FONDATION POUR LES ÉTUDES ET RECHERCHES SUR LE DÉVELOPPEMENT INTERNATIONAL

Working Paper 375 May 2026 Development Policies

Power Fragmentation and the Resource Curse: The Tax Expenditure Channel

Rabah Arezki, Grégoire Rota-Graziosi

Rabah Arezki, FERDI, Université Clermont Auvergne, CNRS, IRD, CERDI, F-63000, Clermont-Ferrand, France, and Harvard Kennedy School of Government.
Contact: rabah.arezki@uca.fr

Grégoire Rota-Graziosi, Université Clermont Auvergne, CNRS, IRD, CERDI and FERDI.

Abstract

This paper explores the economic consequences of (taxing) power fragmentation using both theory and data. We first formalize tax policy as the result of interministerial competition where the Minister of Finance ('Guardian') and the Minister of Mines ('Spender') have distinct objective functions, whereby the former attempts to stop the latter from extending tax incentives to attract investment in the sector. Second, we empirically document that the relative proximity (based on places of birth or co-ethnicity) of the Minister of Mines to the Chief Executive significantly increases tax expenditures from incentives—and reduces the collection of overall tax revenues. The results indicate a novel channel for the resource curse, hinging on executive taxing power fragmentation—rather than changes in relative prices as in the standard Dutch disease model.

Keywords: power fragmentation, institutions, tax policy, resource curse.

JEL Codes: H25, H77, C72, O13.

Aknoledgments: We thank Văn Đạo Lê for excellent research assistance and Michael Ross and Rick van der Ploeg for very helpful suggestions and comments. We acknowledge the support received from UNU-WIDER.

1 Introduction

The dependence on natural resources for exports creates a variety of macroeconomic challenges, known collectively as 'the resource curse' (Van der Ploeg 2011; Frankel 2012; Ross 2012; Venables 2016; Arezki et al. 2017). One standard challenge is the so-called Dutch disease, wherein a natural resource discovery or price appreciation is accompanied by a real exchange rate appreciation, which reduces the competitiveness of non-resource exports. In the present paper, we provide an alternative channel for the resource curse, hinging on taxing power fragmentation. Specifically, we explore how interministerial competition between the Minister of Finance and the Minister of Mines shapes economic outcomes.

The analysis of fiscal power fragmentation in the budget process dates at least back to Wildavsky (1974). A classic distinction is between the Guardian, the Minister of Finance, and the Spenders, other (sectoral) Ministers. The budgetary process may thus be seen as a bargaining process between the Guardian embodied by central agency officials controlling spending and Spenders who advocate for more budget. This dynamic is both adversarial but also complementary, whereby compromise is reached through institutional conflict. While an abundant body of work has investigated the interrelations between budget outcomes and the role of institutions,[1] the formalization of tax policy as an institutional conflict within the executive power is scant.

Several empirical studies have emphasized the role of power fragmentation, including through coalition governments (as opposed to single party governments), on fiscal outcomes. An early contribution by Roubini and Sachs (1989) presents empirical evidence for larger deficits in countries characterized by a short average tenure of government and by the presence of many political parties in a ruling coalition. Beyond the dynamics of coalition government, power fragmentation may result from interministerial competition. While spending power which has received much attention, taxing power—usually assigned to the Minister of Finance—may also be subject to power fragmentation. A related strand of literature has focused on fiscal federalism, a spatial form of power fragmentation.[2] The constitution determines assignment of taxing power amongst different layers of government.[3] Constitutions are, however,

[1] The focus of the strand of literature on the role of institutions on budget outcomes has often been on spending. Notably, Alesina and Perrotti (1999) provide evidence that budget procedures and budget institutions including balanced budget laws do influence budget outcomes and drive spending bias. Other contributions on the political economy of stabilization include Alesina and Tabellini (1990), Alesina and Drazen (1991), and Alesina and Perotti (1995). The literature has also documented evidence of electoral budget cycles, that is how political incumbents influence public finances to boost odds of re-election (see for instance Alt and Lassen 2006; Rogoff 1990). Eslava (2011) provides a useful survey of the literature, both theoretical and empirical, regarding the political economy of fiscal deficits.

[2] Several papers have also explored the role of power fragmentation at the subnational levels. Artés and Jurado (2018) show that government fragmentation has large fiscal implications using data on Spanish municipalities. The authors find that single-party majorities run budgets with a 1.5% point larger primary surplus than that of coalitions. In the context of Germany, Baskaran (2013) shows that coalitions and large cabinets do not increase public expenditures significantly.

[3] Constitutions also set the form of government namely parliamentary vs. presidential systems and determine how decision-making power is divided among different government offices (see Persson and Tabellini 2003).

incomplete contracts. Vertical tax competition may occur as local and central governments do tax the same base (see Keen and Kotsogiannis 2002).

To the best of our knowledge, there is no analysis investigating taxing power fragmentation between cabinet ministers. We fill this gap by exploring, specifically, the competition between the Minister of Finance and the Minister of Mines in the context of economies dependent on mineral resources. The latter is not only able to set sector-specific taxes, such as mining royalties, but is also able to extend tax incentives that erode the tax base set by the Minister of Finance. Hence, tax expenditures result directly from the fragmentation of the taxing power between ministers.

This paper is closely related to the strand of literature emphasizing the institutional channel of the resource curse. Natural resource rents controlled by the state increase the return to state capture in the absence of strong political institutions.[4] Tornell and Lane (1999) describe a 'voracity effect', in which windfalls stemming from changes in the terms of trade lead to state capture by powerful groups. Interestingly, Brollo et al. (2013) document the effect of additional government revenues on political corruption and on the quality of politicians. This paper contributes to this literature by going beyond the assumption of a unitary taxing power.

Our approach, in terms of interministerial competition between the Minister of Finance and the Minister of Mines, is grounded in basic facts. In mineral-rich countries, the Minister of Finance does not have complete control over mining royalty revenue, and the associated base and rates.[5] Rather, these features are set by mining implementation decrees, which are the purview of the Minister of Mines. Further, the Minister of Mines is often directly involved in propping up the activity of the sector, including by extending tax incentives. Additionally, mining codes often introduce special mining funds, which are financed through a share of collected royalties and aim at financing the development of this sector.[6]

The fragmentation of taxing power is not a feature of countries with weak enforcement mechanisms. Japan is a case in point. Jinno and DeWit (1998) describe the tax conflict between the Minister of Finance and the Minister of Home Affairs, which resulted from the property tax reform in Japan during the 1990s. While the Minister of Home Affairs oversaw local and land taxation, the reform offered a window of opportunity for the Minister of Finance to 'invade the Minister of Home Affairs' turf' by levying a tax on land, buildings, and housing assets. This reform culminated in a tax revolt fuelled by the interministerial competition and the bursting of the real estate bubble. In this paper, we effectively formalize tax policy because of interministerial tax competition.

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[4] Robinson et al. (2014) provide a similar model in which incentives for state capture increase with natural resources exports. Mehlum et al. (2006) have shown that good institutions moderate the natural resource curse.

[5] In some countries, the tax administration or authority is not in charge of collecting mining royalty.

[6] Mining codes in several West African countries illustrate these points. For instance, Article 15 of the mining code of Ivory Coast (1996) states that the product of duties, taxes, and fees from the mining sector are allocated between the general budget and the Special Fund for Mining Promotion including support officials working in the Ministry of Mines. Similarly, the 2015 mining code of Burkina Faso introduced a fund for the financing of the geological and mining research and support to the training of earth sciences. Another example, the Ghanaian Minerals Development Fund Act voted on 29 March 2016, is funded through a 20% take on mining royalties and has among other objects to 'support the policy planning, evaluation and monitoring functions of the Ministry [of Lands and Natural Resources] in respect of mining related activities.

To do so, we first present a stylized theory where the Minister of Finance and the Minister of Mines have distinct objective functions, whereby the former attempts to stop the latter from extending tax incentives to attract investment in the sector. The model highlights the role of interministerial competition in determining tax policy by offering a new channel of resource curse not hinging on the traditional Dutch Disease. We then test the main predictions of the theoretical model —specifically, whether tax expenditures increase with the (taxing) power of the Minister of Mines — by exploiting a combination of a novel datasets including tax expenditure and measures of relative distance (based on places of birth or co-ethnicity) of Ministers of Mines and Ministers of Finances with respect to the Chief Executive. We find that the relative proximity of the Ministers of Mines to the Chief Executive significantly increases revenue forgone from tax expenditures—and, more generally, weakens the collection of overall tax revenues.

Given their function to oversee the national budget, Ministers of Finance are more likely to be trained or experienced technocrats (Beate et al. 2014). Thus, Ministers of Finance are less likely to be close allies of their respective Chief Executives. Instead, Minister of Mines are often close allies to the Chief Executive. There is plenty of anecdotal evidence for that. In the Democratic Republic of Congo, former President Joseph Kabila (from 2001 to 2019) and his then Minister of Mines, Martin Kabwelulu (from 2007 to 2019) were both born in the Katanga, Province. During his tenure, Kabwelulu conducted investor-friendly tax policy in the mining sector, extending significant tax exemptions. Other examples include Ecuador and Indonesia. In Ecuador, both former President Moreno and then Minister Illescas were born in Quito and oversaw tax friendly policies in the mining sector. In Indonesia, former President Suharto and his then Minister of Mines and Energy, Sudjana, were both born in Yogyakarta and extended important tax holidays.There is a growing literature emphasizing co-ethnicity, defined as belonging to the same ethnic group as a cabinet minister. For example, O'Brochta (2025) provides novel and extensive evidence of the link between co-ethnicity and cabinet appointments. Importantly, Francois et al. (2015) show that African ruling coalitions are surprisingly large and that political power is allocated proportionally to population shares across ethnic groups, using data on the ethnicity of cabinet ministers since independence. These papers corroborate the fact that the choice of cabinet ministers is not exclusively the result of the Chief Executive selecting members of his own ethnic group. Rather, the choice of cabinet ministers results from a balancing act of the Chief Executive between group elites that are representative of the existing power structure. In this paper, we go beyond the use of co-ethnicity and use places of birth to capture proximity between the Minister of Mines and the Chief Executive. Using places of birth allows us to construct a measure of distance between the Minister of Mines to the Chief Executive relative to the Minister of Finance. Given the turnover in cabinets, the distance/proximity of the Ministers of Mines and Finance relative to the Chief Executive may vary over time. That allows us to exploit the timing of changes in relative distance between places of birth as a source of plausibly exogenous variation in power fragmentation. In turn, we test whether power fragmentation induces changes in tax policy.

The remainder of the paper is organized as follows. Section 2 presents a theoretical model of interministerial competition to explain tax policy. Section 3 describes the data and empirical approach to testing the effect of power fragmentation on tax policy. Section 4 shows the main results are robust to an array of checks. Section 5 concludes.

2 Theory

In this section, we present a stylized theoretical framework formalizing competition between ministers over overlapping tax bases. This interaction alters significantly the tax policy regime, tax revenue, and the equilibrium level of capital invested in the economy.

A The economy

We consider two sectors in the economy: sector M, is the extractive sector (mining), sector E, encompasses the rest of the economy. k denotes the capital-labour ratio invested in each sector. We have two taxes: the first, t, is a tax on capital revenue; the second one is a mining royalty at rate τ, which is only raised on the extractive industries' turnover. The tax on capital may be viewed as a combination of capital income tax and profit tax, while the mining royalty is equivalent to the state's take in so-called production sharing contracts (PSC).[7]

We introduce tax incentives, x, which aim to attract investment in the mining sector by reducing the capital income tax due. In practice, these tax incentives may take several forms including reduced corporate income tax rate, exemption, tax credit. These tax incentives induce tax expenditures.[8]

We assume a representative firm in each sector. The profit of the mining firm is given by:

$$\pi_M(k) = (1-\tau)pf_M(k) - (r+t-x)k,$$

where r is the net return of capital, p is the price of the commodity, x is the tax incentive in the mining sector, and $f_M(.)$ is the production function of the firm. In a similar way, the profit of the representative firm of the non-extractive sectors is given by

$$\pi_E(k) = f_E(k) - (r+t)k,$$

where $f_E(.)$ is the production function of the non-extractive representative firm. Without any loss of generality, we normalize to one the price of the composite good produced by this sector. The net return of capital (r) and the commodity price (p) are assumed to be exogenous.[9]

We make the following assumptions regarding production functions:

[7] Production sharing contracts are commonly used in the extractive sector, which is equivalent to a tax on the extractive sector's turnover.

[8] The OECD (2010) defines tax expenditures as 'provisions of the tax law such as exemptions, deductions, credits, preferential rates, or deferrals that reduce the amount of tax revenue that would otherwise be collected. They are considered to be a form of government spending delivered through the tax system, rather than through direct expenditure.'

[9] We consider that the country is too small to have an impact on any of these variables.

Assumption 1

The production functions are increasing and concave.

$$\forall i \in \{E, M\}, f_i'(k) > 0 > f_i''(k) \text{ and } f_i'''(k) \geq 0. \quad \text{(eq. 1)}$$

Assumption 2

The marginal production function of each sector is log-concave:

$$f_i'(k)\, f_i'''(k) - \left(f_i''(k)\right)^2 \leq 0. \quad \text{(eq. 2)}$$

The non-negativity of the third derivative and the log-concavity of the marginal production functions rely on the curvature of the production function, which will be determinant for the slope of the best response functions of the Ministers and the existence of a Nash Equilibrium. [10]

Each firm maximizes its profit with respect to its investment in capital ($k_{i=E;M}$). We deduce the demand for capital in each sector:

$$\begin{cases} k_M \equiv \underset{k \geq 0}{\operatorname{argmax}} \{\pi_M(k)\} \\ k_E \equiv \underset{k \geq 0}{\operatorname{argmax}} \{\pi_E(k)\} \end{cases}. \quad \text{(eq. 3)}$$

The First Order Conditions (FOCs) of the previous maximization programs yield the following expressions:

$$f_M'(k_M) = \frac{r+t-x}{(1-\tau)p} \text{ and } f_E'(k_E) = r + t. \quad \text{(eq. 4)}$$

We obtain:

$$(t, x, \tau) = f_M'^{-1}\left(\frac{r+t-x}{(1-\tau)p}\right), \quad \text{(eq. 5)}$$

$$k_E(t) = f_E'^{-1}(r + t). \quad \text{(eq. 6)}$$

The assumption of perfect mobility of capital across sectors yields the following capital market clearing condition: [11]

$$(1-\tau)p f_M'\big(k_M(t, x, \tau)\big) - t + x = f_E'\big(k_E(t)\big) - t = r. \quad \text{(eq. 7)}$$

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[10] Such assumptions are usual in Industrial Organization (see Bagnoli and Bergstrom 2005 for a review of log concavity applications in economic science and Rota-Graziosi 2019 in the case of tax competition).

[11] Our setup differs from the standard vertical or even horizontal tax competition literature in the following assumptions: (1) The net return of capital (r) is exogenous; (2) The stock of capital in the whole economy ($k_M + k_E$) is endogenous.

Given the concavity of the production functions, we obtain the following Lemma:

Lemma 1: *We have:*

$$\frac{\partial k_E(t)}{\partial t} < 0, \frac{\partial k_M(t,x,\tau)}{\partial t} < 0, \frac{\partial k_M(t,x,\tau)}{\partial x} > 0, \frac{\partial k_M(t,x,\tau)}{\partial \tau} < 0,$$

$$\frac{\partial k_E(t)}{\partial \tau} = \frac{\partial k_E(t)}{\partial x} = 0,$$

$$\frac{\partial^2 k_E(t)}{\partial t \partial \tau} = 0, \frac{\partial^2 k_E(t)}{\partial t \partial x} = 0,$$

$$\frac{\partial^2 k_M(t,x,\tau)}{\partial t \partial \tau} < 0, \frac{\partial^2 k_M(t,x,\tau)}{\partial t \partial x} < 0, \frac{\partial^2 k_M(t,x,\tau)}{\partial x \partial \tau} < 0,$$

$$\frac{\partial^2 k_E(t)}{\partial (t)^2} > 0, \frac{\partial^2 k_M(t,x,\tau)}{\partial (t)^2} > 0, \frac{\partial^2 k_M(t,x,\tau)}{\partial (x)^2} > 0, \frac{\partial^2 k_M(t,x,\tau)}{\partial \tau^2} < 0.$$

Proof: See Appendix A.

Taxes decrease the demand for capital in both sectors. There is no direct effect of the royalty rate (τ) or of tax incentives (x) on the demand for capital in the non-extractive sector (k_E).

The signs of $\frac{\partial^2 k_M(t,x,\tau)}{\partial t \partial \tau}$ and $\frac{\partial^2 k_M(t,x,\tau)}{\partial t \partial x}$ may induce some common pool issue, when tax instruments are decided by distinct ministers. Demands for capital in both sectors are convex with respect to capital tax rate t, while the royalty rate (τ) decreases the marginal demand for capital in the extractive industry.

B Policy

We describe the payoff function of the two ministries, who interact on the design of tax policy. The objective function of the Minister of Finance (MoF) consists in tax revenue, denoted by $R^{MoF}(t,x,\tau)$, raised through the capital tax, while the payoff function of the Minister of Mining (MoM), denoted by $R^{MoM}(t,x,\tau)$, corresponds to mining royalty revenue raised on the turnover of this sector. The MoM may provide some tax incentives (x) to attract investment in the sector he(she) is in charge.

For the MoF, the payoff function is as follows:

$$R^{MoF}(t,x,\tau) = tk_E(t) + (t-x)k_M(t,x,\tau). \quad \text{(eq. 8)}$$

For the MoM, the payoff function is:

$$R^{MoM}(t,x,\tau) = \tau p f_M(k_M(t,x,\tau)). \quad \text{(eq. 9)}$$

With this set-up, we formalize the interactions of both ministers, which tax an overlapping base: the capital invested in the extractive sector but differ in their respective objective.

As a benchmark, we consider the centralized tax regime, in which the government decides capital tax rate, tax incentives and mining royalty.[12] In this case, total tax revenue is denoted by $R^T(t,x,\tau) = R^{MoF}(t,x,\tau) + R^{MoM}(t,x,\tau)$. The centralized tax policy, denoted by (t^C, x^C, τ^C), results from the following maximization program:

$$(t^C, x^C, \tau^C) \equiv \underset{t\in[0,\bar{t}],x\geq 0,\tau\in[0,\bar{\tau}]}{\operatorname{argmax}} \{R^T(t,x,\tau)\}, \qquad \text{(eq. 10)}$$

under the constraint of a perfect mobility of capital across economic sectors given by:

$$(1-\tau^C)pf'_M\big(k_M(t^C,x^C,\tau^C)\big) + x^C = f'_E\big(k_E(t^C)\big).$$

We consider now that the MoM has some taxing power. More specifically, we assume that the MoF has the power to choose capital tax rate (t), while the MoM is in charge of the royalty rate (τ) and tax incentives (x). Such design would correspond for instance to the case where the Mining Code establishes royalty rates and potential tax incentives to attract foreign investors.[13]

This taxing power assignment corresponds to some form of competition between both Ministers. Each minister decides on his/her tax instrument(s) without considering the impact on his/her counterpart's payoff. The resulting Nash equilibrium is then the solution of the following maximization program:

$$\begin{cases} \mathrm{t}^1 \equiv \underset{t\in[0,\bar{t}]}{\operatorname{argmax}} \{R^{MoF}(t,x,\tau)\} \\ x^1 \equiv \underset{x\geq 0}{\operatorname{argmax}} \{R^{MoM}(t,x,\tau)\} \\ \tau^1 \equiv \underset{\tau\in[0,\bar{\tau}]}{\operatorname{argmax}} \{R^{MoM}(t,x,\tau)\} \end{cases} \qquad \text{(eq. 11)}$$

Comparing the equilibrium values of tax rates and tax incentives when the MoM has a taxing power, we obtain the following proposition.

Proposition 1: *When the MoM has the power to choose royalty rate and tax incentive in the mining sector, we have:*

$$(i) \qquad t^C < t^1, x^C < x^1, \text{ and } \tau^C < \tau^1.$$

$$(ii) \qquad k_E(t^C) > k_E(t^1) \text{ and } k_M(t^C,x^C,\tau^C) < k_M(t^1,x^1,\tau^1)$$

$$(iii) \qquad R^T(t^C,x^C,\tau^C) > R^T(t^1,x^1,\tau^1)$$

Proof: See Appendix B for Proposition 1(i) and (ii).

[12] We will discuss the issue of tax rates discrimination latter in the text, since the taxing power assignment may induce some preferential tax treatments of the extractive sector.

[13] Alternative scenarios are possible (for instance, the MoF chooses tax incentives in the mining sector), but will be note examine here.

Proposition 1(iii) is immediate given the respective maximization programs.

The MoM chooses higher tax incentives ($x^C < x^1$) than the level decided by a central authority (a MoF with full taxing power). These incentives may even cancel any taxation of capital in the mining sector. By contrast, the MoM chooses a higher royalty rate ($\tau^C < \tau^1$). Given its payoff function, the MoM is not interested in taxing capital invested in the mining sector and exempts the mining sector from any income tax. This fragmentation of the taxing power induces the MoF to raise capital tax rate ($t^C < t^1$) to compensate revenue losses.

This taxing power fragmentation is not only detrimental to aggregate tax revenue (Proposition 1(iii)), but it affects also the equilibrium level of capital invested in each economic sector. We observe a decrease in capital invested in the non-extractive sector $\left(k_E(t^C) > k_E(t^1)\right)$ as an immediate consequence of the increase in capital tax rate. Assuming that tax incentives provided by the MoM cancels any capital taxation in the mining sector, we have a paradox: The equilibrium level of capital in this sector is lower, when the MoM has some taxing power: $\mathrm{k_M(t^C, x^C, \tau^C) > k_M(t^1, x^1, \tau^1)}$. The increase in royalty rate dominates capital tax incentive for investors.[14]

We conclude our theoretical analysis by studying the properties of tax strategies between the Ministers. This allows us to establish the existence and uniqueness of the Nash equilibrium corresponding to the tax competition between Ministers. We establish the following proposition:

Proposition 2: *Considering tax incentives as given, capital tax rate and royalty rate are plain and strategic substitutes.*

Proof: See Appendix C.

If the MoF increases its capital tax rate, the MoM reacts by reducing its royalty rate (and reciprocally). Indeed, any increase in one of the two tax instruments reduces the total amount of available capital in the economy and consequently affects the tax revenues of both ministers.

Given the strategic substitutability of tax rates, the game played by both ministers in the considered tax policy regime is submodular. The Nash Equilibrium exists since there are only two players at stake and considering the opposite strategy of one player allows us to transform this submodular game into a submodular game (see Vives, 1999). Moreover, the Nash Equilibrium of this game is commitment

[14] In both equilibria, we observe non-zero tax incentives, which involve capital tax rate discrimination between economic sectors. Capital invested in the mining sector being less taxed than elsewhere (even under the centralized tax policy regime). The OECD (2008, 2010) and the European Commission oppose capital tax rate discrimination and more broadly preferential tax regimes. However, several authors (e.g. Keen 2001; Janeba and Smart 2003; Bucovetsky and Haufler 2007; Gaigné and Wooton 2011) discussed the relevance of such tax regimes highlighting potential gains in tax rate discrimination. The main intuition is that a uniform capital tax rate may induce a more intensive tax competition since this rate concerns the whole tax base, while preferential tax regimes may soften tax competition by isolating footloose economic sectors. These sectors benefit from a reduced rate or even tax exemptions while countries still tax at a higher rate economic sectors in which capital is less mobile. In other words, capital tax rate discrimination would reduce the impact of tax competition on the bases, where capital is more mobile.

robust, i.e. each minister would prefer to play the simultaneous game rather than one of the two Stackelberg games, in which one is the leader, the other the follower.[15]

We now turn to the empirical tests of the basic predictions from the theory.

3 Data and empirical framework

In this section, we describe the data and empirical framework used to test several predictions of the theory linking taxing power fragmentation to tax expenditures and overall tax revenues. Table A1 in Appendix A provides basic statistics related to the variables used in the empirical analysis.

3.1 Data

Tax incentives in the mining sector

The data on revenue forgone is compiled from the Global Tax Expenditures Database (GTED), which aggregates publicly available tax expenditure data from 218 jurisdictions since 1990.[16] This dataset includes provision-level estimates of forgone revenue, details on beneficiaries, and accompanying metadata, such as the legal framework and the duration of the provisions. Each entry is categorized by its tax base, policy objective, beneficiary type, and the form of tax expenditure, with further subcategories applied when relevant. GTED captures both granular (provision-level) and aggregated information but restricts inclusion to reports that present quantifiable indicators of tax expenditure usage, particularly forgone revenue figures.[17]

To identify tax incentives in GTED that are specific to the mining sector, we examine each tax expenditure provision using its unique identifier related to the mining sector. Accordingly, a tax incentive provision is classified as applicable specifically to the mining industry if it meets certain criteria laid out in Table A2 of Appendix A. We also explore stricter criteria that include legal references explicitly associated with the mining sector, such as 'mining code', 'mining law', 'mining act', 'minerals', or 'mines'. Subsequently, we retained all provision IDs falling into one of the categories described above and computed the corresponding revenue forgone. This is measured as the total value of revenue forgone incurred by country c in year t.[18]

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[15] Developing an endogenous timing version of the game, that is introducing a preliminary stage in which each minister would commit to playing early or late, does not modify the equilibrium. Each minister has a first mover incentive (choosing early instead of playing simultaneously), which involves that the perfect subgame Nash equilibrium of the endogenous timing game corresponds to the Nash equilibrium of the static game (see Kempf and Rota-Graziosi 2010).

[16] See URL link to the dataset: **https://gted.taxexpenditures.org/data-download-dashboard/#provisions-search**

[17] There are data limitations due to country-specific benchmark definitions and methodological inconsistencies. Standardization is used to improve comparability over time and across countries. This includes conversions into U.S. dollars and calculations of revenue forgone as a share of GDP and total tax revenue.

[18] See Table A3 in Appendix A for descriptive statistics of the revenue forgone.

As a final step, we conduct a basic test to validate our data. Specifically, we examine the correlation between revenue forgone from tax incentives targeting only the mining sector and the level and change of ores and metals exports. A plausible hypothesis is that such forgone revenue, by lowering production costs and stimulating investment, would lead to an increase in ores and metals exports. Table A4 in Appendix A presents the result, confirming the strong statistical association between tax incentives and the value of exports of mineral products.

Overall tax revenues

Overall tax revenues are obtained from IMF's World Revenue Longitudinal Database (WoRLD). The IMF's WoRLD database[19] provides annual revenue data for 193 countries since the early 1990s, offering detailed insights into tax structures and social contributions. In this study, we focus on total revenues, and taxes on profits and income.

Distance to the Chief Executive

To calculate the distance of the relevant ministers to the Chief Executive, we collected information on the Chief Executive and Ministers—namely, the Minister of Finance, and the Minister responsible for mining (typically the Minister of Mines or the Minister of Natural Resources)—drawing primarily from the Central Intelligence Agency (CIA), World Leaders Dataset. The dataset provides the names and official titles of cabinet members across countries.[20] We then gathered data on dates and places of birth, and ethnic background from a variety of sources including *ethnicolr*—a website which predicts race from names.[21] This allows us to build a unique longitudinal dataset covering the period from 2000 to 2024.

To proxy the proximity/distance between the Minister of Mines and the Chief Executive, we use a relative distance measure. That is the ratio of the Minister of Mines' distance to the Chief Executive to the sum of the respective distance of the Minister of Mines and of the Minister of Finance to the Chief Executive. Formally, let the geographical coordinates of the hometown of leader A be denoted by (φ_A, λ_A), where φ is latitude and λ is longitude. Similarly, let the coordinates of leader B be (φ_B, λ_B). The great-circle distance in kilometers is calculated using the Haversine formula:

$$d(A,B) = 2RArcsin\left(\sqrt{\sin^2\left(\frac{\varphi_B - \varphi_A}{2}\right) + cos(\varphi_A)cos(\varphi_B)\sin^2\left(\frac{\lambda_B - \lambda_A}{2}\right)}\right),$$

with R, the mean radius of the Earth, being equal to 6,371 km.

[19] See **https://www.imf.org/en/Topics/fiscal-policies/world-revenue-longitudinal-database**

[20] See URL link to the dataset: **https://www.cia.gov/resources/world-leaders/foreign-governments/**

[21] See URL link to the website: **https://ethnicolr.readthedocs.io/**. Because *ethnicolr* database provides limited historical coverage, we supplement ethnicity and biographical information primarily from Wikipedia, alongside official government websites and state-affiliated media outlets.

In turn, we compute pairwise distances using the Haversine method implemented in the $distHaversine$ function from *t.*[22] First, we compute the distance between the birth places of Minister of Mines and the Chief Executive for country i. Second, we compute the distance between the Minister of Finance and the Chief Executive for country i. Eventually, the relative distance of the Minister of Mines to the Chief Executive is computed as the ratio of the absolute distance of Minister of Mines to the Chief Executive to the sum of distance of the Ministers of Mines and the Minister of Finance. As the latter ratio increases, it suggests that the relative power of the Minister of Mines goes down.

To complement our measure of relative distance, we also compute a measure of co-ethnicity of relevant cabinet ministers. To do so, we infer ethnicity using using *ethnicolr*[23] and Wikipedia biographies combined to the names and titles of the Chief Executives and Ministers obtained from the CIA's World Leaders Dataset. We construct a dummy indicator which takes the value of one if the Minister of Mines and the Chief Executive share the same ethnicity, and zero otherwise. The dummy indicator is as follows:

$$Co-ethnicityD1_{i,t} = \mathbb{1}\{Ethnicity\big(Minister\ of\ Mines_{i,t}\big) = Ethnicity\big(CEO_{i,t}\big)\}$$

Alternatively, we construct a more restrictive dummy indicator which takes the value of one if and only if the Minister of Mines and the Chief Executive share the same ethnicity and that ethnicity is different from that of the Minister of Finance, and zero otherwise. The dummy indicator is as follows:

$$Co-ethnicityD2_{i,t} = \mathbb{1}\{Ethnicity\big(Minister\ of\ Mines_{i,t}\big) = Ethnicity\big(CEO_{i,t}\big) \neq Ethnicity\big(Minister\ of\ Finance_{i,t}\big)\}$$

We now turn to describing the empirical framework.

3.2 Empirical framework

To examine the relationship between the relative distance of the Minister of Mines to the Chief Executive and tax expenditures, we use local projection method (Jordà 2005; Ugarte-Ruiz 2023). For each forecast horizon $h \in H = \{-3, -2, -1, 0, 1, \dots, 6\}$, the specification is:

$$y_{c,t+h} = a_c^h + b_t^h + \beta_h s_{c,t} + \psi_h y_{c,t-1} + \sum_{l=1}^{6} \theta_{h,l} s_{c,t-l} + \varepsilon_{c,t+h}^h \qquad \text{(eq. 12)}$$

where $y_{c,t}$ is tax forgone for country c in year t, measured as a percentage of GDP, with robustness checks conducted using alternative definitions such as tax expenditures as a share of total tax revenue,

[22] We address differences in political systems. In some countries depending on whether we are in presidential or parliamentary system, the President serves a largely ceremonial role while executive authority rests with the Prime Minister; by contrast, in single-party states such as Vietnam and China, the General Secretary of the Communist Party holds ultimate decision-making power. In each case, the dataset records the individual exercising the most representative political authority and responsibility, irrespective of official title. Finally, in years when multiple individuals occupy the same post (e.g., interim or acting positions), we retain only the most representative figure. For instance, in Austria during 2004 several acting Presidents served temporarily, but only Federal President Heinz Fischer is recorded.

[23] See URL link to access *ethnicolr*: **https://ethnicolr.readthedocs.io/ethnicolr.html**.

or denominated in local currency and USD. The key explanatory variable ($s_{c,t}$) is the geographical distance between the Minister of Mines and the Chief Executive, which serves as the shock of interest.

To account for the dynamic nature of political processes, we include *first* six lags for the shock variable, consistent with the literature showing that agenda-setting, coalition-building, and policy implementation often unfold over four to six years or longer (Jones & Baumgartner, 2005). *Second*, one lag of the dependent variable is included to capture persistence in tax forgone and to ensure the validity of local projection estimators in the presence of serial correlation (Montiel Olea & Plagborg-Møller, 2021). $a_c^h \; and \; b_t^h$ are unit and time fixed effects (allowed to vary with h), absorbing time-invariant unit heterogeneity and common shocks. ε is error term.

Impulse Response Functions. Coefficients are reported per one standard deviation shock in $s_{(c,t)}$. If σ_s is the (within-estimation) standard deviation of s, then the impulse response at horizon h to a one-S.D. innovation equals

$$IRF_h = \hat{\beta}_h \cdot \sigma_s, h = 0,1, \dots ,6, \qquad \text{(eq. 13)}$$

$\hat{\beta}_h$, called the *period-by-period* effect, traces the dynamic response of y at horizon h to $s_{c,t}$ holding controls fixed.

We also report on the cumulative impulse response function (CIRF), which reflects the total effect accumulated from the impact period through horizon h. This approach could be useful when the outcome variable captures stock or level burdens, or when policy relevance lies in the area under the dynamic response path. Accordingly, the reported response has a cumulative effect up to horizon:[24]

$$CIRF_h = \left(\sum_{j=0}^{h} \hat{\beta}_j\right) \cdot \sigma_s, h = 0,1, \dots ,6, \qquad \text{(eq. 14)}$$

Also, placebo horizons of three (3) pre-treatment periods are incorporated to assess the presence of pre-trends; this step provides a robust check of the identifying assumption that the shock is exogenous to prior movements in tax forgone.

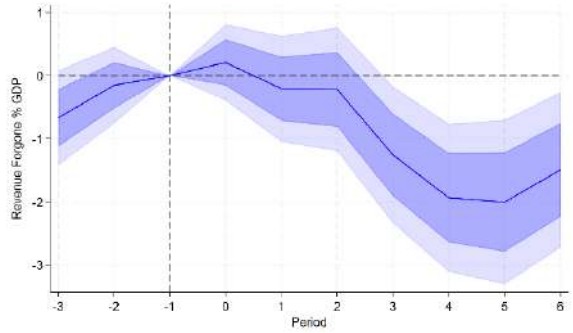
4 Main results

In the following, we present the main results from our empirical analysis of effect of (taxing) power fragmentation and the resource curse. Specifically, we present the results from our regression analysis linking tax expenditures in the mining sector to changes in the distance between the Minister of Mines and the Chief Executive. Figure 1 shows the impulse responses of tax expenditures following shocks to the relative distance between the Minister of Mines to the Chief Executive using local projection methods. We present both 90% and 68% confidence bands based on standard errors that are corrected for heteroskedasticity and autocorrelation using robust Heteroskedasticity and Autocorrelation Consistent estimators.

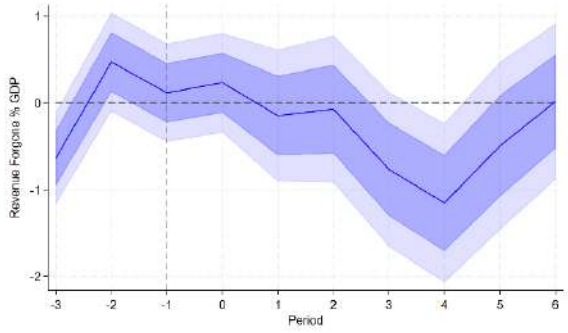
[24] Inference uses the variance of the sum: $Var(\sum_{j=1}^{h} \hat{\beta}_j) = 1_{h+1}^{\top} \bar{V}_{\beta(0:h)} 1_{h+1}$

Figure 1: Impulse responses of tax forgone (% GDP) to relative distance

PANEL A: CUMULATIVE IRF



PANEL B: NON-CUMULATIVE IRF



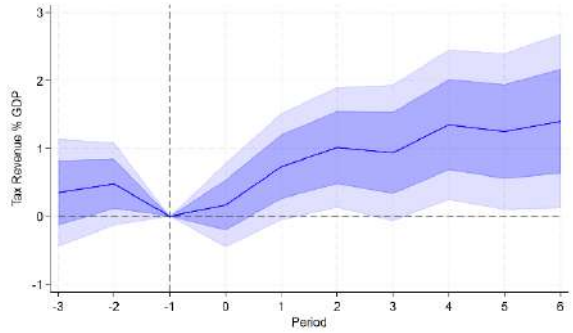
Note: Estimates of the impulse response functions (IRFs) are obtained using local projection methods (Equation 12). The dependent variable is tax expenditures in per cent of GDP, and the independent variable is the distance between the places of birth of the sitting Minister of Finance and the sitting Chief Executive relative to sitting Minister of Finance. The cumulative and non-cumulative IRFs are computed using Equations (13) and (14). The results show 68% (blue) and 90% (grey) confidence intervals.

Source: Authors' illustration based on data described in Section 3.

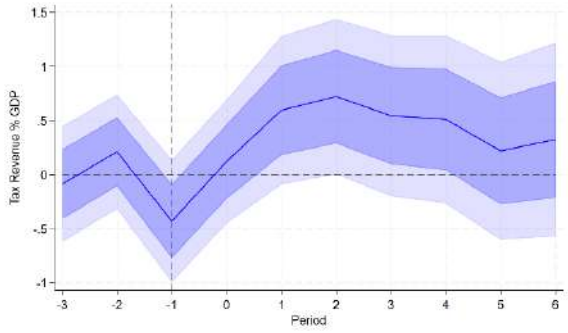
Figure 1 displays the responses of tax expenditures in a cumulative form (Panel A) and in a non-cumulative form (Panel B). The effect on tax expenditures following an increase in distance between the places of birth between the sitting Minister of Mines and the sitting Chief Executive is negative and persistent. A trough is reached five years following the change in distance, after which the effect starts bottoming off in absolute terms. Both Panels A & B of Figure 1 show that the effect of distance is rising consistently in absolute terms over time and is statistically significant at conventional levels. Indeed, the ability of the Minister of Mines to extend tax expenditures is being reduced as the power of the former diminishes relative to that of the Minister of Finance. The results are consistent with the notion that executive power fragmentation affects tax policy and the budget more generally.

Figure 2. Impulse responses of tax revenue collected to relative distance

PANEL A: CUMULATIVE IRF



PANEL B: NON-CUMULATIVE IRF

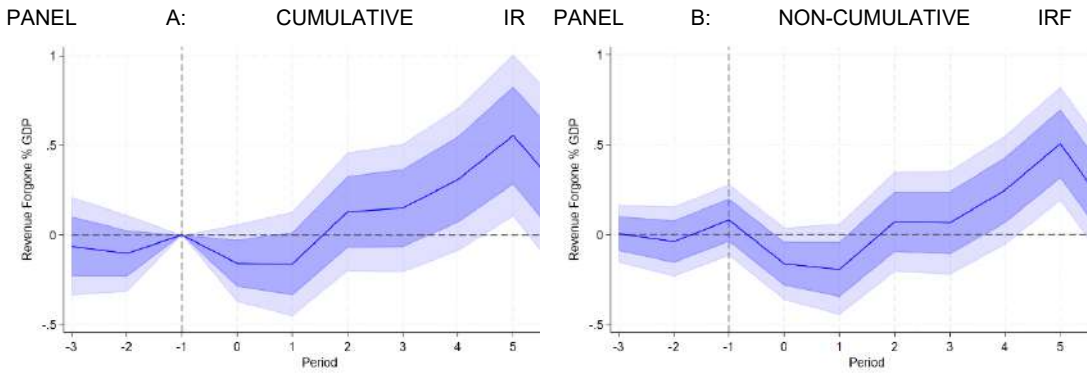


Note: Estimates of the impulse response functions (IRFs) are obtained using local projection methods (Equation 12). The dependent variable is tax revenues collected in per cent of GDP, the independent variable is the distance between the places of birth of the sitting Minister of Mines and the sitting Chief Executive relative to the sitting Minister of Finance. The standard and cumulative IRFs are computed using Equations (13) & (14). The results show 68% (blue) and 90% (grey) confidence intervals.

Source: Authors' illustration based on data described in Section 3.

In turn, we present the results of our regression analysis linking overall tax revenue collected following shocks to distance between the places of birth of the sitting Minister of Mines and the sitting Chief Executive, relative to the sitting Minister of Finance. Figure 2 shows the impulse responses of overall tax revenue collected following shocks to the relative distance between the places of birth of the sitting Minister of Mines and the sitting Chief Executive based on local projection methods. Unsurprisingly, the effect on overall tax revenues following an increase in distance between the Minister of Mines and the Chief Executive is positive and persistent. That contrasts with the negative effect of the increase in that distance on tax expenditures. A peak is reached five years following the change in distance, after which the effect starts declining. Panels A and B in Figure 2 show that the effect of distance is rising consistently over time and is statistically significant at conventional levels. Overall, the results confirm that as the power of the Minister of Mines diminishes relative to that of the Minister of Finance, overall tax revenue mobilization increases. The results are consistent with the guardian role of the Minister of Finance supporting tax revenue mobilization in contrast to the spender role of other Ministers, especially here the Minister of Mines whose increase in power ends up eroding the tax base by extending tax incentives.

Figure 3: Impulse responses of tax revenue forgone to co-ethnicity

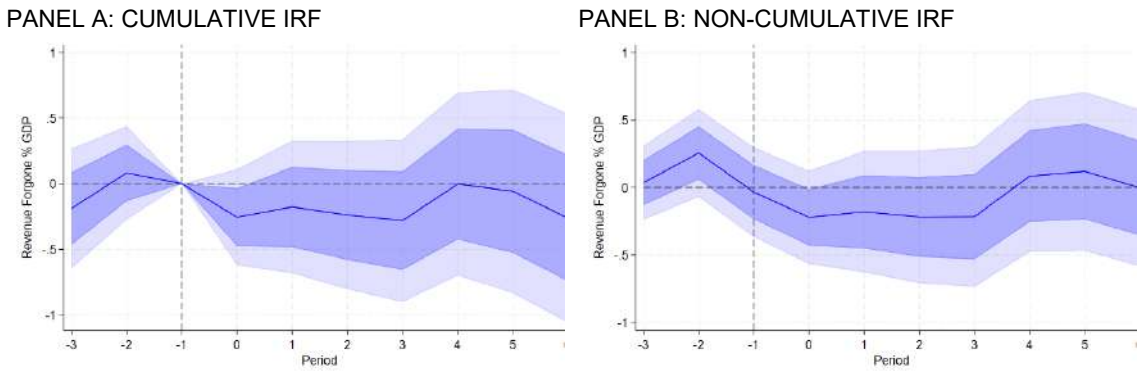


Note: Estimates of the impulse response functions (IRFs) are obtained using local projection methods (Equation 12). The dependent variable is tax expenditures in per cent of GDP, and the independent variable is co-ethnicity. Co-ethnicity is a binary indicator which is equal to one if the Minister responsible for mines and the Chief Executive share the same ethnicity, and zero otherwise. Panel A employs the local projection cumulative IRF as presented in Equation (14), while Panel B displays a non-cumulative IRF. The results show 68% (blue) and 90% (grey) confidence intervals.

Source: Authors' illustration based on data described in Section 3.

Further, we present the results of our empirical analysis linking tax expenditures in the mining sector to changes in co-ethnicity between the Minister of Mines and the Chief Executive. Figure 3 shows the impulse responses of overall tax revenues following shocks to the simple measure of co-ethnicity between the sitting Minister of Mines and the sitting Chief Executive—capturing the proximity between the latter two executives independently of the ethnicity of the Minister of Finance. The effect on tax revenue forgone following an increase in proximity between the Minister of Mines and the Chief Executive is positive and persistent. A peak is reached five years after the change in proximity, after which the effect starts receding. Panels A & B in Figure 3 show that the effect of proximity is statistically significant at conventional levels for the cumulative and non-cumulative forms. Overall, the results confirm that as the power of the Minister of Mines rises, tax expenditures increase. The results are consistent with the spender role of the Minister of Mines who ends up eroding the tax base by extending tax incentives. When using the more restrictive measure of co-ethnicity conditioning on the Minister of Finance having a different ethnicity, the results also show an increase in tax expenditures, but the effects are no longer statistically significant at conventional levels. Notwithstanding the less robust results when using co-ethnicity, the measure of power fragmentation based on geographic distance is our preferred proxy given its granular nature—the co-ethnicity measure is indeed binary. We further present robustness results around the geographical distance measure.

Figure 4. Impulse responses of tax revenue forgone to co-ethnicity (alternative)



Note: Estimates of the impulse response functions (IRFs) are obtained using local projection methods (Equation 12). The dependent variable is tax expenditures, and the independent variable is co-ethnicity. The co-ethnicity indicator is equal to one if the sitting Minister of Mines and the sitting Chief Executive have the same ethnicity, and sitting Minister of Finance has a different ethnicity. Panel A & B respectively present cumulative and non-cumulative IRFs based on the estimation of Equation (14). The results present 68% (blue) and 90% (grey) confidence intervals.

Source: Authors' illustration based on data described in Section 3.

In Appendix D, we present the results using an alternative measure of tax revenues, namely income tax revenues and an absolute distance measure—as opposed to relative measure. Figure D1 in Appendix D shows that an increase in relative distance between the places of birth of the sitting Minister of Mines and the sitting Chief Executive is associated with higher income tax revenue. Figure D2 in Appendix D shows that an increase in the absolute distance between the places of birth of the Minister of Mines (Minister of Finance) and the Chief Executive increases (decreases) income tax revenue mobilization. Further, Figure D3 broadly confirms our main results that an increase in distance between the places of birth of the Minister of Mines (Minister of Finance) and the Chief Executive reduces (increases) tax expenditures. That said, absolute distance measures are less potent in appropriately capturing the fragmentation of power within the executive branch than our preferred measure based on relative distance.

5 Conclusion

This paper explored the economic consequences of (taxing) power fragmentation with both theory and data. We first formalized tax policy as the result of interministerial competition where the Minister of Finance ('Guardian') and the Minister of Mines ('Spender') have distinct objective functions, whereby the former attempts to stop the latter from extending tax incentives to attract investment in the sector. Second, we empirically documented that the relative proximity (based on places of birth or co-ethnicity) of the Minister of Mines to the Chief Executive significantly increases revenue forgone from tax expenditures—and reduces the collection of overall tax revenues. Standard explanation for the resource curse hinge on changes in relative prices, as in the Dutch disease model. The results in this paper indicate a novel channel for the resource curse hinging on executive power fragmentation.

The paper has important implications for policy and for further research avenues. To avert the resource curse, the role of 'guardian' of the Minister of Finance must be preserved. That is notwithstanding the Chief Executive's discretionary role in nominating cabinet ministers. Institutional policy arrangements such as fiscal rules, if implemented appropriately, may limit the power of spending Ministers and the bias towards fiscal deficit. However, tax expenditures have long been overlooked despite their growing

economic significance. Promoting full transparency of tax expenditure is necessary step to rein in the behaviour of spending ministers and reinforce Ministers of Finance. Further research could aim at exploring the link between the introduction of fiscal rule and tax expenditures in different institutional contexts.

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Appendices

Appendix A

From Assumptions (1) and (2), we deduce that

$$\frac{\partial k_E(t)}{\partial t} = \frac{1}{f_E''(k_E(t))} < 0,\ \frac{\partial k_M(t,x,\tau)}{\partial t} = \frac{1}{(1-\tau)p}\frac{1}{f_M''(k_M(t,x,\tau))} < 0,$$

$$\frac{\partial k_M(t,x,\tau)}{\partial x} = -\frac{1}{(1-\tau)p}\frac{1}{f_M''(k_M(t,x,\tau))} = -\frac{\partial k_M(t,x,\tau)}{\partial t} > 0,$$

$$\frac{\partial k_M(t,x,\tau)}{\partial \tau} = \frac{r+t-x}{p(1-\tau)^2}\frac{1}{f_M''(k_M(t,x,\tau))} = \frac{r+t-x}{1-\tau}\frac{\partial k_M(t,x,\tau)}{\partial t} < 0,$$

We notice that $\partial k_E(t)/\partial \tau = 0$ and $\partial^2 k_E(t)/\partial t\,\partial \tau = 0$.

From ($\frac{\partial k_M(t,x,\tau)}{\partial t}$), we deduce that:

$$\frac{\partial^2 k_M(t,x,\tau)}{\partial t\,\partial \tau} = \frac{1}{p(1-\tau)^2}\frac{1}{f_M''(k_M(t,x,\tau))} - \frac{r+t-x}{p(1-\tau)^2}\frac{f_M'''(k_M(t,x,\tau))}{\left(f_M''(k_M(t,x,\tau))\right)^2}\frac{\partial k_M(t,x,\tau)}{\partial t}$$

$$= \frac{1}{1-\tau}\left(1 - \frac{r+t-x}{p(1-\tau)}\frac{f_M'''(k_M(t,x,\tau))}{\left(f_M''(k_M(t,x,\tau))\right)^2}\right)\frac{\partial k_M(t,x,\tau)}{\partial t}$$

From Equation (4), we know that

$$f_M'(k_M(t,x,\tau)) = \frac{r+t-x}{p(1-\tau)}$$

We deduce that

$$\frac{\partial^2 k_M(t,x,\tau)}{\partial t\,\partial \tau} = \frac{1}{1-\tau}(1-\Omega_M)\frac{\partial k_M(t,x,\tau)}{\partial t},$$

where $\Omega_M = \frac{f_M'(k_M(t,x,\tau))f_M'''(k_M(t,x,\tau))}{\left(f_M''(k_M(t,x,\tau))\right)^2}$.

From the log-concavity of $f_M'(.)$ (Assumption 2), we have $\Omega_M \leq 1$, which involves: $\frac{\partial^2 k_M(t,x,\tau)}{\partial t\,\partial \tau} \leq 0$.

From ($\frac{\partial k_M(t,x,\tau)}{\partial t}$) we obtain

$$\frac{\partial^2 k_M(t,x,\tau)}{\partial\tau\,\partial x} = -\frac{2(r+t-x)}{p(1-\tau)^3}\frac{1}{f_M''\left(k_M(t,x,\tau)\right)} - \frac{r+t-x}{p(1-\tau)^2}\frac{f_M'''\left(k_M(t,x,\tau)\right)}{\left(f_M''\left(k_M(t,x,\tau)\right)\right)^2}\frac{\partial k_M(t,x,\tau)}{\partial x}$$

$$\frac{\partial^2 k_M(t,x,\tau)}{\partial\tau\,\partial x} = -\frac{r+t-x}{(1-\tau)^2}\left(2+\frac{1}{p}\frac{f_M'''\left(k_M(t,x,\tau)\right)}{\left(f_M''\left(k_M(t,x,\tau)\right)\right)^2}\right)\frac{\partial k_M(t,x,\tau)}{\partial x} \le 0$$

Regarding the concavity(convexity) of the demand for capital with respect to tax rates, we have:

$$\frac{\partial^2 k_E(t)}{\partial(t)^2} = -\frac{f_E'''\left(k_E(t)\right)}{\left(f_E''\left(k_E(t)\right)\right)^2}\frac{\partial k_E(t)}{\partial t} > 0,$$

$$\frac{\partial^2 k_M(t,x,\tau)}{\partial t^2} = -\frac{1}{p(1-\tau)}\frac{f_M'''\left(k_M(t,x,\tau)\right)}{\left(f_M''\left(k_M(t,x,\tau)\right)\right)^2}\frac{\partial k_M(t,x,\tau)}{\partial t} > 0$$

$$\frac{\partial^2 k_M(t,x,\tau)}{\partial x^2} = \frac{1}{(1-\tau)p}\frac{f_M'''\left(k_M(t,x,\tau)\right)}{\left(f_M''\left(k_M(t,x,\tau)\right)\right)^2}\frac{\partial k_M(t,x,\tau)}{\partial x} > 0$$

$$\frac{\partial^2 k_M(t,x,\tau)}{\partial\tau^2} = 2\frac{r+t-x}{p(1-\tau)^3}\frac{1}{f_M''\left(k_M(t,x,\tau)\right)}$$

$$\frac{\partial^2 k_M(t,x,\tau)}{\partial\tau^2} = \frac{2(r+t-x)}{p(1-\tau)^3}\frac{1}{f_M''\left(k_M(t,x,\tau)\right)} - \frac{r+t-x}{p(1-\tau)^2}\frac{f_M'''\left(k_M(t,x,\tau)\right)}{\left(f_M''\left(k_M(t,x,\tau)\right)\right)^2}\frac{\partial k_M(t,x,\tau)}{\partial\tau}$$

$$\frac{\partial^2 k_M(t,x,\tau)}{\partial\tau^2} = \frac{1}{1-\tau}\left(2-\frac{f_M'\left(k_M(t,x,\tau)\right)f_M'''\left(k_M(t,x,\tau)\right)}{\left(f_M''\left(k_M(t,x,\tau)\right)\right)^2}\right)\frac{\partial k_M(t,x,\tau)}{\partial\tau} < 0$$

Appendix B

Proof of Proposition 1(i)

The First Order Conditions (FOCs) of the centralized solution (10) are given by

$$k_E(t^C) + t^C \frac{\partial k_E(t)}{\partial t}\Big|_{t^C} + k_M(t^C, x^C, \tau^C) + \left[t^C - x^C + \tau^C p f'_M\left(k_M(t^C, x^C, \tau^C)\right)\right] \frac{\partial k_M(.)}{\partial t}\Big|_{t^C} = 0.$$

$$-k_M(t^C, x^C, \tau^C) + \left[t^C - x^C + \tau^C p f'_M\left(k_M(t^C, x^C, \tau^C)\right)\right] \frac{\partial k_M(t,x,\tau)}{\partial x}\Big|_{x^C} = 0.$$

$$p f_M(k_M(t, x, \tau)) + \left[t^C - x^C + \tau^C \tau p f'_M\left(k_M(t^C, x^C, \tau^C)\right)\right] \frac{\partial k_M(.)}{\partial \tau}\Big|_{\tau^C} = 0.$$

The FOCs of (11) are[25]

$$k_M(t^1, x^1, \tau^1) + k_E(t^1) + t^1\left(\frac{\partial k_M(.)}{\partial t}\Big|_{t^1} + \frac{\partial k_E(.)}{\partial t}\Big|_{t^1}\right) = 0$$

$$\tau^1 f'_M\left(k_M(t^1, x^1, \tau^1)\right) \frac{\partial k_M(.)}{\partial x}\Big|_{x^1} > 0$$

$$f_M(k_M(t^1, x^1, \tau^1) + \tau^1 f'_M\left(k_M(t^1, x^1, \tau^1)\right) \frac{\partial k_M(.)}{\partial \tau}\Big|_{\tau^1} = 0$$

Given the previous FOCs, we deduce unambiguously that $x^1 > x^C$.

From $\frac{\partial R^{MoM}(t,x,\tau)}{\partial t} = \tau p f'_M\left(k_M(t, x, \tau)\right) \frac{\partial k_M(.)}{\partial t} < 0$ and $\frac{\partial R^{MoF}(t,x,\tau)}{\partial t}\Big|_{t^1} = 0$, we deduce that

$$\frac{\partial R^T(t, x, \tau)}{\partial t}\Big|_{t^1} = \frac{\partial R^{MoF}(t, x, \tau)}{\partial t}\Big|_{t^1} + \frac{\partial R^{MoM}(t, x, \tau)}{\partial t}\Big|_{t^1} < 0$$
$$= \frac{\partial R^{MoF}(t, x, \tau)}{\partial t}\Big|_{t^C} + \frac{\partial R^{MoM}(t, x, \tau)}{\partial t}\Big|_{t^C} = \frac{\partial R^T(t, x, \tau)}{\partial t}\Big|_{t^C}$$

Given the concavity of $R^T(t, x, \tau)$ with respect to t, we deduce that: $t^1 > t^C$.

Similarly, from $\frac{\partial R^{MoF}(t,x,\tau)}{\partial \tau} = (t - x) \frac{\partial k_M(t,x,\tau)}{\partial \tau} < 0$ and $\frac{\partial R^{MoF}(t,x,\tau)}{\partial \tau}\Big|_{\tau^1} = 0$, we deduce that

[25] The SOCs are respected.

$$\left.\frac{\partial R^{T}(t,x,\tau)}{\partial t}\right|_{t^1} = \left.\frac{\partial R^{MoF}(t,x,\tau)}{\partial t}\right|_{t^1} + \left.\frac{\partial R^{MoM}(t,x,\tau)}{\partial t}\right|_{t^1} < 0$$
$$= \left.\frac{\partial R^{MoF}(t,x,\tau)}{\partial t}\right|_{t^C} + \left.\frac{\partial R^{MoM}(t,x,\tau)}{\partial t}\right|_{t^C} = \left.\frac{\partial R^{T}(t,x,\tau)}{\partial t}\right|_{t^C}$$

Given the concavity of $R^{T}(t,x,\tau)$ with respect to t, we deduce that: $t^1 > t^C$.

Proof of Proposition 1.(ii)

Given that $\frac{\partial k_E(t)}{\partial t} < 0$ (Lemma 1) and $t^C < t^1$ (Proposition 1), we deduce that $k_E(t^C) > k_E(t^1)$.

From the capital market clearing condition, we have:

$$(1-\tau^C)pf'_M\left(k_M(t^C,x^C,\tau^C)\right) - t^C + x^C = r = (1-\tau^1)pf'_M\left(k_M(t^1,x^1,\tau^1)\right) - x^1 + t^1$$

Considering that $t^1 = x^1$,[26] we obtain

$$(1-\tau^C)pf'_M\left(k_M(t^C,x^C,\tau^C)\right) - t^C + x^C = r = (1-\tau^1)pf'_M\left(k_M(t^1,x^1,\tau^1)\right)$$

Considering that $x^C < t^C$: Capital in the mining sector is taxed at the centralized equilibrium, we obtain

$$(1-\tau^C)f'_M\left(k_M(t^C,x^C,\tau^C)\right) < (1-\tau^1)f'_M\left(k_M(t^1,x^1,\tau^1)\right)$$

Given that $\tau^C < \tau^1$ (Proposition 1.(*i*)), we deduce

$$f'_M\left(k_M(t^C,x^C,\tau^C)\right) < f'_M\left(k_M(t^1,x^1,\tau^1)\right)$$

From the concavity of the production function, we have: $k_M(t^C,x^C,\tau^C) > k_M(t^1,x^1,\tau^1)$.

[26] We established in Proposition 1 that the Minister of Mines' (MoM's) payoff function is increasing in the level of tax incentives. This assumption corresponds then to a full exemption of capital taxation in the mining sector. An alternative would be to assume some subsidies, or equivalently negative capital taxation in this sector. Our result remains unchanged.

Appendix C

Plain substitutes refer to the terminology of Eaton (2004) and are equivalent to (first degree) negative externalities. We have:

$$\frac{\partial R^{MoF}(t,x,\tau)}{\partial \tau} = (t-x)\frac{\partial k_M(t,x,\tau)}{\partial \tau} < 0,$$

$$\frac{\partial R^{MoM}(t,x,\tau)}{\partial t} = \tau pf'_M\big(k_M(t,x,\tau)\big)\frac{\partial k_M(t,x,\tau)}{\partial t} < 0.$$

From the FOCs of the maximization program (11), we consider tax incentives *x* as given. We determine the best reply function for each Minister, respectively denoted by $BR_t(\tau)$ and $BR_\tau(t)$ and defined as

$$\frac{\partial R^{MoF}(BR_t(\tau),x,\tau)}{\partial t} = 0$$

$$\frac{\partial R^{MoM}\big(t,x,BR_\tau(t)\big)}{\partial \tau} = 0$$

Following Bulow et al. (1985), we deduce the strategic substitutability of tax instrument from the sign of the best reply function. We have:

$$\frac{\partial BR_t(\tau)}{\partial \tau} = -\frac{\frac{\partial^2 R^{MoF}(t,x,\tau)}{\partial t\,\partial \tau}}{\frac{\partial^2 R^{MoF}(t,x,\tau)}{\partial t^2}}.$$

Since the SOC is respected: $\frac{\partial^2 R^{MoF}(t,\tau)}{\partial t^2} < 0$, we deduce that $\text{sign}\left\{\frac{\partial BR_t(\tau)}{\partial \tau}\right\} = \text{sign}\left\{\frac{\partial^2 R^{MoF}(t,x,\tau)}{\partial t\,\partial \tau}\right\}$. We have:

$$\frac{\partial^2 R^{MoF}(t,\tau)}{\partial t\,\partial \tau} = \frac{\partial k_M(t,x,\tau)}{\partial \tau} + (t-x)\frac{\partial^2 k_M(t,x,\tau)}{\partial t\,\partial \tau} < 0$$

given the sign of $\frac{\partial k_M(t,x,\tau)}{\partial t}$ and $\frac{\partial^2 k_M(t,x,\tau)}{\partial t\,\partial \tau}$.

Similarly, we have

$$\frac{\partial BR_\tau(t)}{\partial t} = -\frac{\frac{\partial^2 R^{MoM}(t,x,\tau)}{\partial t\,\partial \tau}}{\frac{\partial^2 R^{MoM}(t,x,\tau)}{\partial \tau^2}}$$

And

$$\frac{\partial^2 R^{MoM}(t,x,\tau)}{\partial t\,\partial \tau} = pf'_M\big(k_M(t,x,\tau)\big)\frac{\partial k_M(t,x,\tau)}{\partial t} + \tau pf''_M\big(k_M(t,x,\tau)\big)\frac{\partial k_M(t,x,\tau)}{\partial t}\frac{\partial k_M(t,x,\tau)}{\partial \tau} + \tau pf'_M\big(k_M(t,x,\tau)\big)\frac{\partial^2 k_M(t,x,\tau)}{\partial t\,\partial \tau}$$

Given that

$$\frac{\partial^2 k_M(t,x,\tau)}{\partial t\,\partial \tau} = \frac{1}{1-\tau}(1-\Omega_M)\frac{\partial k_M(t,x,\tau)}{\partial t} \text{ and } \frac{\partial k_M(t,x,\tau)}{\partial \tau} = \frac{r+t-x}{1-\tau}\frac{\partial k_M(t,x,\tau)}{\partial t}$$

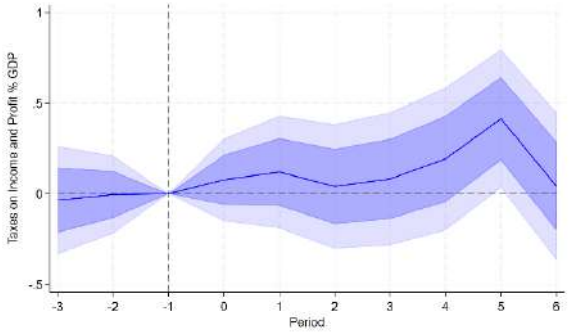
We deduce that

$$\frac{\partial^2 R^{MoM}(t,x,\tau)}{\partial t\,\partial \tau} = pf'_M\big(k_M(t,x,\tau)\big)\left[1+\frac{\tau}{1-\tau}(1-\Omega_M)\right]\frac{\partial k_M(t,x,\tau)}{\partial t} + \tau p\frac{r+t-x}{1-\tau}f''_M\big(k_M(t,x,\tau)\big)\left(\frac{\partial k_M(t,x,\tau)}{\partial t}\right)^2 < 0$$

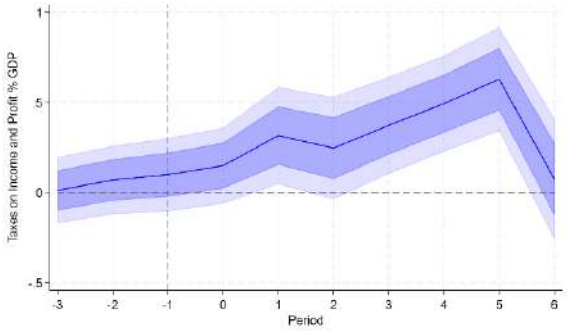
Appendix D: Empirical analysis

Figure D1: Impulse responses of income tax revenue collected to relative distance

PANEL A: CUMULATIVE IRF



PANEL B: NON-CUMULATIVE IRF



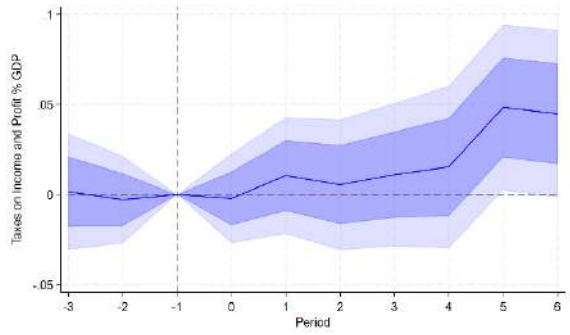
Note: Estimates are obtained using local projections (Equation 12). The dependent variable is income tax revenue collected in per cent of GDP, the independent variable is the distance between the places of birth of the sitting Minister of Mines and the sitting Chief Executive relative to the sitting Minister of Finance. The standard and cumulative IRFs are computed using Equations (13) & (14). The results show 68% (blue) and 90% (grey) confidence intervals.

Source: Authors' illustration based on data described in Section 3.

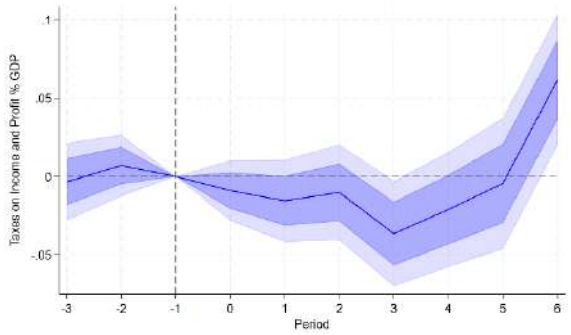
Figure D2: Impulse responses of income tax revenue collected to absolute distance

PANEL A: CUMULATIVE IRF

PANEL A1. Distance: Minister of Mines to Chief Executive

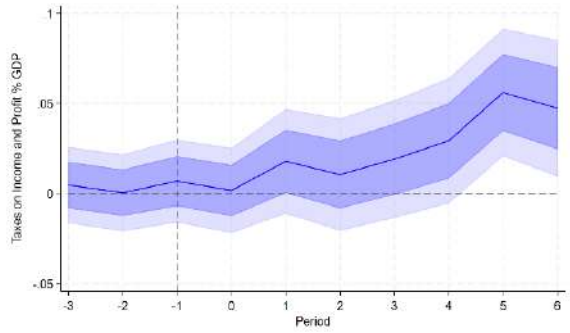


PANEL A2. Distance: Minister of Finance to Chief Executive

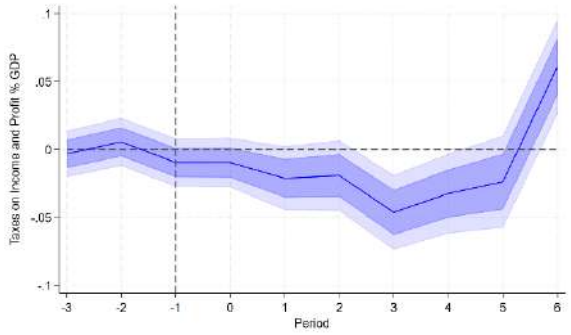


PANEL B: NON-CUMULATIVE IRF

PANEL B1. Distance: Minister of Mines to Chief Executive



PANEL B2. Distance: Minister of Finance to Chief Executive



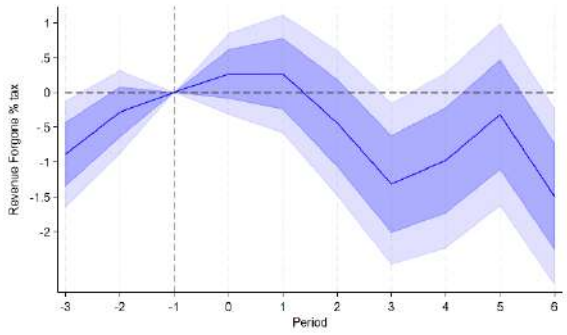
Note: Estimates of the impulse response functions (IRFs) are obtained using local projection methods (Equation 12). The dependent variable is income tax revenue collected, and the independent variables are measures of absolute distance. The absolute distance measures are respectively the distance between the sitting Minister of Mines (Finance) and the sitting Chief Executive. Panel A & B respectively present cumulative and non-cumulative IRFs based on the estimation of Equation (14). The results present 68% (blue) and 90% (grey) confidence intervals.

Source: Authors' illustration based on data described in Section 3.

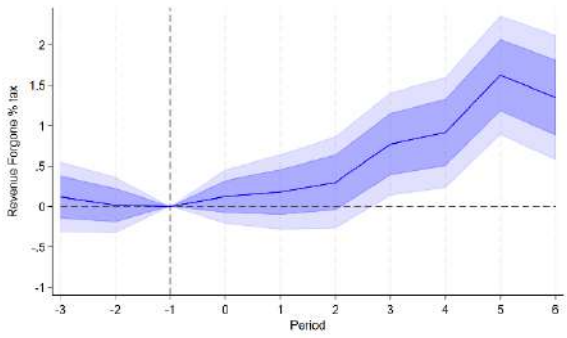
Figure D3: Impulse responses of tax expenditures to absolute distance

PANEL A: CUMULATIVE IRF

PANEL A1. Distance: Minister of Mines and Chief Executive

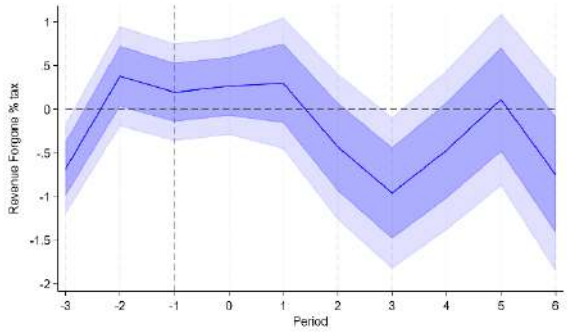


PANEL A2. Distance: Minister of Finance and Chief Executive

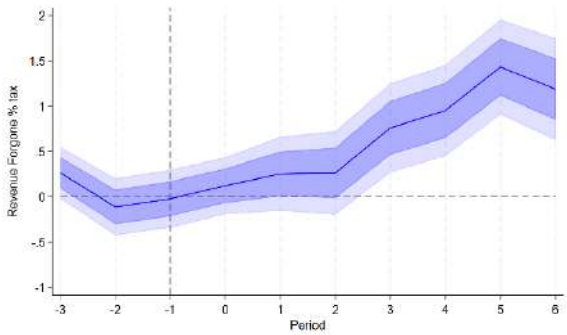


PANEL B: NON-CUMULATIVE IRF

PANEL B1: Distance Minister of Mines and Chief Executive



PANEL B2: Distance Minister of Finance and Chief Executive



Note: Estimates of the impulse response functions (IRFs) are obtained using local projection methods (Equation 12). The dependent variable is tax revenue expenditures, and the independent variables are measures of absolute distance. The absolute distance measures are respectively the distance between the sitting Minister of Mines (Finance) and the sitting Chief Executive. Panel A & B respectively present cumulative and non-cumulative IRFs based on the estimation of Equation (14). The results present 68% (blue) and 90% (grey) confidence intervals.

Source: Authors' illustration based on data described in Section 3.

Supplementary Appendix

Table SA1: Description of variables

Variable(s)	Unit(s)	Source(s)	Obs	Mean	SD	Min	Max
Revenue forgone	(% GDP)	Authors calculated from the Global Tax Expenditures Database	5367.00	1.04	2.42	0.00	34.16
Revenue forgone	(% tax)		5367.00	5.68	13.90	0.00	315.33
Minister of Resources (Mines) to Chief Executive (1)	(km)	Authors' calculation	1880.00	744.91	1836.14	0.00	18995.64
Minister of Finance to Chief Executive (2)	(km)		2203.00	828.65	2199.50	0.00	18755.91
Relative distance	= (1)/{(1) +(2)}		1464.00	0.50	0.28	0.00	1.00
Tax revenue	% GDP	IMF	4119.00	16.59	8.04	0.20	51.91
Taxes on income and profit	% GDP	IMF	3117.00	3.82	3.70	0.00	26.33

Table SA2: Classification criteria for tax incentive provisions

Category	Tax type level 1	Tax type level 2	Type of tax expenditure	Beneficiary level 1	Beneficiary level 2 identification
1	Taxes on income	Corporate income tax	All	Businesses (excluding churches, households, etc.)	Keyword search: *Mining, Mineral producer, Extractive industry, Hydrocarbon producer, Petroleum producer, Petroleum exploitation*, and related terms
2	Taxes on income	Capital gains tax	All	Businesses	Same keyword search as in Category 1
3	Taxes on goods and services	Customs duties	All	Businesses	Same keyword search as in Category 1
4	Taxes on goods and services	Carbon tax	All	Businesses	Same keyword search as in Category 1
5	Taxes on goods and services	Excise taxes	All	Businesses	Same keyword search as in Category 1

Source*:* GTED and authors' calculations.

Table SA3: Descriptive statistics

Variable	Units	Mean	Std. dev.	Min	Max
Revenue forgone	% tax	4.256	12.250	0.000	315.335
Revenue forgone	% GDP	0.777	2.136	0.000	34.157
Ores and metals exports	(% of merchandise exports)	8.027	14.137	0.000	88.179

Source*:* author calculations.

Table SA4: Revenue forgone for mining and oil in relation to ores and metals exports (% of merchandise exports)

VARIABLES	Ores and metals exports (% of merchandise exports)	
Columns	(1)	(2)
Revenue forgone (% of tax)	0.022**	
	(0.011)	
Revenue forgone (% of GDP)		0.139**
		(0.064)
Countries fes	Yes	Yes
Years fes	Yes	Yes
Observations	7,678	7,678
R-squared	0.735	0.735

Note: standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. The missing data are assigned a value of 0.

"Sur quoi la fondera-t-il l'économie du monde qu'il veut gouverner ? Sera-ce sur le caprice de chaque particulier ? Quelle confusion ! Sera-ce sur la justice ? Il l'ignore."

Pascal

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Contact
www.ferdi.fr
contact@ferdi.fr
+33 (0)4 43 97 64 60