values of a joint test that all placebos are equal to zero) is not statistically significant, attesting to the credibility of the parallel trend and the non-anticipation assumptions. Furthermore, panel

B reports the post-treatment estimation results for the first six years of EITI implementation, as well as five pre-treatment estimators ($DID_M^{plb,1}$, $DID_M^{plb,2}$, $DID_M^{plb,3}$, $DID_M^{plb,4}$, and $DID_M^{plb,5}$), corresponding, respectively, to the second, third, fourth, fifth, and sixth years before the implementation of the EITI. The no-significance of these individual pre-treatment estimations results corroborate the placebo joint-test results.⁹ More concretely, this means that before implementing the EITI, EITI member countries did not experience significant changes in the level of resource revenue compared to those who never implemented the EITI. This validates the parallel trends and no anticipation assumptions, which rules out any potential self-selection bias in the EITI membership.

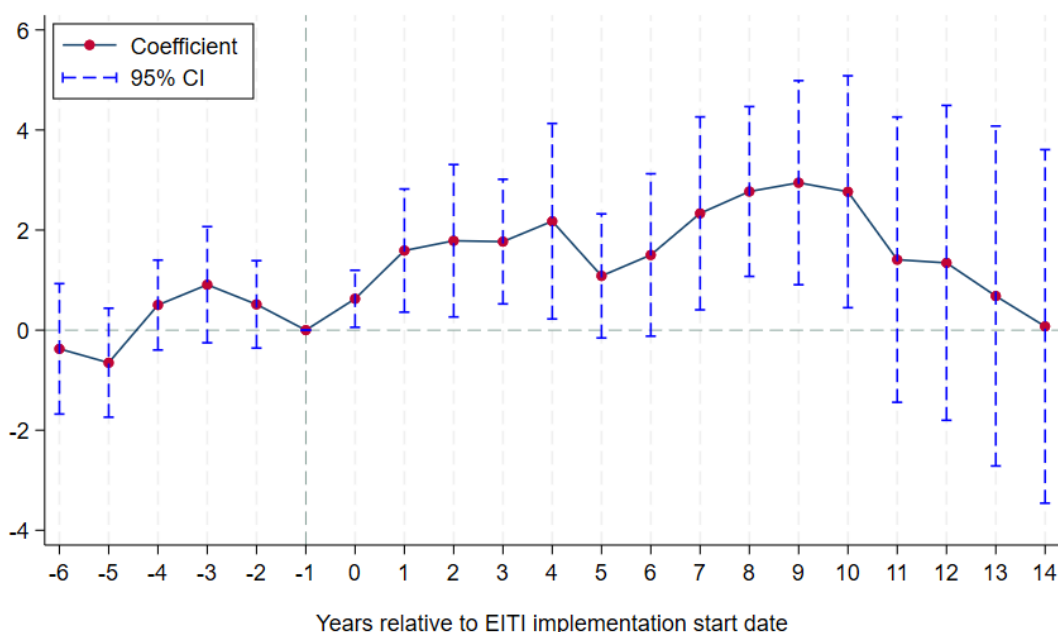


Fig. 3: Representation of the EITI dynamic (annual) effects on resource revenue with the heterogeneous and dynamic TWFE-DID estimator of De Chaisemartin and d’Haultfoeuille (2020; 2022). Estimates from Stata command `did_multiplget` (see De Chaisemartin et al. (2019)). We apply 100 bootstrap replications, and bars represent the 95% confidence intervals around long differences effects and placebo tests. The placebo joint-test is not significant.

Third, Fig. 3 plots both pre-treatment and post-treatment trends. The post-treatment effects represent the estimated dynamic (annual) effects of the EITI implementation. Since De Chaisemartin and d’Haultfoeuille (2020; 2022) consider $t = 1$ as the reference year, this graph shows pre-treatment estimators corresponding to one up to five years before the EITI implementation and fourteen years of post-treatment estimates. Firstly, the results reveal that all pre-treatment estimators are small and not significantly different from zero. Secondly, the results show positive,

⁹Since De Chaisemartin and d’Haultfoeuille (2020) consider $t = -1$ as the reference year, $DID_M^{plb,1}$ compares the difference in the outcome between EITI and non-EITI countries in $t - 1$ with the difference between the two groups in $t - 2$, $DID_M^{plb,2}$ makes such a comparison between $t - 1$ and $t - 3$, while $DID_M^{plb,3}$ makes such a comparison between $t - 1$ and $t - 4$, and so on.

For space reason, we do not report all the annual estimations results. All results are available on request.

statistically significant and increasing post-treatment effects of the EITI implementation on resource revenue. We observe an immediate significant effect following the introduction of the EITI (by 0.63 percentage points), which remains significant up to ten years after EITI membership (by 2.76 percentage points).¹⁰

Finally, Table C1 presents the estimated average impact of implementing the EITI based on the effects after one year ($t + 1$) from the start of EITI implementation (column (1)) up to the first fourteen years ($t + 14$) of EITI implementation (column (14)). This table indicates that the average cumulative effects of the EITI implementation on resource revenue are positive, statistically significant, and increasing over the implementation period. Moreover, none of the pre-treatment estimators and the joint placebo test are statistically different from zero.

Our results provide evidence that EITI membership and implementation of the standard offer a real opportunity for the extractive sector to contribute to better resource revenue mobilization in member developing countries. These results demonstrate the effectiveness of the EITI in increasing resource revenue collection, the institution having been considered at its creation as the most influential and promising international organization for promoting transparency, accountability, and better governance in the extractive sector.

6 Robustness analysis

The main estimation results in Section 5 indicate that the EITI implementation significantly increases resource revenue in developing member countries compared to non-member countries. We conduct several additional robustness checks in this section to verify these findings.

First, we test the robustness of the results using alternative samples and controlling for various additional control variables likely to influence the EITI membership and resource revenue. Second, the dynamic of world prices of the main extractive resources produced by countries is an important factor in estimating the effects of the EITI on resource revenue. We then exploit the exogenous variation in natural resources' world prices by controlling for the world prices of each country's main extractive resource produced on the one hand, and also constructing a resource production price index on the other hand. Third, we use three alternative definitions of the dependent variable. Fourth, we test for robustness by conducting four placebo tests. Finally, we estimate the treatment effects of the EITI implementation using alternative estimation methods like ordinary difference-

¹⁰The fact that the annual effects become insignificant from period $t+11$ does not mean that there is no longer any effect of the implementation of the EITI on resource revenue, but it is simply due to the fact that there are fewer observations for effect estimation from this period.

in-differences (ordinary DID) method and panel instrumental variables (IV) method.

6.1 Alternative samples and additional control variables

On the one hand, we consider alternative samples obtained by excluding some countries or periods. First, we remove countries that are not long-time members of the EITI.¹¹ Second, we remove countries suspended/excluded from the EITI for a long period.¹² This exclusion helps to prevent any potential bias caused by these periods of non-implementation of the EITI, even if the evaluation method used already allows us to take this into account. Third, we exclude the period before the creation of the EITI (the period before 2003). Finally, although some EITI member countries are not resource-dependent countries, we think that the institution is primarily intended for resource-dependent countries (because they have a higher motivation to join). For this reason, we consider a specification in which we retain only countries highly dependent on natural resources in the sample. Based on the literature, we consider developing resource-dependent countries as those for which resource exports account for an average of 25% or more of their total merchandise exports throughout the analysis period (Haglund, 2011) or those for which the share of extractive rents in GDP is greater than or equal to 10% on average during the analysis period (Dobbs et al., 2013). The results of these respective specifications are represented in Fig. 4, and we report the respective post-average treatment effects using these alternative sub-samples in columns (2)-(5) of Table 2. These results are consistent with our main findings and show positive and statistically significant effects of the EITI implementation on resource revenue, with treatment effects ranging from 2.00 to 2.72 percentage points.

On the other hand, we test the robustness of our results using additional control variables that are likely to influence the decision to implement the EITI and resource revenue. Referring to the literature, we identified four main groups of additional control variables¹³: **A- Membership to other international organizations in the field of natural resources management**: dummy variables indicating membership in the Kimberly Process (KP), membership in the International Conference on the Great Lakes Region (ICGLR), membership in the Organization of Petroleum Exporting Countries (OPEC), and membership in the Organization of Petroleum Exporting Countries + (OPEC+). **B- Additional socio-economic variables**: public debt (% of GDP), trade

¹¹We exclude from the sample countries that joined the EITI during the five years prior to the end of the study period. These include Mexico and Suriname, which joined in April 2015 and February 2016, respectively (See Table B2).

¹²We exclude countries suspended from the EITI for more than one year. These include Gabon, Equatorial Guinea, Honduras, Liberia, Madagascar, Niger, and Sao Tome and Principe (See Tables B2 and B7).

¹³The reasons for the choice of these variables are discussed in Appendix A.2.

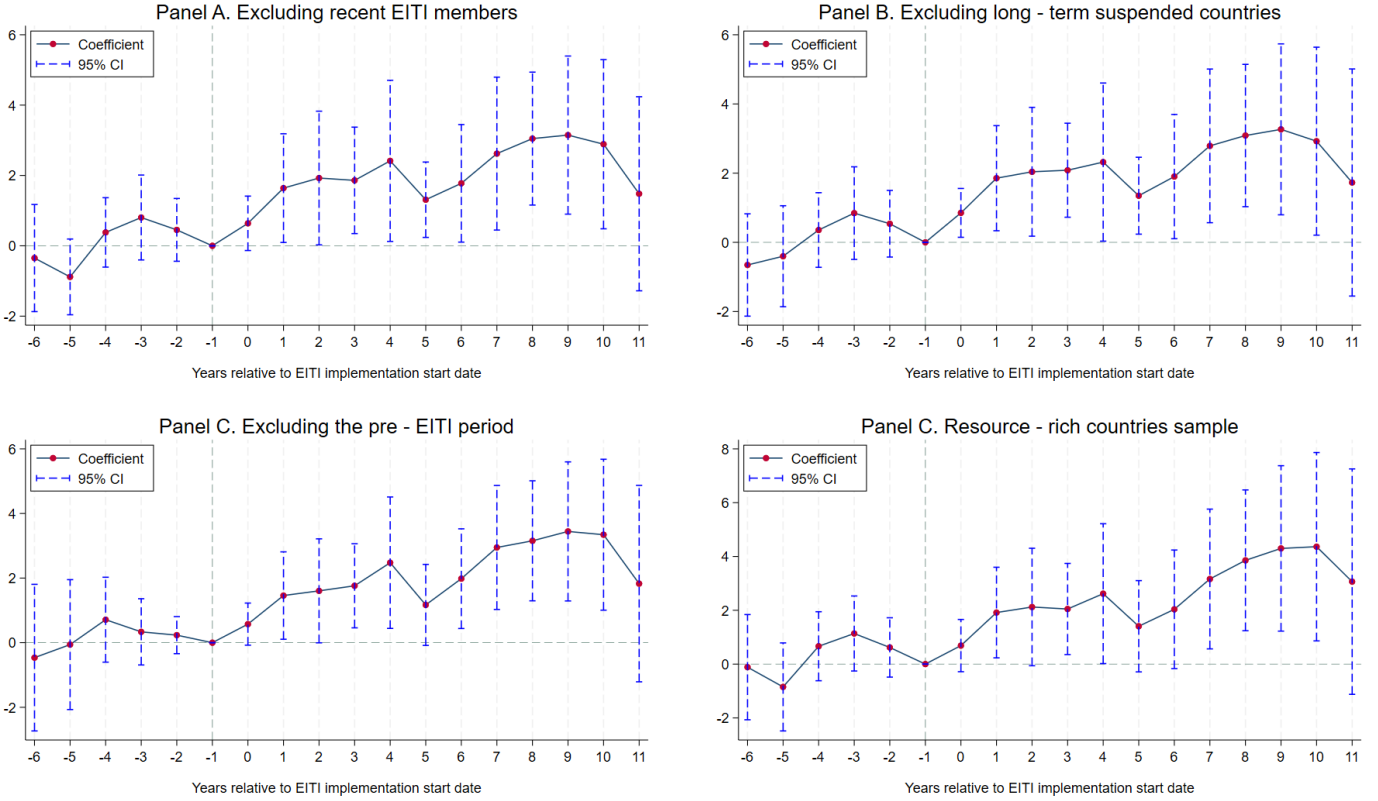


Fig. 4: Representation of the EITI dynamic effects on resource revenue with the heterogeneous and dynamic TWFE-DID estimator of De Chaisemartin and d’Haultfoeuille (2020; 2022) on alternative samples and applying 100 bootstrap replications. Bars represent the 95% confidence intervals around long differences effects and placebo tests.

openness (% of GDP), inflation rate, exchange rate, the share of agriculture in value-added, financial development, domestic public investment (% of GDP), government total expenditure (% of GDP), population growth, and human capital index. **C- Conflicts and geographic variables:** internal and external conflict indicators, dummy variables for Sub-Saharan African and Latin America countries. **D- National reforms and major international events:** fiscal rules implementation, IMF programs, and dummy variables characteristic of the global financial crisis and corresponding to the commodity super-cycle period. In order to avoid a potential bias due to reverse causality, these variables are lagged by one year, as well as the control variables used in the main analysis (Except for dummy variables). The results of these specifications are reported in columns (1)-(22) of Table 2, while Figs. C1, C2, C3, C4, and C5 (in Appendix C) plot the pre-treatment and pre-treatment effects. These different specifications are consistent with our baseline results and confirm the robustness of our results to the addition of control variables since these variables support our conclusion that implementing the EITI increases resource revenue mobilization in developing member countries compared to non-member countries. Furthermore, as noted by Lu et al. (2023), the striking pattern with the DID_M estimation is that the inclusion of additional control variables only slightly modifies the estimation results. Moreover, these specifi-

cations allow us to address concerns about potential estimation bias from omitting pertinent EITI membership determinants.

Table 2: EITI and Resource Revenue
Additional control variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable: Resource Revenue	Kimberly Process membership	ICGLR membership	OPEC membership	OPEC+ membership	Public Debt	Trade openness	Inflation	Exchange rate
EITI	1.8450*** (0.7121)	1.8450*** (0.7121)	1.8450*** (0.7121)	1.8450*** (0.7121)	1.7399** (0.6770)	1.8626** (0.7734)	1.8450*** (0.7121)	1.8795*** (0.6620)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Placebo joint-test p-value	0.3624	0.3624	0.3624	0.3624	0.3184	0.3351	0.3624	0.303
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Dependent variable: Resource Revenue	Agriculture value-added	Financial development	Domestic public investment	Government total expenditures	Population growth	Human capital	Internal conflicts	External conflicts
EITI	1.7807** (0.6964)	1.9198*** (0.7097)	1.8450*** (0.7121)	1.8454*** (0.7120)	1.8450*** (0.7121)	2.1628*** (0.7573)	1.8450*** (0.7121)	1.8450*** (0.7121)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Placebo joint-test p-value	0.1622	0.2484	0.3624	0.4618	0.3624	0.4679	0.3624	0.3624
	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
Dependent variable: Resource Revenue	Sub-Saharan region	Latin-America region	Fiscal rule	IMF programs	Global financial crisis	Commodity prices super cycle period	Main resource world prices	Fuel and mineral price index
EITI	1.8450*** (0.7121)	1.8450*** (0.7121)	1.8450*** (0.7121)	1.8450*** (0.7121)	1.8450*** (0.7121)	1.8450*** (0.7121)	2.0980** (0.8411)	2.0980** (0.8411)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Placebo joint-test p-value	0.3624	0.3624	0.3624	0.3624	0.3624	0.3624	0.1858	0.1857

Results are obtained using the heterogeneous and dynamic TWFE-DID estimator of [De Chaisemartin and D'Haultfoeuille \(2020; 2022\)](#), as well as 100 bootstrap replications and 5 placebo years. Robust standard errors are in parentheses. EITI membership is the treatment variable, and unreported constant is included. Control variables: natural resources rents (log), corruption index, trade openness (log), foreign direct investment (log), commodity price index, constant GDP per capita (log), and inflation. All of these variables are lagged by one year. * Significant at the 10% level; ** Significant at the 5% level; *** Significant at the 1% level.

6.2 Focus on main mineral and fuel world prices

The dynamic of world prices of the main extractive resource (mineral and fuel) produced by countries is an important factor in estimating the effects of the EITI on resource revenue. Indeed, the evolution of world prices of the resources produced by each country is a factor that can affect both the decision to join the EITI and the resource revenue of countries. In particular, if countries are treated during a downturn or upturn in the price cycle of the main extractive resources they produce, this could influence the estimated treatment effect. Moreover, the world prices of major extractive resources have risen over the 2000-2014 period (see Fig. C6). The literature has shown that resource revenue tends to be highly volatile, mainly driven by the volatility of energy and minerals world prices ([Segal, 2012](#); [Crivelli and Gupta, 2014](#)). This volatility in extractive resource

world prices may represent a threat to the identification in our study, as part of the estimated effect could be due to the evolution of extractive resource world prices over the study period. We, therefore, need to address this identification threat to ensure the validity of our results.

In the first step, like [Berman et al. \(2017\)](#), we exploit exogenous changes in the world prices of the main extractive resource produced by each country in the sample. We identify nine extractive resources for which price data are available, and we define the main extractive resource produced by each country as the extractive resource with the highest production value over the entire study period. Extractive resources retained are bauxite (aluminum), coal, copper, gold, iron, oil, platinum, silver, and zinc.¹⁴ More details on the sources of annual international commodity prices are available in Appendix C in Table C5. We thus replace the commodity price index variable used in the main analysis with the logarithm of world prices of the main extractive resource produced for each country. The results are resumed in columns (23) of Table 2, and indicate that the EITI implementation increases resource revenue by an average of around 2.10 percentage points.

In the second step, to consider the influence of the majority of extractive resources produced by the countries in the sample, we construct a country-specific international extractive resource production price index that captures the benefits of variations in international extractive resource prices. Based on the literature ([Collier and Goderis, 2008](#); [Arezki and Brückner, 2012](#); [Ehrhart and Guineau, 2013](#)), we construct this index as follows:

$$RPriceIndex_{it} = \prod_{r \in R}^N \times RPrice_{r,t}^{\beta_{i,r}} \quad (3)$$

Where $RPrice_{r,t}$ is the international price of extractive resource r in year t , and $\beta_{i,r}$ is the average (time invariant) value of production of extractive resource r in the GDP of country i . We thus control by this construct extractive resource production price index and present results in column columns (24) of Table 2. The result does not change, and the average effect of implementing the EITI on resource revenue remains positive and statistically significant.

All the results of robustness tests performed in this subsection are consistent with our primary results: implementing the EITI significantly increases resource revenue. Therefore, we can conclude that our results are robust to the variation in resource world prices, and these results address any concerns about potential bias from the volatility in resource world prices.

¹⁴The list of the main extractive resource for each country is available in Appendix B, in Table B8.

6.3 Alternative dependent variables

Our main dependent variable is resource revenue in percentage of GDP. We check the robustness using the following alternative dependent variables: resource revenue (in percentage of total government revenue) and total government revenue (in percentage of GDP). We thus re-estimate Equation 2 using these variables as dependent variables. The results are reported in columns (1)-(2) of Table 3 and show positive and statistically significant effects of the EITI implementation. Implementing the EITI increases, on average, the share of resource revenue in total government revenue by 3.89 percentage points (representing 21.98% compared to the control group sample average) and the share of total revenue in GDP by 2.03 percentage points (representing 10.06% compared to the control group sample average). In addition, since total resource rents have been used in the literature as a proxy for natural resource revenue, we use this variable as alternative dependent variable. The result is reported in column (3) of Table 3, and indicates that implementing the EITI also increase total resource rents by 2.79 percentage points (representing 25.87% compared to the control group sample average). This effect corroborates the findings of [Okada and Shinkuma \(2022\)](#). All of these results, therefore, indicate that the use of alternative dependent variables does not alter our results which attest to their robustness, and also highlight the effects of the EITI implementation on total revenue mobilization.

Table 3: EITI and Resource Revenue
Robustness and composition effects analysis

Dependent variable:	Alternative dependent variables			Composition effects	
	(1)	(2)	(3)	(4)	(5)
Resource revenue (% total revenue)	3.8910** (1.7601)				
Total government revenue (% GDP)		2.0264*** (0.7449)			
Total natural resource rents (% GDP)			2.7946*** (0.8949)		
Resource tax revenue (% GDP)				0.7455** (0.3272)	
Resource non-tax revenue (% GDP)					1.5289** (0.6641)
Mean in control group	17.71	20.14	10.80	1.41	2.97
Placebo joint-test p-value	0.3557	0.2424	0.4789	0.2747	0.5567
Control variables	Yes	Yes	Yes	Yes	Yes
Country and Year fixed effects	Yes	Yes	Yes	Yes	Yes

Results are obtained using the heterogeneous and dynamic TWFE-DID estimator of [De Chaisemartin and d'Haultfoeuille \(2020; 2022\)](#), using 100 bootstrap replications and 5 placebo years. Robust standard errors are in parentheses.
* Significant at the 10% level; ** Significant at the 5% level; *** Significant at the 1% level

6.4 Placebo tests

The implementation of the EITI standard is accompanied by other reforms and policies (often common to countries). In addition to the robustness tests already conducted, we conducted four different placebo tests. First, we perform random falsification tests considering placebo treatment dates in the treatment group by randomly assigning implementation dates to the EITI countries. Specifically, we randomly shift the treatment dates of the treated units and re-estimate the effect of the EITI implementation on resource revenue. Second, we use total non-resource revenue, and its components (non-resource tax revenue and non-resource non-tax revenue) as alternative dependent variables. By doing so, we want to check whether the treatment effects are due to the EITI implementation and to test if the treatment effect found in our baseline results is specific to resource revenue. The intuition is that if our baseline results are due to the EITI implementation and are specific to resource revenue, estimating the treatment effects of the EITI implementation using placebo dates or using non-resource revenue components should produce non-statistically significant effects. The results (Table C2, columns (1)-(4)) indicate non-significant effects of the EITI implementation for all placebo tests which confirms that our results are not driven by confounding factors such as the implementation of other reforms or policies. In other words, the EITI implementation is the cause of our results, and the effects highlighted in this paper are specific to resource revenue rather than any other public revenue, such as non-resource tax revenue or non-resource non-tax revenue. Moreover, authors like [Bornhorst et al. \(2009\)](#) and [Crivelli and Gupta \(2014\)](#) have highlighted a negative relationship between resource revenue and total domestic non-resource revenue, qualified as the "revenue curse". Indeed, it has been established that countries relying on resource revenue are more likely to mobilize less domestic non-resource revenue ([Moore, 1998](#)). In the same line, [Collier \(2006\)](#) has explained that resource rents lead to a lower domestic tax effort, while reducing the incentive for the public scrutiny of government. The results highlighted in this section suggest that apart from the positive effects on the mobilization of resource revenue, implementing the EITI has no negative effects on other sources of revenue.

6.5 Alternative estimation methods

In order to verify that our results are not influenced by the analysis method, we test the robustness using two alternative estimation methods. Specifically, we use ordinary difference-in-differences (ordinary DID) method and panel instrumental variables (IV) estimation method.

Ordinary difference-in-differences (ordinary DID) estimation method. We start by

using ordinary difference-in-differences (ordinary DID) method and estimate the effects of the EITI implementation on resource revenue by estimating Equation 1. This method accounts for individual specific heterogeneity and omitted time invariant country-specific factors that influence resource revenue. The results are resumed in column (1) of Table C3 and indicate a positive relation between the EITI implementation and resource revenue.

Panel Instrumental Variable (IV) method. To deal with the potential self-selection bias in the EITI membership (Lujala, 2018), some studies in the literature used the panel instrumental variable (IV) method. In our analysis, we have already controlled for the determinants of the EITI membership. In addition, in all our estimates using the DID_M estimator, we tested the parallel trend and non-anticipation assumptions, and the results ruled out any potential self-selection bias from the EITI implementation. Following the literature (Villar, 2020; Okada and Shinkuma, 2022), we complete this robustness analysis using an instrumental variable (IV) estimation approach. As an instrumental variable, we use the number of neighboring countries (with common borders) that are EITI members. The use of this neighborhood variable as an instrumental variable comes from studies on the geographic diffusion of public policies (see, for example, Kotera and Okada, 2017; Acemoglu et al., 2019; Gilardi and Wasserfallen, 2019; Caselli and Reynaud, 2020). The intuition is that a country’s participation in the EITI is influenced by the (exogenous) participation of its neighbors because a country is more likely to participate if its neighboring countries join the EITI. We therefore construct our instrument as follows:

$$NeighboursEITI_{it} = \sum_{j \neq i}^N EITI_{jt} \quad (4)$$

Where j indicates the countries that border country i in year t (its neighboring country). $EITI_{jt}$ is a dummy variable equal to 1 when the country j is an EITI member in year t . Finally, the variable $NeighboursEITI_{it}$ is our first instrument and indicates, for each country in the sample and each year, the number of its neighboring countries that are EITI members.

In addition to this instrument, we use the lagged EITI as a second instrument. Indeed, in addition to the test of the relevance of the instruments, the use of two instruments allows us to perform the tests of exogeneity (exclusion condition) and instruments strength.

The results are presented in column (2)-(5) of Table C3. Columns (2) in panel A presents the results of the first stage equation where we regress the treatment variable on our neighboring instrument and all control variables of the baseline model, and indicate that our instrument are positively and significantly correlated to the treatment variable. Column (3) in panel B presents the second-stage estimation result, and confirms the positive and statistically significant effects

of implementing the EITI on resource revenue in developing countries. The coefficient associated with the treatment variable is 1.69, and significant at the 5% threshold. Finally, columns (4)-(5) shows the first stage and the second-stage results, when we include the lagged *EITI* variable as additional instrument. The results remains unchanged, and show that implementing the EITI increases resource revenue in developing member countries. In addition, the Kleibergen-Paap F-statistics in columns (3) and (5) are significantly higher than the value of the Stock-Yogo test at the 10% critical threshold and the Hansen p-value in column (5) is greater than 0.10 (attesting the relevance and strength of instruments used as well as confirming the exclusion condition).

7 Composition effects

In this section, we analyze the composition effect of the EITI implementation on resource revenue to identify the resource revenue component that might be most affected by the EITI implementation. The results showed in Sections 5 and 6 highlighted robust positive and statistically significant treatment effects of implementing the EITI on resource revenue in developing countries. The literature has shown that developing countries have a weak tax system (Knack, 2009; Besley and Persson, 2014) and that resource non-tax revenue seems to be more source of resource revenue than resource tax revenue (Prichard et al., 2014; Manley and Lassourd, 2019). Thus, we assume that implementing the EITI may affect both types of resource revenue, with a stronger effect on the non-tax component than on tax component. We then disaggregate resource revenue into resource non-tax revenue and resource tax revenue and estimate the effect of implementing the EITI on these two components. The results in columns (4)-(5) of Table 3 indicate that implementing the EITI increases both types of revenue. However, a comparison of coefficients reveals a more significant effect on resource non-tax revenue than on the resource tax. Indeed, implementing the EITI, on average, increases resource non-tax revenue by 1.53 percentage points and resource tax by 0.75 percentage points, both statistically significant at the 5% threshold.

8 Transmission channels

As explained earlier, we assumed that the improvement of the investment climate and the increase in foreign direct investment inflows and extractive resources exports are the main channels through which the EITI implementation may affect resource revenue.

In this section, we test these three potential transmission channels by adopting a two-step

Table 4: EITI and Resource Revenue
Validity of transmission channels

Panel A: Relationship between the channel and resource revenue			
	(1)	(2)	(3)
Investment climate	1.9375*** (0.6514)		
Foreign direct investment		0.5252*** (0.1073)	
Extractive resources exports			0.3214*** (0.0191)
Control variables	Yes	Yes	Yes
Country & Year fixed effects	Yes	Yes	Yes
Observations	913	1023	1022
R ²	0.1973	0.1993	0.3720
Panel B: Effect of the EITI implementation on the channel			
	(1)	(2)	(3)
	Investment climate	Foreign direct investment	Extractive resources exports
<i>DID_M</i>	0.1420** (0.0654)	0.5139*** (0.1753)	3.6152*** (0.1.4036)
Control variables	Yes	Yes	Yes
Country & Year fixed effects	Yes	Yes	Yes
Placebo joint-test p-value	0.6341	0.7536	0.4486

Results of the main channels through which EITI implementation should affect resource revenue. Panel A presents the relationship between the different potential channels and resource revenue based on panel Fixed Effects (FE) estimations. Panel B reports the effect of EITI implementation on the potential channels based on the heterogeneous and dynamic TWFE-DID estimator of [De Chaisemartin and d'Haultfoeuille \(2020; 2022\)](#). Robust standard errors are in parentheses. * Significant at the 10% level; ** Significant at the 5% level; *** Significant at the 1% level.

approach. In the first step, we test the relationship between the potential channel and resource revenue by performing a panel fixed effects (FE) estimation, controlling for country and year-fixed effects (Panel A of Table 4). In the second step, we analyze the effect of the EITI implementation on channels using the heterogeneous and dynamic two-way fixed effects difference-in-differences estimator (Panel B of Table 4). Our intuition is that if the potential channel positively (respectively negatively) and significantly affects resource revenue and that implementing the EITI has a positive (respectively negative) and significant effect on this channel, then this channel represents a valid channel through which transit the effect of the EITI implementation on resource revenue.

The results in Panel A indicate that investment climate¹⁵, foreign direct investment, and extractive resources exports are positively correlated with resource revenue. Furthermore, the results in Panel B (columns (1)-(3)) show the average effects of EITI implementation on these three channels and indicate a positive and statistically significant effect of implementing the EITI on investment climate, foreign direct investment inflows, and extractive resources exports. In summary, these results provide evidence that the improvement of the investment climate and the increase in foreign direct investment and extractive resources exports are the main channels through which the EITI implementation increases resource revenue in developing countries.

¹⁵We use the regulatory quality index as a proxy for the investment climate. More details are available in Table C5.

9 Conclusion

This study evaluates the dynamic treatment effects of the EITI implementation on resource revenue mobilization, using a sample of 67 developing countries from 1995 to 2020. In order to properly account for the staggered design in EITI implementation with units moving in and out of treatment status, our empirical strategy relies on the heterogeneous and dynamic two-way fixed effects difference-in-differences estimation method. Our results show that, overall, implementing the EITI increases resource revenue in member developing countries compared to non-member countries. Moreover, we show that the EITI implementation effects are positive and significant during the first ten years after membership and, more interestingly, that the EITI implementation cumulative effects remain positive and significant over the implementation period.

Our findings are robust to several robustness checks, such as considering alternative estimation samples, including additional control variables, exploiting the exogenous variation in extractive resources world prices, exploring alternative dependent variables, conducting placebo tests, and employing alternative estimation methods including an instrumental variables identification. Additional analysis on resource revenue components concludes that the increase in resource revenue can be attributed to higher increases in resource non-tax revenue compared to resource tax revenue, and that EITI implementation does not reduce other sources of revenue. Finally, we provide evidence that an improvement in investment climate and an increase in foreign direct investment inflows and extractive resources exports are valid transmission channels through which the EITI implementation increases resource revenue in developing member countries. Beyond the public economic benefits of EITI, these findings raise the question of EITI's effectiveness in financing economic development and reducing inequality. Indeed, are the additional revenues from natural resources benefiting the population? Are they used to promote investment, foster economic growth and redistribute wealth to populations, or only benefit governments and investors in the extractive industry? These questions could provide the basis for future research on the EITI's effectiveness.

This paper has clear economic policy implications. On the one hand, the EITI standard is an instrument that can be used by developing countries to drive reforms in extractive sector management in order to benefit from better collection of resource revenue and improve their domestic revenue mobilization. On the other hand, the EITI board should increase requirements for disclosure of resource revenue allocated to the national budget and promote better disclosure of quasi-fiscal expenditures resulting from these revenues to ensure that these additional revenues are used to foster sustainable development and reduce poverty in developing member countries.

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Appendix A Justification of control variables

A.1 Control variables in the main analysis

First, the constant GDP per capita is included to capture the country's development level. Indeed, countries with a low level of development are more likely to join the EITI because they are considered to benefit most from the EITI, and they are also exposed to external pressures due to their high dependence on aid from the international community (Pitlik et al., 2010; David-Barrett and Okamura, 2016; Öge, 2016a; Kasekende et al., 2016; Lujala, 2018). The development of the economy is also positively correlated with domestic revenue mobilization since it improves the capacity to collect public revenue (Sen Gupta, 2007; Bornhorst et al., 2009; Crivelli and Gupta, 2014).

Second, Official Development Assistance (ODA) is used as a measure of a country's dependence on international aid and assistance. Countries that are more dependent on ODA are more likely to implement the EITI (David-Barrett and Okamura, 2016; Kasekende et al., 2016; Lujala, 2018). The international community perceives the commitment to join the EITI positively and can reward these countries with increased ODA flows. However, the relationship between aid and revenue is ambiguous (Benedek et al., 2014; Mawejje, 2019). Sen Gupta (2007) found a weaker positive effect of foreign aid on resource mobilization.

Third, Foreign direct investment (FDI) inflows positively influence the likelihood of implementation of the EITI standard (Öge, 2016a; Kasekende et al., 2016; Lujala, 2018). Indeed, countries for which FDI flows are an important source of revenue are most likely to implement the EITI to demonstrate their commitment to promoting transparency in the management of the extractive sector in order to maintain and increase their FDI flows (Öge, 2016a; Lujala, 2018).

Fourth, mineral and fuel dependence is also an internal motivation for countries to join the EITI (Pitlik et al., 2010; Öge, 2016a; David-Barrett and Okamura, 2016; Kasekende et al., 2016; Lujala, 2018). Countries with high dependence on natural resources are the most likely to be affected by the resource curse. They are considered to be the countries that should benefit most from the public benefits of EITI due to the importance of extractive revenues in their national income.

Fifth, implementing the EITI lends credibility to reforms aimed to improve institutional quality (Pitlik et al., 2010). The most corrupt countries are then the most likely to implement the EITI. The level of democracy is also positively correlated with the likelihood of joining the EITI (Pitlik et al., 2010; Öge, 2016a; Lujala, 2018). In addition, membership in the EITI is an opportunity for countries perceived to have low institutional quality to send a signal about their commitment to promoting transparency and good governance in resource management and combating corruption in order to improve their reputation within the international community (David-Barrett and Okamura, 2016; Öge, 2016a; Kasekende et al., 2016; Lujala, 2018). Governments with popular support and higher law and order are also more likely to initiate reforms toward greater transparency (Lujala, 2018). Moreover, the literature has also shown that poor institutional quality negatively affects revenue mobilization (Bornhorst et al., 2009; Mawejje, 2019).

In addition, we include the commodity price index to account for global changes in commodity world prices. It captures the effects associated with changes in world commodity prices, particularly export price index (since the sample is composed of developing countries, the export price index is more relevant to this study because these countries are commodity exporters due to their low industrialization).

A.2 Additional control variables in the robustness analysis

Firstly, membership in a global organization promoting better governance could influence the decision to join the EITI, and thus the effects of its implementation. We control four other organizations that promote better governance in the extractive sector at the state level. These are the Kimberly Process (KP), the International Conference on the Great Lakes Region (ICGLR), and the Organization of Petroleum Exporting Countries (OPEC and OPEC+). The KP, created in 2003, is a major initiative for better global governance in the diamond sector. The ICGLR is composed of 12 African countries and aims to promote peace, security, democracy, and development in the Great Lakes Region. OPEC brings together the world's major oil producers. These countries are traditionally associated with the resource curse (Sovacool et al., 2016). OPEC membership reduces the likelihood of EITI membership (Pitlik et al., 2010). This could be explained either by the fact that OPEC members consider that they already have a common system of transparency, notably through the publication of their crude oil production, or by the more restrictive nature of the EITI, which would strongly limit the incentives for under-reporting and would avoid any "free-riding" behavior (Pitlik et al., 2010). OPEC+ is an alliance between OPEC member countries and ten other oil-producing countries, formed in 2016. The lists of Kimberley Process, ICGLR, OPEC, and OPEC+ member countries are available in Appendix B (Tables B4 and B5).

Secondly, the influence of additional economic variables must be taken into account in our analysis. External public debt can influence a country's decision to join the EITI. Countries with high levels of external debt are likely to face external pressure from their creditors to carry out reforms aimed at improving governance. These countries may see EITI membership as a way of signaling to the international community their commitment to greater transparency in public finances, thus gaining favors from creditors in return. Some work suggests that Nigeria's substantial debt cancellation in 2005 was linked to the country's willingness to undertake reforms to promote good governance, including the implementation of the EITI (Kasekende et al., 2016; Lujala, 2018). The economic literature has provided evidence of the influence of trade openness as a mechanism of the natural resource curse. The willingness to improve trade openness through EITI membership could influence a country's decision to join the institution. In addition, Sen Gupta (2007) found a positive relationship between trade openness and tax mobilization. The inflation level is also included to capture macroeconomic stability, a precondition for the successful implementation of reforms. The literature has shown that countries exploiting important resources can experience exchange rate appreciation, which can impede economic diversification (Corden and Neary, 1982) and affect the share of natural resource revenue in total government revenues. The EITI's involvement in the extractive indus-

tries value chain, through the promotion of better revenue management and allocation, aims to foster sound macroeconomic policy in order to limit the potential negative effects of Dutch disease. We also control the agricultural sector development, since this sector is more complicated to tax (Sen Gupta, 2007; Crivelli and Gupta, 2014). A higher share of the agriculture sector in value-added could affect the revenue collection of other sectors. Strong financial institutions, by promoting better governance and information availability, facilitate achieving a transparent economic system (Dutta and Mukherjee, 2018). The level of financial development could thus influence a country's domestic capacity to implement the EITI. We also consider government domestic public investment and government total expenditures. Indeed, the level of domestic public investment and public spending depends on the availability of public revenues and can influence governments' ability to mobilize domestic revenue. Finally we also control for total population growth and human capital. These variables could influence a country's decision to join the EITI in the sense that a larger and better-educated population is more likely to hold leaders accountable and, therefore, to call for anti-corruption and governance improvement policies.

Thirdly, conflicts may influence EITI implementation and domestic revenue. A country's experience of conflict is a crucial determinant of EITI membership (Lujala, 2018), mainly when these conflicts are centred around natural resources. Conflict-affected countries can be encouraged to undertake reforms in the extractive sector through the presence and influence of international organizations that provide development assistance. This has been the case in Liberia, where the implementation of the EITI was an important factor in the governance reforms promoted by international development organizations (Lujala, 2018). Berman et al. (2017) have found that implementing the EITI helps to mitigate the negative effect of rising mineral prices on the occurrence of conflict. Political stability could also influence governments' ability to collect domestic revenue. There appears to be a geographic diffusion mechanism for the EITI in Sub-Saharan Africa. Indeed, the fact that a country is located in Sub-Saharan Africa has a positive influence on the decision to join the EITI (Öge, 2016a), which could be explained by the high dependence of these countries on foreign investment and international aid. As explained by Sen Gupta (2007), geographic factors like being a Sub-Saharan African or a Latin American country influence the performance in revenue collection.

Fourthly, other country-level policies and major international events can also influence resource revenue mobilization. Indeed, we control for fiscal rules implementation and IMF programs that can affect public administration effectiveness to mobilize revenue. Moreover, transparency and accountability in the extractive sector have received increasing international attention and have been identified as a mechanism to mitigate the negative effects of the global financial crises (Mejía Acosta, 2013). Some countries made significant progress in implementing the EITI during the economic crisis between 2008 and 2009. The period 2003-2008 was also marked by a generalized rise in world mineral prices qualified as a "commodity super-cycle" (Chávez and Rodríguez-Puello, 2022), and membership of most of the EITI countries in the sample, so it is important to control for a dummy variable that is characteristic of this period.

Appendix B Study sample and descriptive statistics

Table B1: List of countries in the study sample

Angola	Gabon	Lesotho	Serbia
Burkina Faso	Ghana	Madagascar	Sao Tome and Principe
Bangladesh	Guinea	Mexico	Suriname
Bulgaria	Guinea-Bissau	Mali	Syrian Arab Republic
Bosnia and Herzegovina	Equatorial Guinea	Myanmar	Chad
Belarus	Honduras	Mongolia	Togo
Belize	Indonesia	Mauritania	Tajikistan
Botswana	India	Malaysia	Turkmenistan
China	Iran, Islamic Rep.	Namibia	Timor-Leste
Cote d'Ivoire	Iraq	Niger	Tunisia
Cameroon	Jamaica	Nigeria	Tanzania
Congo, Dem. Rep.	Jordan	Paraguay	Uganda
Congo, Rep.	Kazakhstan	Russian Federation	Venezuela, RB
Colombia	Kenya	Rwanda	Vietnam
Algeria	Lao PDR	Sudan	Zambia
Egypt, Arab Rep.	Liberia	Sierra Leone	Zimbabwe
Ethiopia	Libya	El Salvador	

Table B2: EITI members with important dates and their status at the end of the study period

EITI Country	Commitment	Creation of the multi-stakeholder group	candidate validation	Compliance	Suspension/withdrawal period	Status at 31/12/2020
Burkina Faso	July 2007	December 2008	May 15, 2009	February 2013	-	Compliant
Cote d'Ivoire	May 2007	February 2008	May 12, 2008	May 2013	-	Compliant
Cameroon	March 2005	June 2005	September 27, 2007	October 2013	-	Compliant
Congo, Dem. Rep.	January 2005	November 2005	September 2007	July 2014	April 18, 2013-July 2, 2014	Compliant
Congo, Rep.	June 2004	October 2006	September 27, 2007	February 2013	-	Compliant
Colombia	May 2013	February 2014	October 15, 2014	-	-	Candidate
Ethiopia	August 2009	July 2009	March 19, 2014	-	-	Candidate
Gabon	May 2004	July 2005	September 2007	-	February 2013-October 2021	Suspended
Ghana	June 2003	February 2005	September 27, 2007	October 2010	-	Compliant
Guinea	April 2005	February 2012	September 27, 2007	July 2014	December 2009-March 2011	Compliant
Equatorial Guinea	January 2005	July 2007	February 22, 2008	-	April 2010	Suspended
Honduras	January 2013	February 2013	May 22, 2013	-	February-July 2018 & April 2019-	Candidate
Indonesia	December 2008	June 2010	November 24, 2010	October 2014	February-December 2015	Compliant
Iraq	March 2009	September 2010	February 10, 2010	December 2012	-	Compliant
Kazakhstan	June 2005	October 2005	September 27, 2007	October 2013	-	Compliant
Liberia	May 2007	April 2007	September 27, 2008	October 2009	2018-March 2020	Compliant
Madagascar	January 2006	January 2008	February 22, 2008	-	October 25, 2011-June 6, 2014	Candidate
Mexico	April 2015	November 2016	October 25, 2017	-	-	Candidate
Mali	August 2006	June 2007	September 22, 2007	August 2011	-	Compliant
Myanmar	December 2012	February 2014	July 02, 2014	-	-	Candidate
Mongolia	April 2006	January 2006	September 2007	October 2010	-	Compliant
Mauritania	September 2005	December 2006	September 27, 2007	February 2012	-	Compliant
Niger	March 2005	July 2005	September 2007	March 2011	October 2017-January 2019	Re-commitment
Nigeria	November 2003	February 2004	September 27, 2007	March 2011	-	Compliant
Sierra Leone	October 2007	June 2007	February 22, 2008	April 2014	-	Compliant
Sao Tome and Principe	December 2004	December 2007	February 22, 2008	-	2010-2011	Candidate
Suriname	February 2016	December 2016	May 24, 2017	-	February-June 2019	Candidate
Chad	September 2007	February 2010	April 16, 2010	October 2014	-	Compliant
Togo	December 2009	March 2010	October 10, 2010	May 2013	-	Compliant
Tajikistan	August 2012	August 2012	February 26, 2013	-	-	Candidate
Timor-Leste	May 2007	May 2007	February 22, 2008	July 2010*	March-June 2017	Compliant
Tanzania	November 2008	November 2009	February 16, 2009	December 2012	September-December 2015	Compliant
Zambia	July 2008	September 2008	May 15, 2009	September 2012	-	Compliant

Source: Author's construction from <https://eiti.org/countries>. Information on suspension causes is available on request.

Table B3: Descriptive statistics for the full sample

Variables	Observations	Mean	Standard deviation	Minimum	Maximum
Natural resource revenue	1461	5.4217	10.3990	0	79.1104
Constant GDP per capita in logarithm	1690	7.5418	0.9755	5.3632	9.7074
Official development assistance in logarithm	1648	6.0274	9.1060	-0.4612	94.4421
Foreign direct investment	1685	3.9231	8.0897	-37.1726	161.8237
Mineral dependency	1647	18.119	23.6753	0	92.717
Fuel dependency	1647	25.6611	32.2022	0	99.5345
Corruption index	1383	2.1588	0.8230	0	6
Polity2	1574	1.0140	5.7632	-9	10
Law and Order index	1383	3.1500	1.0557	0.5	6
Commodity price index	1693	106.8674	41.532	18.412	299.5954

Table B4: List of Kimberley Process (KP) and ICGLR members

Kimberley Process				ICGLR members
Country	Membership date	Country	Membership date	Country
Angola	2003	Lao PDR	2003	Angola
Bangladesh	2006	Liberia	2007	Burundi
Belarus	2003	Lesotho	2003	Central African Republic
Botswana	2003	Mexico	2008	Congo, Dem. Rep.
China	2003	Mali	2013	Congo, Rep.
Cote d'Ivoire	2003	Malaysia	2003	Kenya
Cameroon	2012	Namibia	2003	Rwanda
Congo, Dem. Rep.	2003	Russian Federation	2003	Sudan
Congo, Rep.	2003	Sierra Leone	2003	Tanzania
Gabon	2018	Eswatini	2011	Uganda
Ghana	2003	Togo	2003	Zambia
Guinea	2003	Tanzania	2003	
Indonesia	2005	South Africa	2003	
India	2003	Vietnam	2003	
Kazakhstan	2012	Zimbabwe	2003	

Source: Author's construction from <https://www.kimberleyprocess.com/en>; and <https://www.icglr.org/index.php/fr/>.

Table B5: List of countries in the sample that are members of OPEC and OPEC⁺

Country	Membership date	Withdrawal date	Status in 2019
Angola	2007	-	Member
Congo, Rep	2018	-	Member
Ecuador	1973 and 2007	1992 and 2020	Member
Equatorial Guinea	2017	-	Member
Gabon	1975 and 2016	1995	Member
Indonesia	1962 and 2016	2008 and 2016	Retired
Iran, Islamic Rep.	1960	-	Member
Iraq	1960	-	Member
Kazakhstan ⁺	2016	-	Member
Libya	1962	-	Member
Malaysia ⁺	2016	-	Member
Mexico ⁺	2016	-	Member
Nigeria	1971	-	Member
Russian Federation ⁺	2016	-	Member
Sudan ⁺	2016	-	Member

Source: Author's construction from https://www.opec.org/opec_web/en/about_us/25.htm. ⁺: OPEC⁺

Table B6: Six types of minerals according to the SITC classification

Mineral type	SITC code and description
Fuel	SITC 3: Mineral fuels (including natural gas), lubricants and related materials.
Minerals (Non-Fuel)	SITC 27: Crude fertilizers, other than those of division 56, and crude minerals (excluding coal, oil and precious stones). SITC 28: Metallic ores and metal waste. SITC 667: Pearls and semi-precious stones. SITC 68: Non-ferrous metals. SITC 971: Gold, non-monetary.

Source: Haglund (2011)

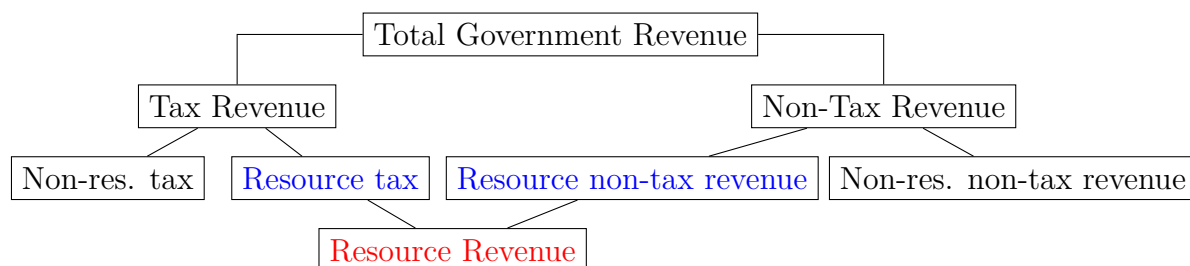


Figure B1: Government revenue structure according to UNU-WIDER GRD definition. Source: Author's construction based on UNU-WIDER GRD and Opper et al. (2021)

Table B7: Timeline in the EITI implementation

Country/Year →	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Burkina Faso					•	•	•	•	•	•	•	•	•	•	•	•	•	•
Cote d'Ivoire					•	•	•	•	•	•	•	•	•	•	•	•	•	•
Cameroon			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Congo, Dem. Rep.			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Congo, Rep.		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Colombia											•	•	•	•	•	•	•	•
Ethiopia							•	•	•	•	•	•	•	•	•	•	•	•
Gabon							•	•	•	•	•	•	•	•	•	•	•	•
Ghana	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Guinea			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Equatorial Guinea			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Honduras																•	•	•
Indonesia						•	•	•	•	•	•	•	•	•	•	•	•	•
Iraq							•	•	•	•	•	•	•	•	•	•	•	•
Kazakhstan			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Liberia						•	•	•	•	•	•	•	•	•	•	•	•	•
Madagascar				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Mexico													•	•	•	•	•	•
Mali				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Myanmar																		
Mongolia				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Mauritania			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Niger			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Nigeria	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Sierra Leone					•	•	•	•	•	•	•	•	•	•	•	•	•	•
Sao Tome and Principe		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Suriname								•	•	•	•	•	•	•	•	•	•	•
Chad					•	•	•	•	•	•	•	•	•	•	•	•	•	•
Togo							•	•	•	•	•	•	•	•	•	•	•	•
Tajikistan																		
Timor-Leste				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Tanzania						•	•	•	•	•	•	•	•	•	•	•	•	•
Zambia						•	•	•	•	•	•	•	•	•	•	•	•	•

Source: Author's construction based on information from EITI website. Notes: • EITI implementation period • Breaking points in EITI implementation.

Table B8: Main extractive resource produced by sample countries

Country	Main resource	Country	Main resource	Country	Main resource
Angola	oil	Burkina Faso	gold	Bangladesh	oil
Bulgaria	silver	Bosnia and Herzegovina	bauxite	Belarus	oil
Belize	oil	Botswana	copper	China	silver
Cote d'Ivoire	oil	Cameroon	oil	Congo, Dem. Rep.	copper
Congo, Rep.	oil	Colombia	oil	Algeria	oil
Ecuador	oil	Egypt, Arab Rep.	oil	Ethiopia	gold
Gabon	oil	Ghana	gold	Guinea	bauxite
Guinea-Bissau	-	Equatorial Guinea	oil	Honduras	silver
Indonesia	silver	India	silver	Iran, Islamic Rep.	oil
Iraq	oil	Jamaica	bauxite	Jordan	oil
Kazakhstan	oil	Kenya	gold	Lao PDR	silver
Liberia	gold	Libya	oil	Lesotho	-
Madagascar	gold	Mexico	silver	Mali	gold
Myanmar	oil	Mongolia	silver	Mauritania	iron
Malaysia	oil	Namibia	silver	Niger	oil
Nigeria	oil	Pakistan	oil	Paraguay	-
Russian Federation	oil	Rwanda	gold	Sudan	oil
Sierra Leone	bauxite	El Salvador	-	Serbia	coal
Sao Tome and Principe	-	Suriname	bauxite	Syrian Arab Republic	oil
Chad	oil	Togo	gold	Tajikistan	silver
Turkmenistan	oil	Timor-Leste	-	Tunisia	oil
Tanzania	gold	Uganda	gold	Venezuela, RB	oil
Vietnam	oil	Zambia	copper	Zimbabwe	gold

Source: Author's construction based on data from "theglobaleconomy": <https://www.theglobaleconomy.com/download-data.php>, and World Bank Commodity Price Data: <https://www.worldbank.org/en/research/commodity-markets>.

Appendix C Robustness and sources of data

Table C1: EITI and Resource Revenue
Dynamic (cumulative) treatment effects

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Resource Revenue	$t + 1$	$t + 2$	$t + 3$	$t + 4$	$t + 5$	$t + 6$	$t + 7$
<i>Post average DID_M</i>	1.1085*** (0.4271)	1.3346*** (0.5090)	1.4598*** (0.5234)	1.5993*** (0.5903)	1.5552*** (0.5702)	1.5696*** (0.5830)	1.6758*** (0.6171)
Placebo joint-test p-value	-	0.2705	0.4532	0.2772	0.3624	0.3624	0.3624
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country and Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dependent variable:	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Resource Revenue	$t + 8$	$t + 9$	$t + 10$	$t + 11$	$t + 12$	$t + 13$	$t + 14$
<i>Post average DID_M</i>	1.7872*** (0.6239)	1.9040*** (0.6377)	1.9866*** (0.6572)	1.9544*** (0.6546)	1.9350*** (0.6748)	1.8949*** (0.6937)	1.8449*** (0.7121)
Placebo joint-test p-value	0.3624	0.3901	0.3623	0.3623	0.3623	0.3623	0.3623
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country and Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Results are obtained using the heterogeneous and dynamic TWFE-DID estimator of [De Chaisemartin and D'Haultfoeuille \(2022\)](#). Robust standard errors are in parentheses. * Significant at the 10% level; ** Significant at the 5% level; *** Significant at the 1% level

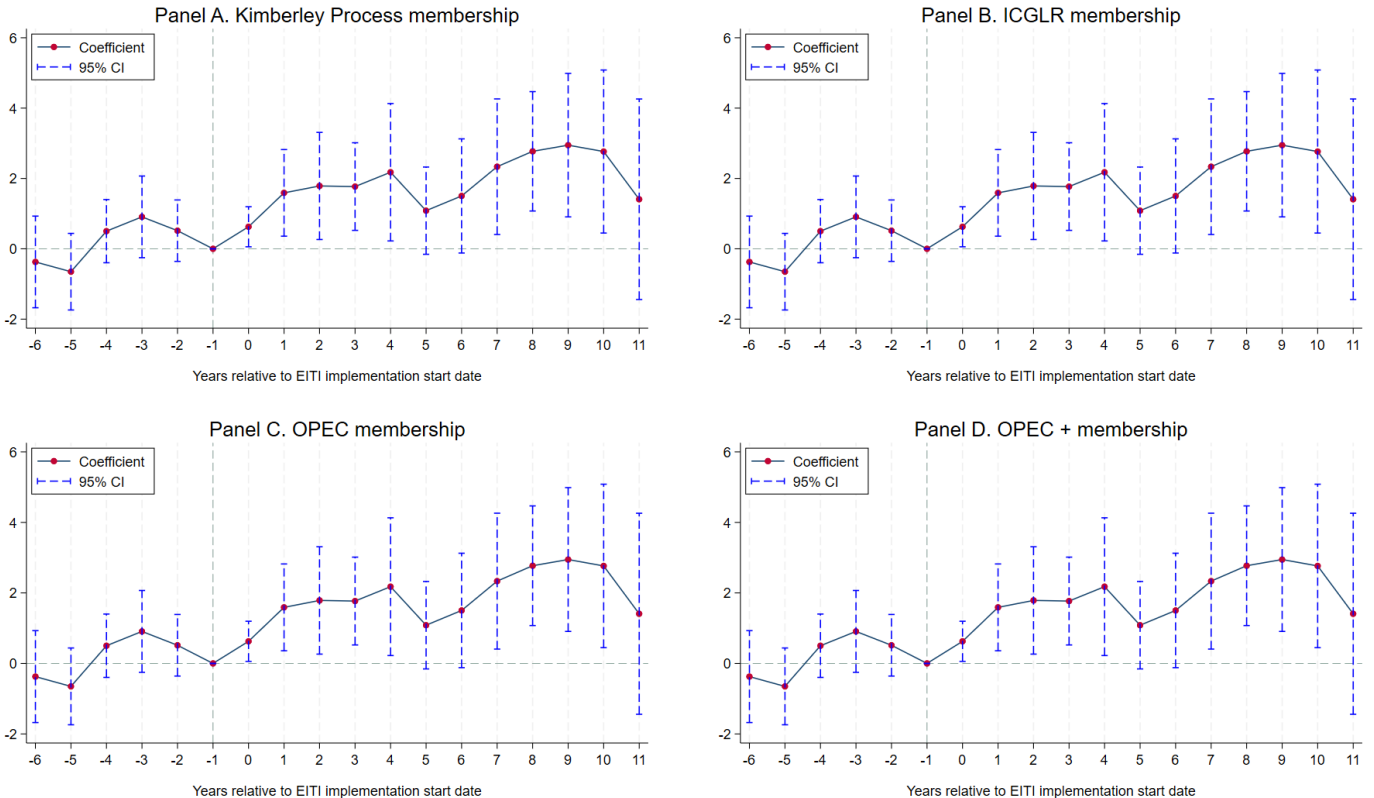


Figure C1: EITI dynamic effects on resource revenue using the dynamic and heterogeneous TWFE estimator of [De Chaisemartin and d'Haultfoeuille \(2020; 2022\)](#), applying 100 bootstrap replications. Control variables are also included. The placebo joint test is not significant.

Table C2: EITI and Resource Revenue
Placebo analysis

Dependent variable	(1)	(2)	(3)	(4)
Resource Revenue				
Placebo using false treatment definition	0.2939 (1.3447)			
Placebo using total non-resource revenue		-0.0521 (0.5330)		
Placebo using non-resource tax revenue			0.1235 (0.5075)	
Placebo using non-resource non-tax revenue				0.1543 (0.3153)
Mean in control group	4.83	17.26	13.04	3.23
Placebo joint-test p-value	0.4043	0.3338	0.4453	0.5591

Robust standard errors are in parentheses. * Significant at the 10% level; ** Significant at the 5% level; *** Significant at the 1% level

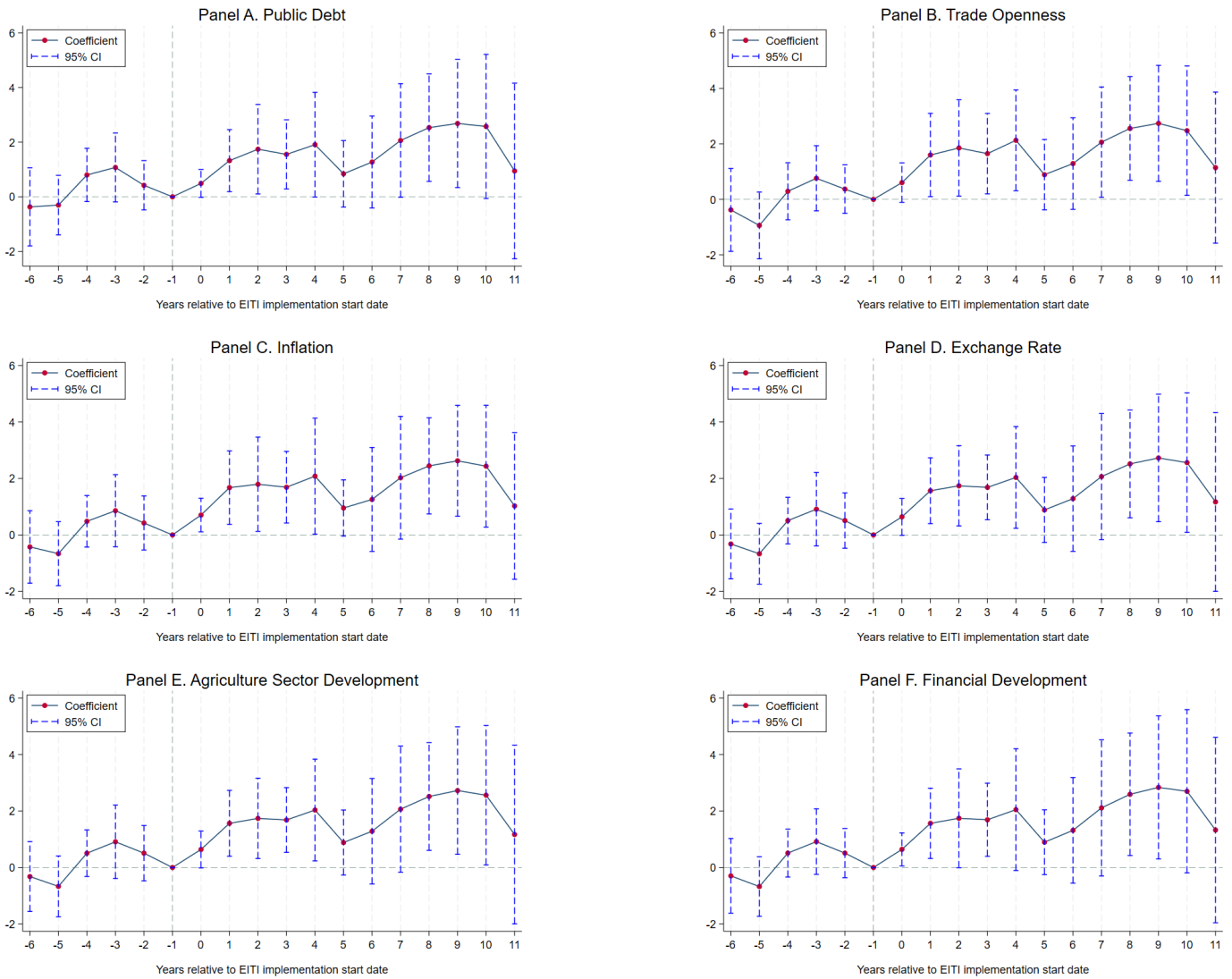


Figure C2: EITI dynamic effects on resource revenue using the dynamic and heterogeneous TWFE estimator of De Chaisemartin and d'Haultfoeuille (2020; 2022), applying 100 bootstrap replications. Control variables are also included. The placebo joint test is not significant.

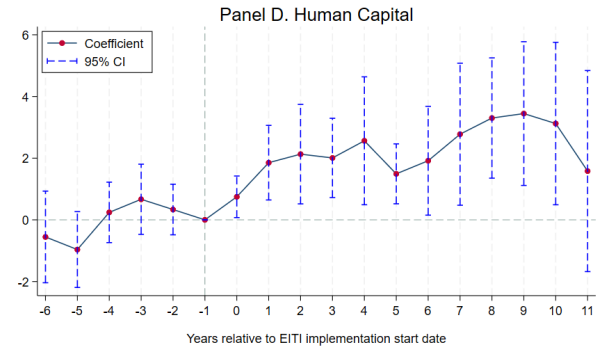
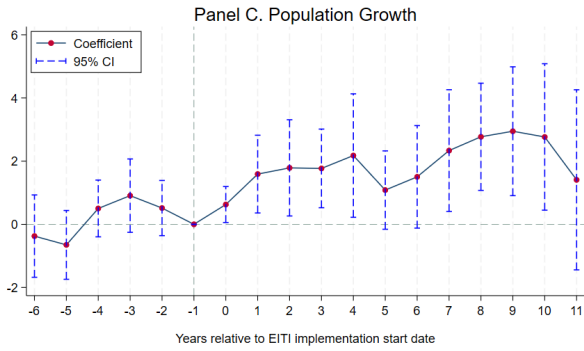
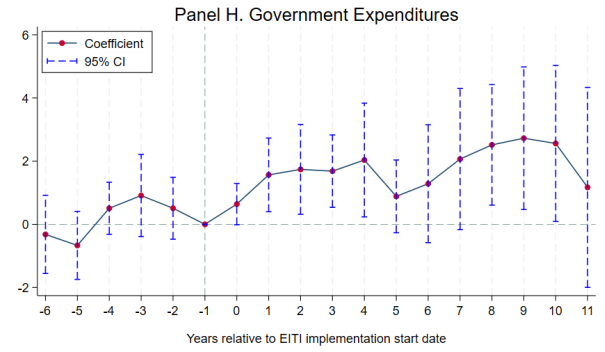
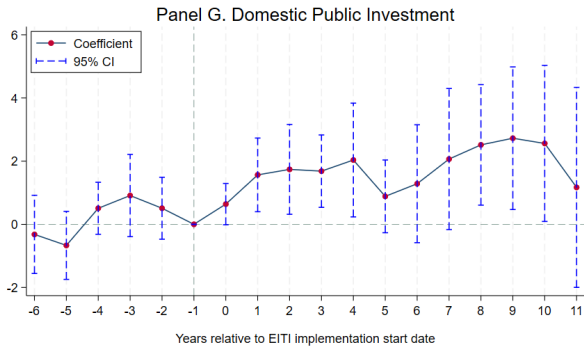


Figure C3: EITI dynamic effects on resource revenue using the dynamic and heterogeneous TWFE estimator of [De Chaisemartin and d'Haultfoeuille \(2020; 2022\)](#), applying 100 bootstrap replications. Control variables are also included. The placebo joint test is not significant.

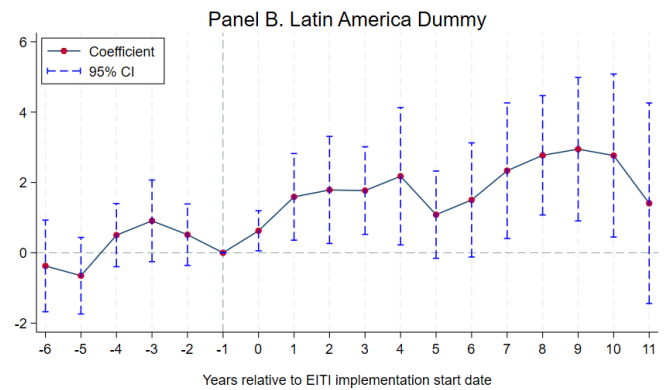
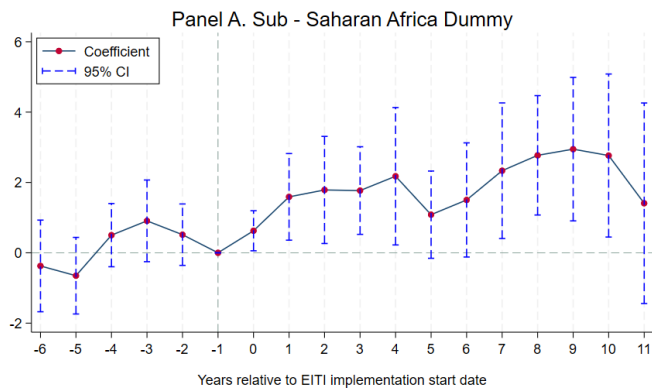
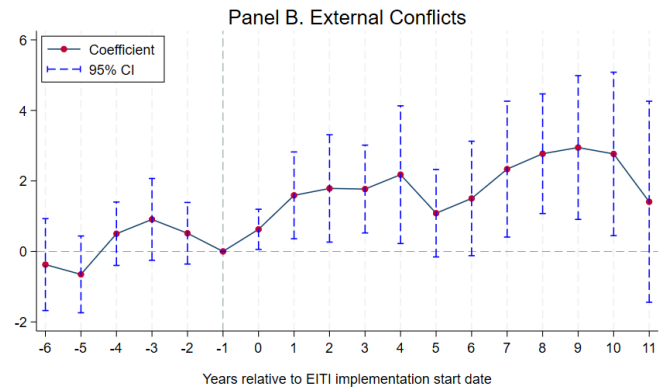
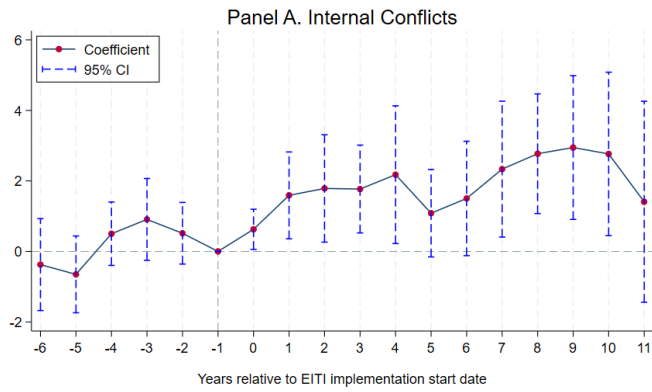


Figure C4: EITI dynamic effects on resource revenue using the dynamic and heterogeneous TWFE estimator of [De Chaisemartin and d'Haultfoeuille \(2020; 2022\)](#), applying 100 bootstrap replications. Control variables are also included. The placebo joint test is not significant.

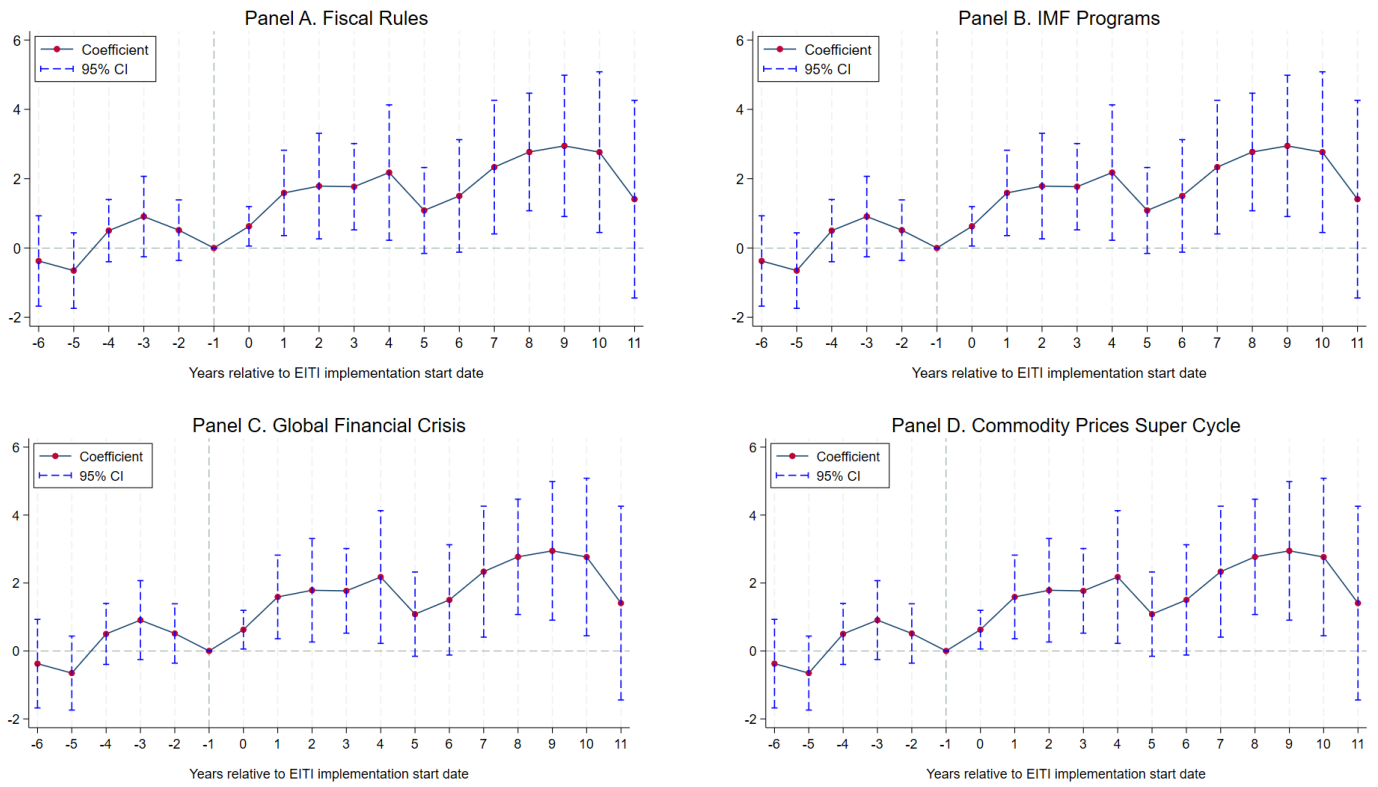


Figure C5: EITI dynamic effects on resource revenue using the dynamic and heterogeneous TWFE estimator of De Chaisemartin and d'Haultfoeulle (2020; 2022), applying 100 bootstrap replications were used. Control variables are also included. The placebo joint test is not significant.

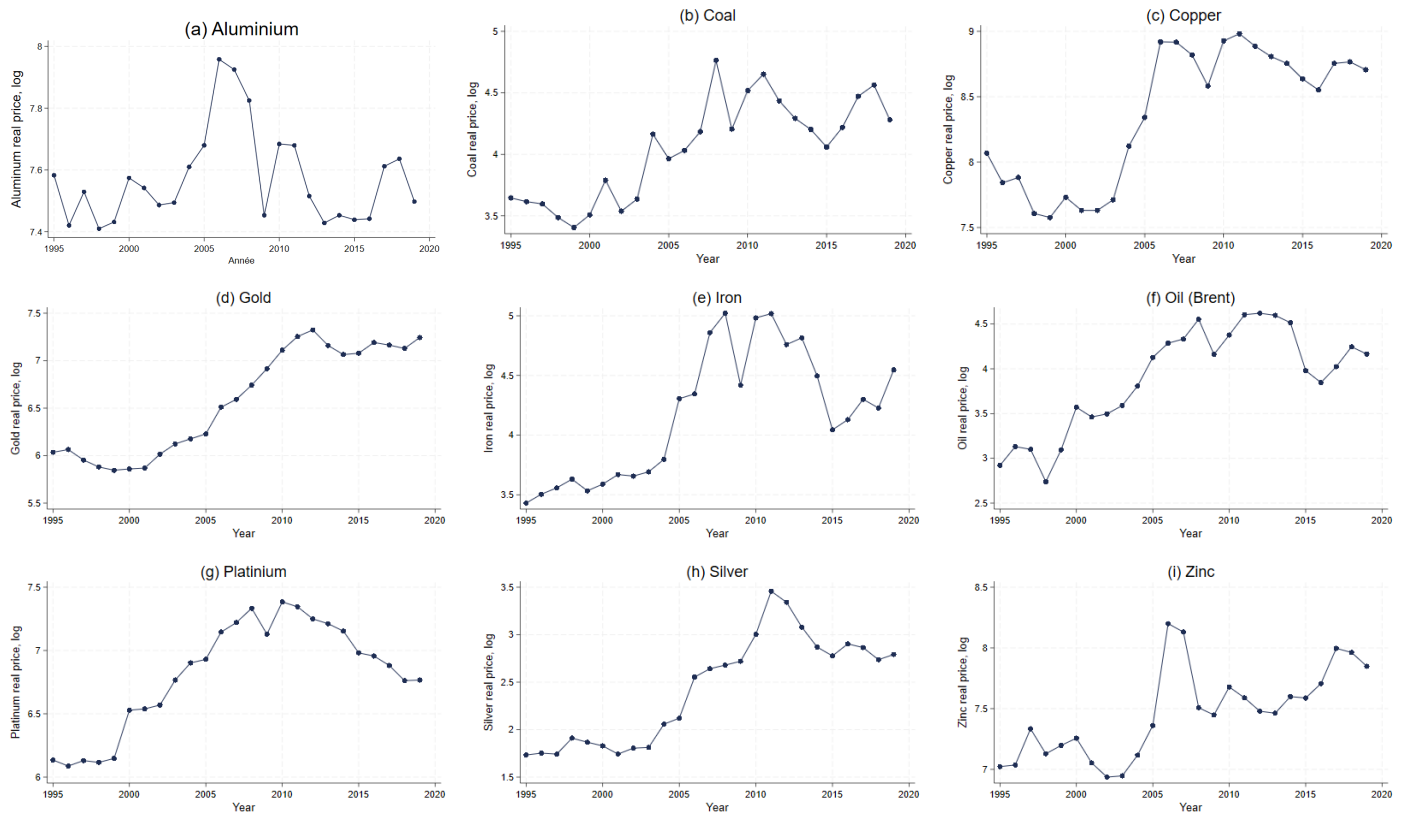


Figure C6: Minerals and fuel prices (log scale)

Table C3: EITI and Resource Revenue (Alternative estimation methods)

	Ordinary TWFE	Panel Instrumental variables results			
	results	One instrument	(3)	Two instruments	(5)
Treatment variable: EITI	(1)	(2)	(3)	(4)	(5)
Panel A: first-stage (Instruments)					
NeighbourEITI		0.1208*** (0.0090)		0.0317*** (0.0084)	
Lagged EITI				0.7464*** (0.0411)	
Dependent variable: Resource revenue					
Panel B: regression results					
EITI	1.1693** (0.5787)		1.6993** (0.8497)		1.0235*** (0.3940)
Constant GDP per capita (log)	1.5342 (1.0954)		-1.9094*** (0.6363)		-1.6253*** (0.6341)
Official development assistance	-0.0055 (0.0371)		0.0462 (0.330)		0.0392 (0.0308)
Foreign direct investment	0.0350 (0.0291)		0.0423 (0.0366)		0.0497 (0.0359)
Mineral dependency	0.0083 (0.0143)		-0.0107 (0.0108)		-0.0039 (0.0077)
Fuel dependency	0.0660*** (0.0181)		0.0842*** (0.0136)		0.0880*** (0.0134)
Corruption index	-0.6818 (0.4481)		-0.5975** (0.2906)		-0.6179** (0.2972)
Polity2	0.0233 (0.0640)		-0.0529 (0.0424)		-0.0419 (0.0426)
Law and order index	0.2906 (0.2474)		0.4218* (0.2486)		0.3916 (0.2398)
Commodity price index	0.0048 (0.0083)		0.0041 (0.0041)		0.0040 (0.0041)
Observations	1022		1022		1022
Kleibergen-Paap F-stat	-		181.542		422.746
Stock-Yogo critical values (10%)	-		16.38		19.93
Hansen test (p-value)	-		-		0.3820
Control variables	Yes		Yes		Yes
Country and Year fixed effects	Yes		Yes		Yes
ATTs with negative weights	11.66%		-		-
R ²	0.9000		0.1030		0.0853

Panel A presents the first-stage results (with NeighbourEITI and lagged EITI used as instruments). Panel B presents the second-stage results (with EITI as the treatment variable). Robust standard errors are in parentheses. * Significant at the 10% level; ** Significant at the 5% level; *** Significant at the 1% level.

Table C4: Sources and definition of data

Variables	Description	Sources
Dependant variable		
Resource revenue	Total resource revenue in percentage of GDP.	Government Revenue Dataset https://doi.org/10.35188/UNU-WIDER/GRD-2022 .
Treatment variable		
<i>EITI</i>	Dummy variable equal to 1 if the country <i>i</i> implements the EITI in year <i>t</i> and 0 otherwise.	Author's construction based on information available at (https://eiti.org/countries) and Lujala (2018).
Control variables in the main analysis		
Constant GDP per capita (log)	Natural logarithm of constant GDP per capita.	World Development Indicators (WDI). World Bank.
ODA	All Official development assistance (ODA), expressed as a percentage of GDP.	World Development Indicators (WDI). World Bank.
FDI	Foreign direct investment, net inflows expressed as a percentage of GDP.	World Development Indicators (WDI). World Bank.
Mineral dependency	Share of mineral exports in total merchandise exports.	Author's construction based on data from UNCTADstat. https://unctadstat.unctad.org/datacentre/ .
Fuel dependency	Share of fuel exports in total merchandise exports.	Author's construction based on data from UNCTADstat. https://unctadstat.unctad.org/datacentre/ .
Corruption index	Assessment of corruption within the political system. Index ranges from 0 to 6 (lower scores represent higher levels of corruption).	International Country Risk Guide (ICRG).
Law and order index	An assessment both of the strength and impartiality of the legal system and of popular observance of the law.	International Country Risk Guide (ICRG).
Polity2	The polity score is computed by subtracting the p_autocore from the p_democ score; Index ranges from +10 (strongly democratic) to -10 (strongly autocratic).	Polity IV dataset https://www.systemicpeace.org/inscrdata.html .
Commodity Price Index	Commodity net exports price index. Individual commodities weighted by ratio of net exports to total commodity trade.	International Monetary Fund (IMF), Gruss and Kebhaj (2019).
Control variables in robustness, transmission channels analysis		

Table C5: Sources and definition of data

Variables	Description	Sources
Extractive rents	Total of oil, natural gas, coal, mineral and forest rents (in percentage of GDP).	World Development Indicators (WDI), World Bank.
Trade openness (% of GDP)	Trade is measured as a share of GDP.	World Development Indicators (WDI).
Agricultural value-added	Agriculture, forestry, and fishing, value added (in percentage of GDP).	World Development Indicators (WDI).
Population growth	Annual population growth rate for year t is the exponential rate of growth of midyear population from year $t-1$ to t , expressed as a percentage. Population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship.	World Development Indicators (WDI).
Regulatory quality	Regulatory quality captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. Estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from approximately -2.5 to 2.5.	World Governance Indicators (WGI), Kaufmann et al. (2010).
Public debt (% GDP)	General government gross debt as a percentage of GDP.	International Monetary Fund (IMF).
Inflation	Inflation, average consumer prices (Percent change).	World Economic Outlook (WEO) - International Monetary Fund (IMF).
Government total expenditures	General government total expenditure (in percentage of GDP).	World Economic Outlook (WEO) - International Monetary Fund (IMF).
Public investments	General government domestic, expressed as a percentage of GDP.	IMF Investment and Capital Stock dataset.
Fiscal rule	Dummy variable equal to 1 if the country i applies a fiscal rule in year t . A fiscal rule is a long-lasting constraint on fiscal policy through numerical limits on budgetary aggregates. Fiscal rules typically aim at correcting distorted incentives and containing pressures to overspend, particularly in good times, so as to ensure fiscal responsibility and debt sustainability.	International Monetary Fund (IMF).
IMF programs	Dummy variable equal to 1 if the country i benefits from an IMF program in year t .	International Monetary Fund (IMF), Dreher (2006).
Financial development	Degree of development of financial institutions and financial markets in terms of depth, access, and efficiency.	International Monetary Fund (IMF) https://data.world/imf/financial-development-fd .
Total revenue	Government total domestic revenue (resource revenue and non-resource revenue) in percentage of GDP, excluding grants and social contributions.	Government Revenue Dataset. https://doi.org/10.35188/UNU-WIDER/GRD-2022 .
Resource tax	Total taxes collected from the extraction of natural resources (extractive industries corporate income taxes and indirect resource taxes), in percentage of GDP.	Government Revenue Dataset. https://doi.org/10.35188/UNU-WIDER/GRD-2022 .
Resource non-tax revenue	Total non-tax revenue collected from the extraction of natural resources (royalties, export taxes, profit sharing, and profits of state-owned enterprise), in % of GDP.	Government Revenue Dataset. https://doi.org/10.35188/UNU-WIDER/GRD-2022 .
Non-resource tax	Total taxes excluding resource taxes and social contributions, in percentage of GDP.	Government Revenue Dataset. https://doi.org/10.35188/UNU-WIDER/GRD-2022 .
Non-resource non-tax revenue	Total non-tax revenue excluding resource non-tax revenue and social contributions, in percentage of GDP.	Government Revenue Dataset. https://doi.org/10.35188/UNU-WIDER/GRD-2022 .
Internal conflict index	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 points to Very High Risk.	International Country Risk Guide (ICRG).
External conflict index	An assessment both of the risk to the incumbent government from foreign action, ranging from non-violent external pressure to violent external pressure. A score of 4 points equates to Very Low Risk, and a score of 0 points to Very High Risk.	International Country Risk Guide (ICRG).
Exchange rate	Exchange rate, national currency/USD (market + estimated).	Penn World Table, version 10.0, www.ggd.net/pwt .
Human capital	Human capital index, based on years of schooling and returns to education.	Penn World Table, version 10.0, Feenstra et al. (2015).
Kimberley Process	Dummy variable equal to 1 if the country i is member of Kimberley Process in year t .	Author's construction based on information available at https://www.kimberleyprocess.com/en .
ICGLR	Dummy variable equal to 1 if the country i is member of the International Conference on the Great Lakes Region in year t and 0 otherwise.	Author's construction based on information available at https://www.icglr.org/index.php/fr/ .
OPEC	Dummy variable equal to 1 if the country i is member of the Organization of the Petroleum Exporting Countries in year t and 0 otherwise.	Author's construction based on information available at https://www.opec.org/opec_web/en/about_us/25.htm .
OPEC+	Dummy variable equal to 1 if the country i is member of the Organization of the Petroleum Exporting Countries alliance in year t and 0 otherwise.	Author's construction based on information available at https://www.opec.org/opec_web/en/about_us/25.htm .
Global financial crisis	Dummy variable equal to 1 during the period of the financial crisis (years 2007, 2008, and 2009).	Author's construction.
Commodities super-cycle period	Dummy equal to 1 for commodity super-cycle years (2003 to 2008).	Author's construction.
Sub-Saharan African region	Dummy variable equal to 1 if the country i is located in Sub-Saharan Africa.	Author's construction.
Latin American region	Dummy variable equal to 1 if the country i is located in Sub-Saharan Africa.	Author's construction.
Main Mineral world price	This is the world price (in logarithm) of the main commodity (energy or metal) produced by the country. The main commodity is defined as the one for which the value of production is the highest over the entire study period (1995-2019). The world price of oil is "Brent oil prices".	"theglobaleconomy": https://www.theglobaleconomy.com/ and https://www.worldbank.org/en/research/commodity-markets .