The end of tax incentives in mining? Tax policy and mining foreign direct investment in Africa.

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Abstract

African countries generally cut corporate income tax (CIT) rates in the hopes of attracting foreign direct investment (FDI), but the effectiveness of tax rate reductions in attracting extractive industries FDI is controversial. This paper estimates the impact of CIT rates, as applied to mining companies, on FDI inflows to the gold and silver sectors of African economies. The estimation results indicate that the impact of mining CIT rate on the host country's gold and silver FDI inflows is negative, but not statistically significant, at the conventional levels of significance. These results indicate that cuts in CIT rates applied to mining companies will not necessarily attract FDI to gold and silver projects. Moreover, we find a strategic complementarity in gold and silver FDI inflows between countries, suggesting that an increase in the host country's gold and silver FDI inflows may stimulate FDI to gold and silver projects in neighboring countries. Furthermore, the results show that infrastructure, government stability and gold and silver reserves positively affect gold and silver FDI inflows. The main findings of the paper suggest that, instead of granting corporate tax incentives, governments may consider improving the quality of socio-economic infrastructure, the availability of geological information, and promoting political and economic stability for attracting mining investments.

Keywords: FDI in gold and silver, mining corporate tax rate, panel data, spatial econometrics, Africa

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1. Introduction

Foreign direct investment (FDI) in the mining sector holds significant development benefits, including the financing of infrastructure, job creation, transfers of technology, and revenue generation (Hanusch et al., 2019). To attract investments in the mining sector, African governments often design mining fiscal regimes toward offering corporate income tax incentives (Van Blerck, 1994). However, the effectiveness of tax cuts in attracting FDI in the mining sector is controversial. Opponents of tax incentives argue that these incentives are ineffective in attracting FDI and are even harmful to economic growth and development because they deprive developing countries of tax revenue that would have been used to finance the supply of public goods and services (IMF, 2014; N'guessan and Esse, 2017; Oates, 1972; World Bank, 2005). However, the proponents of tax incentives argue that these incentives are needed to compensate for the disadvantages of the poor business environments in developing countries (socio-political instability, corruption, poor infrastructure). They argue that the revenue-losses argument is misplaced since revenue losses from tax incentives may be compensated for by the positive effects of FDI on economic growth, and thereby increase the income tax base (OECD, 2008).

This persistent debate around the impact of tax policy on FDI has, thus far, considered aggregate FDI inflows to all the economic sectors of the host country, whereas the specifics of some economic sectors, like the mining sector, might influence the relationship between tax policy and FDI inflow in these sectors (Vivoda, 2011, 2017). To the best of our knowledge, only two studies (Ali-Nakyea and Amoh, 2018; Obeng, 2014) have estimated the effects of tax policy on FDI in the mining sector in Africa. This scarcity of studies on the determinants of FDI in the mining sector is surprising given the relative importance of FDI inflows to the natural resources sector in Africa

(Morisset, 1999; UNCTAD, 1999). The two existing empirical studies on the impact of tax policy on FDI in the mining sector in Africa, however, have some limitations. In fact, by comparing trends in FDI inflows and tax incentives in the mining sector in Ghana, the conclusion from the study of Ali-Nakyea and Amoh (2018) could not be interpreted as causality between tax incentives in the mining sector and the FDI flows. Moreover, their analysis is somewhat biased because they compare tax incentives in the mining sector with aggregate FDI flows, and not FDI flows for the mining sector specifically. Again, in Ghana, Africa’s largest gold producer since 2018, Obeng (2014) finds that the corporate tax rate has a negative and significant effect on FDI flows into the mining sector over the period 1986–2012. The main result from the study of Obeng (2014) must, however, be taken carefully because this author uses statutory corporate tax rate to predict FDI to the mining sector, whereas the corporate income tax (CIT) rate as applied to mining companies was not strictly the same as the statutory corporate tax rate in Ghana over the entire period 1986–2012. In addition, because the dependent variable is available quarterly, Obeng (2014) uses an algorithm to transform annual data into quarterly data for the explanatory variables, something which is likely to lead to biased estimations due to measurement errors in the explanatory variables.

More generally, beyond these potential intrinsic limitations, previous studies on the impact of tax policy on mining FDI provide country-specific evidence based on time series data. Panel data has advantages over time series in terms of accurate statistical inference and the efficiency of econometric estimates (Hsiao, 2007). The results from a panel data analysis could be used to inform policy orientations in more than one country, whereas policy implications from the country-specific study based on time series cannot be generalized to many countries. Against this background, the contribution of this paper to the empirical literature on the impact of tax policy on FDI is threefold.

First, we focus on African economies and on the mining sector for providing precise policy-oriented conclusions, since African countries tend to grant more tax incentives than their peers in Asia and Latin America to attract FDI to the mining sector (IGF,[3] 2019). This paper also fills an important gap in the related economic literature by providing the first cross-country evidence on the impact of the CIT rate, as applied to mining companies, on FDI inflows to the mining sector in Africa.

Second, as emphasized by Blonigen et al., (2007) and empirically tested by Boly et al. (2020) for African economies, an increase in FDI in one country can affect the level of FDI in neighboring countries. These spillover effects of FDI inflows are more plausible in the mining sector, where a mineral deposit can cross borders and generate foreign investments in another country, in addition to the first host country. Previous studies on the effects of tax policy on FDI in mining, which are country-specific studies (Ali-Nakyea and Amoh, 2018; Obeng, 2014), have ignored potential spillover effects from FDI and from corporate tax policy between countries. Technically, LeSage and Pace (2009) warn that ignoring the spatial interactions in regression models can create severe econometric issues, including biased standard errors and biased estimates.

Finally, because mining operations are risky and capital-intensive, and given the limited number of major multinational mining companies, countries tend to engage in competition among themselves to attract mining investments through grants of generous fiscal provisions for mining projects (Obeng, 2014; Van Blerck, 1994). In practice, when the multinational mining companies generally negotiate for preferential tax treatment for

[3] IGF is the Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development.

their investments, they bring to the attention of the host government the offers of neighboring governments, such tax incentives to mining investors.[4] From that perspective, a host country may react to changes in other countries' mining tax regimes by modifying its own mining tax regime, to retain its attractiveness for mining investments. This implies that the FDI inflows for a host country is influenced by its own corporate tax rate for the mining sector and by other countries' mining tax regimes as well. The dynamic spatial Durbin model (DSDM) allows controlling for such spillover effects between countries on mining taxation.

Similarly, the degradation of the quality of the standard determinants of FDI inflows to the mining sectors (e.g., infrastructure, political and social stability) in neighboring countries could lead FDI to move from these countries to a given host country's mining sector and vice versa, all other things being equal. In fact, the degradation of infrastructure, the occurrence of political and social instability, or the depletion of reserves may lead multinational mining companies to withhold and reduce new investments in a host country and increase their investments abroad. This suggests that the key determinants of FDI inflows to the mining sector in other countries may also affect a host country's mining FDI inflows. The DSDM allows for taking onboard these spillover effects between countries of the key drivers of FDI in the mining sector.

This paper takes into account these cross-border considerations by estimating a spatial econometric panel-data model to control for spillover effects in mining tax policy and FDI inflows to the mining sector for African economies. The rest of the paper

[4] The mining companies urged the government of Zambia to review the mining fiscal regime, to remove the provision of non-deductibility of royalties for the calculation of corporate tax income, by arguing that this provision is harmful to mining investments and by also mentioning that it has been removed from the mining tax regimes of two neighboring countries: Namibia and Zimbabwe (Zambia Chamber of Mines, Media Statement, 28th September 2020. http://mines.org.zm/no-green-light-for-mining-investment-in-the-2021-budget-zcm/).

is structured as follows: Section 2 reviews the literature on the relationship between tax policy and FDI in the mining sector. Section 3 develops the empirical methodology used to estimate the impact of corporate tax rates applied to mining compagnies on FDI in gold and silver projects. Section 4 presents and interprets the estimation results and checks the robustness of these results. Section 5 concludes the paper.

2. Literature Review

The literature on the impact of tax policy on FDI inflows is inconclusive. Tax incentives could attract FDI because the incentives may offset the negative effects of bad tax systems and counterbalance the effects of weak macroeconomics, poor infrastructure, and a lack of effective institutions in developing countries and, thereby, reduce the cost of doing business (Hassett and Hubbard, 2002; Holland and Vann, 1998; Owens, 2004; Tavares-Lehmann et al., 2012; Wilson, 1999). In the same vein, Wilson (1999) emphasizes that when capital is perfectly mobile, any policies aimed at changing the tax rate could affect the net return on capital and thus influence the multinationals' investment location decisions.

However, tax incentives may distort investment decisions, promote corruption, and lead to misallocation of resources (Bird, 1993; Easson and Zolt, 2002). Tax incentives generate significant revenue losses because they erode the tax base and multinational companies tend to abuse tax incentives to reduce their tax burden through tax avoidance (Bond et al., 2000). Weaknesses in tax revenue collection reduce the capacity of the government to finance basic infrastructures and thereby reduce the country's performance in attracting FDI. Furthermore, as outlined by Easson and Zolt (2002), the enforcement of tax incentives may be difficult and this could open doors to corruption and rent-seeking activities from tax officials, and therefore discourage FDI inflows.

As for the theoretical framework, the empirical literature on the impact of tax policy on FDI is controversial as well (Abbas and Klemm, 2013;Ali-Nakyea and Amoh, 2018; Babatunde and Adepeju, 2012; Boly et al., 2020; Cleeve, 2008; Lin and Wang, 2014; ; Van Parys and James, 2010; Zee et al., 2002). Some studies find that tax cuts increase FDI net inflows (Abbas and Klemm, 2013; Boly et al., 2020). However, Kinda (2018) and Van Parys and James (2010) conclude that there is no significant impact of tax policy on FDI inflow. These studies specifically focus on the impact of tax policy on the aggregated FDI net inflows.

For African economies, only a handful of studies have analyzed the impact of taxes on FDI in the natural resources sector (Ali-Nakyea and Amoh, 2018; Babatunde and Adepeju, 2012). Ali-Nakyea and Amoh (2018) find that tax incentives for foreign investors in Ghana have not had their expected positive effect on FDI inflow in the natural resource sectors. However, their study does not analyze causality between tax incentives and FDI inflows. More specifically, for the mining sector, Obeng (2014) finds that the corporate tax rate negatively affects mining FDI inflow in Ghana. The results from Obeng (2014) should, however, be regarded carefully because this author considers the statutory corporate tax rate[5] in his analysis, whereas the corporate tax rate applied to mining companies (35 percent) was different from the statutory CIT rate (25 percent) in Ghana over the period 2012–2015. In Côte d’Ivoire, N’guessan and Esse (2017) use a financial model to simulate the profitability of the Yaoure gold mining project under a scenario where no tax holiday is granted to the mining company. They find that the tax holiday was unnecessary to attract mining companies to the project. The results from their simulations reveal that even without the five-

[5] In Ghana, the statutory corporate income tax rate is not equal to the corporate income tax rate, as applied to mining companies for all the years over the period 1986–2012.

year tax holiday, the mine’s internal rate of return was 25 percent, a level of profitability that is sufficient enough to induce investment. In a general perspective, Saidu (2007) concludes that while an unattractive mining tax regime can drive away investment, an attractive mining tax regime will not necessarily attract foreign direct investment to mining sectors in Niger and Indonesia.

3. Empirical Analysis

Following Boly et al. (2020) and Blonigen et al. (2007), we specify a DSDM for estimating the impact of corporate tax rates applied to mining companies on FDI inflows to gold and silver sectors. The DSDM captures both the spatial interactions between FDI inflows among countries and the cross-border effects generated by changes in a host country’s tax policy on its neighboring countries’ FDI inflows. When a mining company is developing a mining project in a host country, that mining company may realize that the mineral deposit crosses borders between that host country and at least one of its neighboring countries. Accordingly, the neighboring country, which was not initially concerned about the mining operations, may attract the mining company’s attention for the exploration and exploitation of minerals because the discovered mineral deposit geologically extends into that neighboring country. Moreover, when mining companies find positive prospects from exploration in any given country, additional motivation exists for them to invest in exploration activities in neighboring countries, based on the fact that neighboring countries may have similar geological deposits in the surrounding areas. The DSDM considers these potential interactions by including as an explanatory variable, the average weighted value of FDI inflows in gold and silver sectors in other countries (WFDI).

As mining operations are risky by nature, countries tend to grant generous fiscal terms to attract mining companies. Accordingly, the country may react to changes in other countries' corporate tax policies for mining companies by modifying its own tax policy, to preserve its mining corporate tax base and to remain attractive for FDI inflows to its mining sector. FDI inflows for a host country therefore depend both on the domestic corporate tax policy for the mining sector (CITm) and on the other countries' corporate tax policies for their mining sectors (WCITm). The DSDM allows controlling for such interactions.

Similarly, the deterioration of the quality of the standard determinants of FDI to the mining sector (e.g., infrastructure, political and social stability) in neighboring countries could lead FDI to move from these countries to a given host country's mining sector, all other things being equal. This suggests that the standard determinants of FDI inflows to the mining sector in neighboring countries (WX) may also influence a host country's FDI inflows to the mining sector.

The experiences from previous FDI made in a host country's mining sector may influence foreign investors' decisions to invest in mining activities in that country, suggesting that the current level of FDI in the mining sector could be affected by the history of FDI in this sector. The DSDM accounts for this aspect by including among the explanatory variables, the one-period lagged value of the dependent variable (Yt-1). Technically for identification, the inclusion of the time-lagged dependent variable helps in controlling for autocorrelations of errors and for indirectly controlling for the impact of omitted factors from the model, which may have impacted gold and silver FDI inflows in the past (Singh and Jun, 1999).

However, the full DSDM model may suffer from identification problems. To circumvent the identification problem with the full DSDM, we follow Elhorst (2010), who imposed as a restriction the nullity of the parameter for the time and space-lagged dependent variable in the full DSDM (η=0) of the following equation:

$$FDIm_{it} = \delta FDIm_{i,t-1} + \eta WFDIm_{j,t-1} + \rho WFDIm_{jt} + \beta_1 \tau CITm_{it} + \beta_2 W\tau CITm_{jt} + \theta_1 X_{it} + \theta_2 WX_{it} + \vartheta_i + \mu_t + \varepsilon_{it} \quad (1)$$

This is the least-restrictive model, although this restriction limits the variability of the ratio between indirect and direct effects (Elhorst, 2012). The same restriction for the identification of DSDM is considered in Franzese and Hays (2007), Kukenova and Monteiro (2009), Jacobs et al. (2009), and Brady (2011).

The estimated empirical model is specified as follows:

$$FDIm_{it} = \delta FDIm_{i,t-1} + \rho WFDIm_{jt} + \beta_1 \tau CITm_{it} + \beta_2 W\tau CITm_{jt} + \theta_1 X_{it} + \theta_2 WX_{it} + \vartheta_i + \mu_t + \varepsilon_{it} \quad (2)$$

where $FDIm_{i,t}$ is the amount of FDI inflows to gold and silver sectors in country i, in year t; and $FDI_{i,t-1}$ is its value in year t-1, for country i; W is a spatial weight matrix; $W\ FDIm_{j,t}$ is the amount of FDIm in neighboring countries; $CITm_{it}$ is the statutory CIT rate applied to mining companies in country , in year t; $W\ CITm_{jt}$ is the CIT rate applied to mining companies in neighboring countries multiplied by the weighting matrix W; X_{it} is a vector of FDI determinants in the mining sector in country , in year t; $WFDIm_{jt}$ is the weighted average values of FDI determinants in the mining sector in other countries, except country i; ϑ_i is country fixed effects to control for time-invariant, unobserved country heterogeneity; μ_t is time dummies controlling for common shocks affecting African economies each year; ε_{it} is the usual independent and identically distributed error term; and ρ is a spatial autocorrelation term.

The estimation of Equation (2) requires the specification of the connectivity matrix W. Since geographically close countries are likely to have similar geological properties—and, based on the fact that transport costs are generally relatively lower for geographically close countries—tax policy interactions for attracting FDI into mining sectors, and spillover effects from FDI inflows to mining sectors, are likely to be large for geographically close mineral-rich countries. Based on this consideration and following the literature in spatial econometrics, we use geographical distance to measure closeness using a spatial weighting matrix W. Algebraically, an element w_{ij} of the geographic distance spatial connectivity matrix is specified as follows:

$$w_{ij} = \begin{cases} \frac{1/d_{ij}}{\sum_j 1/d_{ij}}, & for\ i \neq j \\ 0, & for\ i = j \end{cases}$$

with d_{ij} as the Euclidean distance between the capitals of countries i and j.

To our knowledge, this paper is the first to control for both the spatial spillover effects of FDI and corporate tax policy for the mining sector, using a Dynamic Spatial Durbin Model estimated with geographic neighborhood matrices.

The estimation of Equation 1 raises endogeneity issues that need to be addressed. In fact, while the host country's mining tax policy may affect FDI inflows into the mining sector, mining investors may request preferential tax treatments before they concretize their investments intentions. This reverse causality between FDI inflow and tax regime causes the endogeneity of the tax rate variable in Equation 1. In addition, the mutual spillover effects in FDI into mining sectors between countries creates an endogeneity issue of the spatially lagged dependent variable ($WFDIm_{jt}$). The inclusion of the time-lagged dependent variable ($FDIm_{i,t-1}$) among the explanatory variables creates a dynamic panel data bias (Nickell, 1981) in the estimations, due to potential correlation between omitted variables in the equation and $FDIm_{i,t-1}$.

To address the endogeneity issues in the regressions, we use the bias-corrected Quasi-maximum-likelihood (QML) estimator developed by Yu et al. (2008) for a dynamic model with spatial-fixed effects and extended to the time-fixed effects spatial model by Lee and Yu (2010). The bias-corrected QML estimator is an estimation method that was introduced by Elhorst (2003, 2010) to correct the bias in the maximum likelihood estimator, and for the estimation of dynamic spatial econometric models (Elhorst, 2012). The QML estimator produces consistent estimates for spatial models that have the spatial-lagged dependent variable among the explanatory variables (Lee, 2004). For Stata users, Belotti et al. (2017) have developed the command “xsmle” for estimating spatial dynamic panel-data models using a maximum likelihood estimator.

Vivoda (2011, 2017) summarize the key standard determinants of FDI in the mining sector. These determinants are classified into nine principal categories: geological, political, regulatory, marketing, fiscal, monetary, environmental, social, and operational and profit factors. In the regressions, we therefore control for the variables, which cover almost all the dimensions of the nine categories of factors that could affect foreign investors’ decisions to invest in mining projects in Africa. In addition to the tax rate variable, the control variables include gold and silver reserves, political stability, infrastructure, and nominal exchange rate. The sources of these data are presented in the next section.

4. Data

We build a balanced panel dataset for 16 African countries, over the period 2003–2015, for estimating the impact of mining corporate tax rates on gold and silver FDI inflows. The construction of the dataset was dictated by the availability of data.

We start the construction of the database with data on FDI inflows to the mining sector. We collect data on the amount of FDI inflows to gold and silver projects for selected African economies from FDI markets. The database of FDI flows to gold and silver sectors covers 24 African economies, over the period 2003–2015. The years over which data for the dependent variable (FDI in gold and silver sectors) are available is therefore retained as the time span of the panel dataset. FDI inflows to gold and silver projects from the FDI markets database are expressed in millions of US$. We run regressions with FDI data in percent of gross domestic product (percent GDP). Data on FDI inflows to gold and silver projects in percent GDP are obtained by dividing FDI inflows in millions of US$ by current GDP in millions of US$. Data on current GDP in millions of US$ are extracted from the World Development Indicators (WDI) of the World Bank.

Data on the statutory CIT rates applied to mining companies are extracted from the database on mining taxation in Africa[6] developed by *La Fondation pour les Etudes et Recherches sur le Développement International (FERDI)* (The Foundation for Studies and Research on International Development) (Laporte et al., 2018). FERDI's database on mining taxation provides annual data on CIT rates applied to mining companies, for 21 African countries, over the period 1980–2019.

When we merged data on FDI in gold and silver with data on CITs for mining, we obtained 15 countries for which data on both were available over the period 2003–2015. This means that nine countries, for which we have data on FDI in gold and silver, could not be kept in the dataset under construction because data on CIT rates for mining were not available for these countries from FERDI's database. The total number of observations for the 15 countries, over the period 2003–2015, is 195.

We decided to increase the number of total observations, to strengthen the statistical power of inferences from regressions

[6] The database is available through the following link: https://fiscalite-miniere.ferdi.fr

to obtain efficient and robust estimates. Among the nine countries for which data on gold and silver FDI are available (but which could not be retained in the dataset due to unavailability of data on mining CIT rates), Morocco is the only country for which we found reliable documents and materials which provide information on mining CIT rates over a long period. Moreover, Morocco is the only country for which the standard determinants of FDI inflows to the mining sector (mentioned in Section 3) can be easily collected over long periods on an annual basis. Morocco is also Africa's largest producer of silver. For these reasons, we include Morocco as an additional country in the final dataset. Data on CITs on mining for Morocco are collected from tax authorities of Morocco.[7] Regressions are therefore carried out on a final, balanced, panel dataset for 16 countries over the period 2003–2015.

We use the African Infrastructure Development Index (AIDI) developed by the African Development Bank (AfDB, 2018) to measure access to infrastructure. AIDI is a weighted average of nine indicators of infrastructure articulated around four major components: transport, electricity, information, and communications technology (ICT), and water and sanitation (AfDB, 2018). The index ranges from 0 (low infrastructure development) to 100 (high infrastructure development). The methodology used to compute AIDI is described in greater detail in AfDB (2018). Infrastructures are critical for the development of mining projects. Good transport infrastructure (roads, railways, airports) and reliable sources of energy (electricity) reduce production costs and could stimulate mining investments. We therefore expect the impact of infrastructure on FDI in gold and silver will be positive in our regressions.

[7] http://www.apsf.pro/DOCS/ESPACE%20DOC/FICALITE_mesures-par-objectif-1990-2011.pdf
http://saaidi-consultants.com/resources/tome-2-de-la-circulaire-n-717-commentant-les-dispositions-du-code-general-des-impots/

The nominal exchange rate is included to control for the macroeconomic conditions. Data on the nominal exchange rate (local currency/US$) have been extracted from Penn World Table version 9.0 (Feenstra et al., 2015). A stable exchange rate does not disturb the financial conditions and expectations of the mining company. A depreciation of the nominal exchange rate is therefore expected to negatively affect mining investments.

The endowment of natural resources plays a crucial role in attracting mining investments. In fact, countries that are well endowed with significant mineral deposits are more likely to attract large mining investments because high profitability perspectives are positively correlated to large deposits (Jara, 2017). We control for the impact of resource endowment in the baseline equation. Data on proven gold and silver reserves are collected from the wealth account dataset of the World Bank (Lange et al., 2018). The World Bank's wealth account dataset separately provides reserves data for each mineral, expressed in constant 2014 US dollars. We therefore add data on gold reserves and data on silver reserves to obtain data on gold and silver reserves. We anticipate a positive impact of gold and silver reserves on FDI in gold and mining projects due to high profitability perspectives positively associated with large minerals deposits (Jara, 2017).

Multinational mining companies pay greater attention to government stability for reducing political risks on their investments. In fact, in Africa, changes in government are often followed by attempts to renegotiate the fiscal terms of existing mining contracts, something which causes instability of mineral fiscal regimes and significantly disturbs mining investments.[8] We take onboard these considerations and include in the regressions the number of years the incumbent chief executive is

[8] Recent experience in Mali corroborates this observation. The new transition government that took office in October 2020, after a military coup, announced that it intends to renegotiate all the mining contracts signed over the past decade when the former administration was in office.

in power, as a proxy of government stability. Data on the number of years the chief executive has been in office is extracted from the Database of Political Institutions (Cesi et al., 2018)

Table 1 provides descriptive statistics for all the variables used in this analysis. The average FDI inflows to gold and silver projects are 0.8 percent of GDP, while the average statutory CIT rate applied to mining companies, for our sample of 16 countries, is 28.26 percent, with the lowest rate at 15 percent (applied in Zimbabwe, over the period 2003–2014) and the highest at 40.5 percent (applied in Niger, over the period 2003–2005). On average, for our sample, the top five recipient countries of FDI in their gold and silver sectors, over the observation period, are Burkina Faso, Democratic Republic of the Congo, Ghana, Mali, and Sierra Leone.

Table 1: Descriptive statistics

Variables	Observations	Mean	Std. dev.	Min	Max
Gold and silver FDI inflows (%GDP)	208	0.78	3.23	0.00	38.97
CIT rate mining	208	28.26	6.36	15.00	40.50
Resource tax revenue (%GDP)	208	1.57556	2.3121	0	8.8369
Exchange rate	208	871.88	1,491.80	0.87	7,485.52
Control of corruption	208	-0.7007	0.4623	-1.5252	0.5681
Government stability	208	7.8028	6.5256	1.00	28.00
Infrastructures	208	15.74	14.04	2.23	78.97

Manufacturing sector value-added (%GDP)	208	12.32	5.46	1.58	26.89
Log (gold and silver reserves)	208	20.77	3.43	2.29	25.32

Figure 1 displays the statutory CIT rate applied to mining companies, for each country in 2003 and 2015. The CIT rate applied to mining companies in 2015 is lower than its value in 2003 for all the countries in the sample except for Democratic Republic of the Congo, Kenya, Mauritania, Morocco, Nigeria, and Tanzania, where the mining CIT rate is the same for the years 2003 and 2015. More precisely, Côte d'Ivoire, Niger, and Mali are the countries that have cut their mining CIT rate the most, by around 10 percentage points from the year 2003 to 2015.

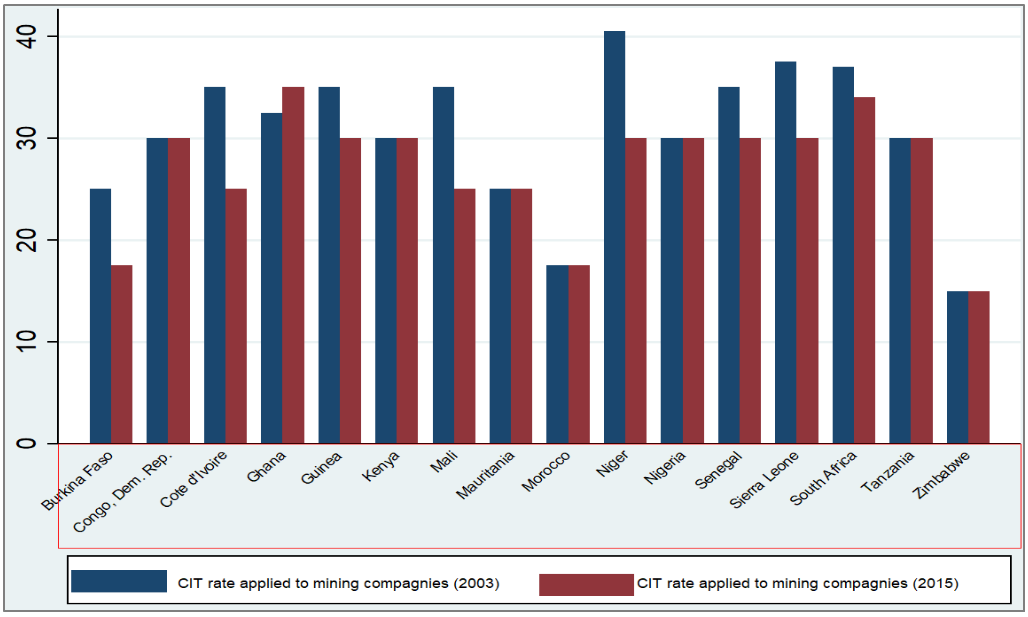
The fact that Mali and Burkina Faso, two of the three countries that have experienced the largest cuts in their mining CIT rates, are also among the top five recipients of FDI inflows to their gold and silver sectors, may suggest a positive correlation between cuts in mining CIT rates and gold and silver FDI inflows. This positive correlation between reductions in mining CIT rates and gold and silver FDI inflows is confirmed in Figure 2. Although the trend in FDI into gold and silver projects is decreasing for the sample of countries under observation, these countries experienced higher levels of gold and silver FDI inflows at the beginning of the super cycle of commodities[9] in 2000 as compared with the level of gold and silver FDI inflows after the global recession in 2008 (Figure 2). The decline in gold and silver FDI inflows from 2003–2015, a period during which CIT rates applied to mining companies were also declining, shows

[9] the commodity super cycle is a period of high demand and prices for commodities in the world market (Ballón et al., 2017)

the possible insignificance of the impact of mining CIT reductions on FDI inflows.

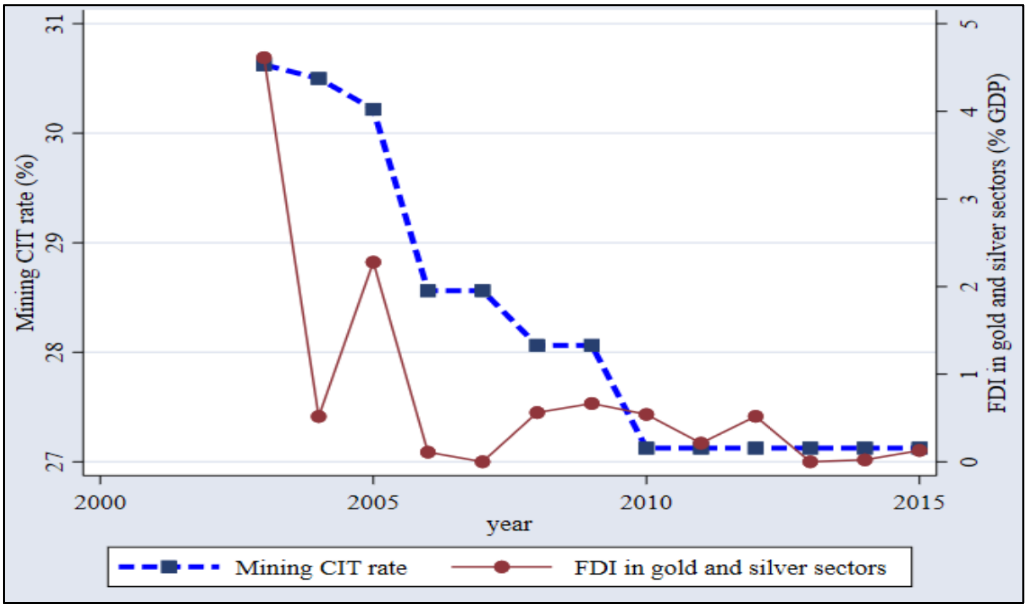
The relationship observed from the graphical analysis could be biased by econometric problems because the influence of other factors that may affect the tax policy and FDI nexus is ignored by the graphical analysis. We therefore undertake an econometric analysis to further explore the impact of CIT rates applied to mining on FDI into gold and silver sectors. The results from the econometric analysis are presented in the next section.

Figure 1: Corporate income tax rates applied to mining companies in Africa



Source: Authors' calculations using FERDI's database and tax authorities of Morocco.

Figure 2: FDI inflows to gold and silver sectors and CIT rates applied to mining companies



Source: Authors' calculations from FERDI's database, tax administration websites, and FDI markets.

5. Results

This section presents the main findings from the regressions and then analyzes the robustness of these findings. Before discussing the estimation results, we present the results from the specification tests carried out for corroborating the choice of the DSDM with fixed effects to estimate the impact of mining CIT rates on FDI inflows to gold and silver sectors. We first estimate a non-spatial panel fixed-effects model with the ordinary least square (OLS) estimator with Driscoll-Kraay standard errors (Table 2, column 1). Then, we run the Moran I test on the residual from that OLS estimation to test for the presence of spatial autocorrelation in the data. The test rejects the null hypothesis of no spatial autocorrelation at the 5 percent threshold (Moran's I test Statistic = 0.2952; P-value=0.025) suggesting that there is a need to extend the non-spatial model with spatial interaction effects. Since the Moran

I test does not tell us the functional form of the spatial interaction effects, we test the appropriateness of the dynamic spatial autoregressive (DSAR) model and the spatial error model (SEM) for estimating the impact of mining CIT rates on gold and silver FDI inflows against the DSDM. LeSage and Pace (2009) reveal that the DSDM specification is reduced to DSAR specification if the coefficients of the spatially lagged independent variables are null. Accordingly, for evaluating the suitability of the DSDM against the DSAR, we test the joint nullity of the coefficients of the spatially lagged independent variables ($\beta 2 = \theta 2 = 0$, see Equation (1)). The test rejects the null hypothesis and thereby rejects the DSAR specification at the 1 percent level ($\chi 2$ (5) = 301.59). The SEM is also reduced to the DSDM if $\rho\beta 1 + \beta 2 = 0$ and $\rho\theta 1 + \theta 2 = 0$ in Equation (1) (Burridge, 1981). The null hypothesis that $\rho\beta 1 + \beta 2 = 0$ and $\rho\theta 1 + \theta 2 = 0$ (χ (5) = 352.38, Prob > $\chi 2$ = 0.00) is rejected at the 1 percent level, indicating that the DSDM is more appropriate than the SEM. Since the above two likelihood ratio tests confirm the appropriateness of the DSDM over the SEM and DSAR specifications, we use the Hausman test to finally discriminate between the fixed-effects and the random-effects DSDM. The result of the Hausman test (χ (11) = 472.78, Prob > $\chi 2$ = 0.0000) leads to the rejection of the null hypothesis of independence between the unobserved country fixed effects and the independent variables suggesting that a fixed-effects DSDM is preferable to a random-effects DSDM for this study.

5.1. Main results

Table 2 reports the results of the estimation of the impact of mining CIT rates on gold and silver FDI. In column 1, we ignore the spatial spillover effects in FDI and CIT between countries by estimating a non-spatial model. We find that the impact of the CIT rate is positive but not significant at the conventional level of significance (Table 2, column 1). However, the estimation results reported in column 1 are biased because of the omission of the spatial variables in the regression. Yet, these variables are relevant as developed in Section 3 and corroborated by the Moran’s I test and the spatial models’ specification tests (Lagrange Multiplier tests) we ran. The omitted variable bias problem is addressed in the baseline specification by accounting for the impact of the spatially lagged variables through the estimation of a dynamic spatial Durbin model (DSDM).

The results from the estimation of the baseline fixed-effects DSDM specification (Equation 1) show that the spatial interaction term (rho) is positive and statistically significant at the 1 percent significance level (Table 2, column 2). This result suggests that an increase in FDI inflows to gold and silver sectors in a host country may stimulate FDI inflows to gold and silver sector of its neighbors in Africa. The development pattern of the Canadian multinational mining company Endeavour Mining around the West African Birimian Greenstone Belt corroborates this empirical result. The Birimian Greenstone Belt across Burkina Faso, Côte d’Ivoire, Guinea, and Mali is highly prospective. Endeavour Mining has taken advantage of its presence in Côte d'Ivoire to expand over Burkina Faso and Mali for optimizing the exploitation of the geological potential of the region after a sound mastery of the investment climate and the commercial reserves of the gold deposit belt that spills over the three neighboring countries. Moreover, we find that past values of FDI to gold and silver projects positively affect current levels of FDI inflows to gold and silver sectors (Table 2, column 2). This result indicates that previous experiences from FDI in gold and silver projects matter for attracting FDI inflows to gold and silver sectors. The expansion of Endeavour Mining operations in Côte d’Ivoire illustrates this result. In fact, the good collaboration between Ivorian national authorities and Endeavour Mining, coupled with the profitability of the company’s first mining project in Côte d’Ivoire (the Ity project located in west Cote d'Ivoire, production started in 1991), have encouraged Endeavour Mining to expand that Ity project in 2019 with additional investments. Moreover, Endeavour Mining later invested in another mining project (Agbaou project) located in south Cote d'Ivoire (production started in 2014).

The direct and indirect impacts of mining CIT rates on gold and silver FDI inflows are reported in the results tables. The direct impact of CIT rates applied to mining corresponds to the impact of a change in the CIT rate applied to mining in country i on gold and silver FDI for that country i. The indirect impact refers to the impact of a change of the CIT rate applied to mining companies in country i on gold and silver FDI inflows in the other countries j, except country i (LeSage and Pace, 2009).

The direct impact of mining CIT rates on FDI inflows to gold and silver sectors is negative but not statistically significant at the conventional levels of significance in the short run and long run[10] (Table 2, columns 4 and 7). These results provide indications that a generous mining tax regime will not necessarily attract mining investments. Our results are aligned with those of Saidu (2007), who finds that an attractive tax regime for mining companies will not necessarily translate into more FDI inflows to the mining sector. The absence of a statistically significant impact of mining CIT on gold and silver FDI could be explained by the fact that basically, mining investors will not take into consideration mining fiscal regimes and incentives that are "too good to be true" for deciding the destination country of their mining investment (IGF and OECD, 2018). The tax arrangements are an element of a broader set of tools for decision making, and, clearly, a mining company would be rigorously unlikely to make an investment where profitability

[10]Short-term effects are the partial derivatives of FDI, with respect to an independent variable, while ignoring δ in equation (1). Long-term effects are partial derivatives of FDI, with respect to an independent variable, while considering constant the share of FDI in %GDP in all countries $FDI_{i,t-1} = FDI_{i,t} = FDI*$ and $W.FDI_{i,t} = W.FDI*$ (Boly et al., 2020; Elhorst, 2014, p. 106).

depends on preferential tax treatment promised by a government (IGF and OECD, 2018). Furthermore, mining investors may prefer diversifying their investment locations to reduce the operational risks from dependence on a single host country, regardless of the preferential tax treatment offered by that host country.

For the control variables, the results show that infrastructures, political stability, and gold and silver reserves have positive and significant impacts on FDI inflows to gold and silver sectors (Table 2, columns 4 and 7). These results suggest that structural and institutional factors that positively affect investment profitability as well as the geological potential (resource endowment) and the availability of geological information are crucial for attracting mining investments.

Table 2: Impact of corporate tax rates applied to mining companies and FDI in gold and silver sectors: Baseline results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Gold and silver FDI inflows (%GDP)	Non-Spatial model	Estimates		Short-run marginal effects			Long-run marginal effects		
		Main	WX	Direct	Indirect	Total	Direct	Indirect	Total
L.(gold and silver FDI inflows)	0.0275***	0.0448***							
	(0.0081)	(0.0138)							
CIT rate mining	0.0073	-0.0299	0.2044	-0.0360	0.1804	0.1444	-0.0380	0.1877	0.1498
	(0.0146)	(0.0257)	(0.1737)	(0.0231)	(0.1357)	(0.1539)	(0.0241)	(0.1409)	(0.1598)
Infrastructure	-0.0171**	0.0399**	0.0526	0.0407***	0.0444	0.0851	0.0426***	0.0458	0.0884
	(0.0057)	(0.0157)	(0.1395)	(0.0123)	(0.1118)	(0.1222)	(0.0128)	(0.1162)	(0.1269)
Government stability	0.0282**	0.0183*	0.1022***	0.0149*	0.0736***	0.0886***	0.0155*	0.0760***	0.0916***
	(0.0126)	(0.0096)	(0.0368)	(0.0080)	(0.0224)	(0.0270)	(0.0083)	(0.0230)	(0.0278)
Exchange rate	-0.0001	0.0000	0.0021***	0.0001	0.0018	0.0020	0.0001	0.0019	0.0020
	(7.79e-05)	(0.0001)	(0.0005)	(0.0307)	(0.0063)	(0.0250)	(0.0321)	(0.0070)	(0.0259)
Log (gold and silver reserves)	0.0374***	0.1624***	0.8616***	0.1391***	0.6237***	0.7628***	0.1447***	0.6446***	0.7893***
	(0.0076)	(0.0182)	(0.1067)	(0.0167)	(0.1020)	(0.1171)	(0.0175)	(0.1072)	(0.1229)
rho		0.3635***							
		(0.1319)							
sigma2_e		1.3490***							
		(0.3937)							
Observations	192	192	192	192	192	192	192	192	192
Number of countries	16	16	16	16	16	16	16	16	16
Log likelihood		-740.2	-740.2	-740.2	-740.2	-740.2	-740.2	-740.2	-740.2

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

Notes: CIT rate mining: corporate income tax rate applied to mining companies. Sigma2_e is the standard deviation of idiosyncratic errors; rho is the coefficient of the spatial-lagged-dependent variable.

5.2. Robustness analysis

Considering the qualifications of domestic mining suppliers and local content

Given that the mining sector may source some of its intermediate input requirements from domestic suppliers of goods and services, as part of national local-content policy requirements, the mining sector is likely to be linked with the manufacturing sector (backward linkages). The manufacturing sector provides goods to the mining sector, including machinery and equipment, transport equipment, wood products, fabricated metal products, non-metallic minerals (cement, bricks), chemicals, and petroleum products. We therefore include the manufacturing sector's value-added to take into account that the performance of the manufacturing sector may influence the choice of location for mining investments. Data on manufacturing value-added, as a percentage of GDP, are taken from the World Development Indicators (WDI) database of the the World Bank.

The main results of this paper remain unchanged when the impact of manufacturing value-added is controlled in the regression. The direct impact of mining CIT rates on gold and silver FDI inflows is negative and statistically insignificant (Table 3, columns 3 and 6). As expected, the impact of manufacturing value-added on FDI in the gold and silver mining sectors is positive and statistically significant at 5 percent (Table 3, columns 3 and 6), suggesting that the existence of a well-developed domestic mining suppliers' network/market may stimulate foreign investments in mining sectors.

Considering the potential impact of corruption on mining FDI

We control for the impact of corruption on mining FDI in the baseline specification, to test whether corruption in the host country influences investment decisions in mining projects (Kolstad and Wiig, 2013). The index for control of corruption from the World Governance Indicators (Kraay et al., 2010) is used as the corruption indicator. The index measures the perception of corruption, and it ranges from -2.5 to 2.5, with higher values indicating a better control of corruption in the host country. While the main findings of this paper remain qualitatively stable when the control of corruption index is included in the baseline equation, we find that corruption does not have a statistically significant impact on gold and silver FDI inflows (Table 4, columns 3 and 6). A similar result is found in Canare (2017), which concludes that there is not a significant relationship between corruption and FDI inflows for low- and middle-income countries. He explains this result by the fact that, given low-income countries are perceived as mostly corrupt, investors select other institutional indicators, instead of corruption, to determine the locations of their investments among low- and middle-income countries. We borrow this explanation from Canare (2017) for our estimation result, indicating the absence of a significant impact of corruption on gold and silver FDI in Africa. In fact, although the quality of institutions is important for choosing investment locations, mining investors examine different indicators of institutional environments for investment in African countries. For foreign mining investors, government stability tends to be a more important factor than corruption in discriminating between African countries for mining investments. The estimation results support this observation because the impact of corruption on FDI in gold and silver sectors is not significant, whereas government stability has a positive and significant impact on gold and silver FDI inflows (Table 2, columns 4 and 7; Tables 3 and 4 , columns 3 and 6). This preference for political stability over corruption for deciding which African country to invest in, could be explained by the fact that investors focus more on unpredictable factors like institutional stability than corruption, which is somewhat predictable in African countries.

This consideration may explain the absence of statistically significant impacts of corruption on FDI inflows to gold and silver sectors.

Controlling the impact of other fiscal instruments applied to mining companies

For making investment decisions, mining companies will consider not only corporate tax burden but also the overall tax burden of all other taxes payable by mining companies (extraordinary taxes on income, profits and capital gains, environmental taxes, property taxes, royalties). Furthermore, from a neutral tax reform perspective, policymakers may make significant adjustments to other fiscal instruments as well as to the CIT base, to compensate for changes in CIT rates applied to mining companies. We take these considerations into account by including resource tax revenue among the explanatory variables in the baseline equation. The variable resource tax, as a percent of GDP, is extracted from the ICTD-GRD database (UNU-WIDER Government Revenue Dataset, 2020).[11] The inclusion of resource tax revenue among the control variables does not change the main result of this paper. The estimation results confirm the absence of evidence of a direct impact of CIT rates applied to mining companies on FDI inflows to gold and silver sectors (Table 5). We find that resource tax revenue does not have a significant impact on FDI in gold and silver projects (Table 5, columns 3 and 6).

Alternative weighting matrix: Geology and production costs

Beyond geographical proximity, countries with the same level of minerals reserves and similar production conditions may be more competitive with each other for attracting mining investments.

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11 Since spatial econometric models cannot be run with a variable containing missing values, we replace the missing values for the variable resource tax revenue with 30 percent of the value of total tax revenue, as a proportion of GDP, because, on average, resource revenue accounts for 30–40 percent of government revenue for resource-rich countries in Africa (UNECA, 2018, p.8 and p.78).

Accordingly, the mineral rents[12] difference reflects the similarity of mineral endowments and production costs, as determined by the quality of infrastructure and human capital, and the geological and financial information collection costs. For example, the most gold-rich countries of sub-Saharan Africa (Ghana, Mali, and South Africa) are more likely to engage in competition with each another, to attract FDI, than with less-gold-rich countries, such as Kenya, Mauritania, and Niger. In summation, countries are linked one to another, but the intensity of connectivity is stronger between countries with similar levels of mineral rents.

The elements of the mineral rents weighting matrix are based on the absolute difference in mineral rents (Rent) between countries i and j. The inverse of the absolute difference is taken such that the weighting matrix attributes a higher weight to countries that have a smaller absolute difference in mineral rents. Algebraically, an element w_{ij} of the rent difference weighting matrix is given as follows:

$$w_{ij} = \begin{cases} \dfrac{(|Rent_i - Rent_j|)^{-1}}{\sum_j (|Rent_i - Rent_j|)^{-1}}, & for\ i \neq j \\ 0, & for\ i = j \end{cases}$$

The main estimation results obtained with the geographic distance weighting matrix remain unchanged when differences in mineral rents between countries are alternatively used as the weighting matrix for estimating the baseline specification (Table 6). The results show that a reduction in CIT rates applied to mining companies does not have a statistically significant impact on FDI inflows to gold and silver sectors for the host country (Table 6, columns 3 and 6). However, the estimation results show that the impact of cuts in the host country on the other countries’ gold and silver FDI inflows (indirect effects)

12 Mineral rents correspond to the difference between the revenue obtained from the sales of gold and silver produced and the costs incurred to produce these minerals.

turns statistically significant in the short run and in the long run (Table 6, columns 4 and 7). These results provide indications that a too-generous mining tax regime will not necessarily attract investments to the mining sector, but it is likely to divert mining investments from the host country to other countries. The mining FDI inflow diversion effects could be explained by the desire of mining investors to diversify their investment locations to reduce the risks of a greater dependence on one host country, although that host country offers a preferential tax treatment for mining investments.

6. Conclusion

This paper contributes to the larger literature on tax policy and FDI by estimating the impact of CIT rates applied to mining companies on FDI inflows to the gold and silver sectors of African economies. In the tradition of Blonigen et al. (2007), and following Boly et al. (2020), we specify a dynamic spatial Durbin model with fixed effects for estimating the impact of mining CIT rates on gold and silver FDI inflows. This spatial econometric model considers previous experiences from foreign investments in mining sectors and interactions in mining FDI as well as interactions in corporate tax policy for mining activities between countries.

We find no statistically significant impact of mining CIT rates on the host country’s gold and silver FDI inflows. When differences in resource rents between countries is used as a connectivity matrix, we find preliminary evidence that an increase in CIT rates is likely to increase FDI inflows to neighboring countries, whereas it has no significant impact on the host country’s gold and silver FDI inflows. These results suggest an attractive mining tax treatment will not necessarily attract investments to mining sectors because investors may diversify their mining investments away from one location, to minimize operational risks, regardless of preferential tax treatments offered by a host country.

Moreover, the estimation results show that infrastructure, political stability, and manufacturing value-added positively affect FDI in gold and silver sectors. These results urge policymakers to act toward creating an enabling investment environment, instead of cutting corporate tax rates in the hopes of attracting mining investments. Furthermore, we find that past values of FDI in gold and silver projects positively affect the current level of FDI in gold and silver projects, suggesting that a country’s history in mining operations is likely to stimulate mining investments. From a policy perspective, this result suggests that governments should make all possible arrangements to avoid a dispute or conflict with mining companies operating in their country, such that bad experiences from previous investments in the sector do not constitute an obstacle for attracting mining investments.

References

Abbas, S. A., and Klemm, A. (2013). A partial race to the bottom: Corporate tax developments in emerging and developing economies. *International Tax and Public Finance*, *20*(4): 596–617.

AfDB (2018). The Africa Infrastructure Development Index 2018. African Development Bank, Statistics Department. https://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/Economic_Brief_-_The_Africa_Infrastructure_Development_Index.pdf.

Ali Nakyea, A., and Amoh, J. K. (2018). Have the generous tax incentives in the natural resource sector been commensurate with FDI flows?: A critical analysis from an emerging economy. *International Journal of Critical Accounting,* 10(3/4): 257–273.

Babatunde, S. A., and Adepeju, S. (2012). The impact of tax incentives on foreign direct investment in the oil and gas sector in Nigeria. IOSR Journal of Business and Management, 6(1): 1–15.

Ballón, E., Molina, R., Viale, C., & Monge, C. (2017). Mining and Institutional Frameworks in the Andean Region. *The Super Cycle and Its Legacy, or the Difficult Relationships Between Policies to Promote Mining and Hydrocarbon Investment and Institutional Reforms in the Andean Region*.

Belotti, F., Hughes, G., and Mortari, A. P. (2017). Spatial panel-data models using Stata. The Stata Journal, 17(1): 139–180.

Bird, R. M. (1993). Threading the fiscal labyrinth: Some issues in fiscal decentralization. National Tax Journal, [[volume and issue numbers?]]: 207–227.

Blonigen, B. A., Davies, R. B., Waddell, G. R., and Naughton, H. T. (2007). FDI in space: Spatial autoregressive relationships in foreign direct investment. European

Economic Review, 51(5): 1303–1325. https://doi.org/10.1016/j.euroecorev.2006.08.006

Boly, A., Coulibaly, S., and Kéré, E. N. (2020). Tax Policy, Foreign Direct Investment and Spillover Effects in Africa. *Journal of African Economies*, 29(3): 306–331.

Bond, S., Chennells, L., Devereux, M. P., Gammie, M., and Troup, E. (2000). *Corporate tax harmonisation in Europe: A guide to the debate*. IFS Report.

Bouterige, Y., de Quatrebarbes, C., and Laporte, B. (2019). La fiscalité minière en Afrique, quelle évolution récente en 2018. *Revue de droit fiscal*.

Brady, R.R. (2011). Measuring the diffusion of housing prices across space and over time. *Journal of Applied Econometrics* 26(2): 213–231.

Burridge, P. (1981). Testing for a common factor in a spatial autoregression model. *Environment and Planning A, 13*(7): 795–800.

Canare, T. (2017). The effect of corruption on foreign direct investment inflows: Evidence from a panel of Asia-Pacific countries, in *The changing face of corruption in the Asia Pacific,* pp. 35–55 (Elsevier).

Cesi, C., Keefer, P., and Scartascini, C. (2018). Database of Political Institutions 2017 (DPI2017). *Inter-American Development Bank. Numbers for Development*, 29.

Cleeve, E. (2008). How effective are fiscal incentives to attract FDI to Sub-Saharan Africa? *The Journal of Developing Areas*, 42(1): 135–153.

Easson, A., and Zolt, E. M. (2002). *Tax incentives*. World Bank Instutute (Washington, DC: World Bank).

Elhorst, J.P. (2003). Specification and estimation of spatial panel data models. *International Regional Science Review* 26(3): 244–268.

———. (2010). Spatial panel data models, in *Handbook of Applied Spatial Analysis*, pp. 377–407.

———. (2012). Dynamic spatial panels: Models, methods, and inferences. *Journal of Geographical Systems*, 14(1): 5–28.

Feenstra, R. C., Inklaar, R., and Timmer, M. P. (2015). The next generation of the Penn World Table. *American Economic Review*, 105(10): 3150–3182.

Franzese Jr, R.J. and Hays, J.C. (2007). Spatial econometric models of cross-sectional interdependence in political science panel and time-series-cross-section data. *Political Analysis* 15(2): 140–164.

Hanusch, M., Aguilar, J., Hund, K. L., Bogoev, J., Baskaran, G. C., and Hayman, J. J. (2019). *Digging Beneath the Surface: An Exploration of the Net Benefits of Mining in Southern Africa* (Washington, DC: World Bank).

Hassett, K. A., and Hubbard, R. G. (2002). Tax policy and business investment, in *Handbook of public economics*, Vol. 3: 1293–1343 (Elsevier).

Holland, D., and Vann, R. J. (1998). *Tax Law Design and Drafting*. 2nd Volume (Washington, DC: International Monetary Fund).

Hsiao, C. (2007). Panel data analysis—Advantages and challenges. *Test*, 16(1): 1–22.

IGF (Intergovernmental Forum on Mining, Metals and Sustainable Development) (2019). *Insights on Incentives: Tax Competition in Mining*.

IGF and OECD. (2018). The hidden cost of tax incentives on mining: Public comments. Retrieved from https://www.oecd.org/tax/beps/hidden-cost-of-taxincentives-in-mining-oecd-igf-public comments.pdf.

IMF. (2014). Spillovers in international corporate taxation. *Policy Papers, 14*.

Jacobs, J.P., Ligthart, J.E., and Vrijburg, H. (2009). *Dynamic Panel Data Models Featuring Endogenous Interaction and Spatially Correlated Errors*.

Jara, J. J. (2017). Determinants of country competitiveness in attracting mining investments: An empirical analysis.

Resources Policy, *52*: 65–71. https://doi.org/10.1016/j.resourpol.2017.01.016

Kinda, T. (2018). The quest for non-resource-based FDI: Do taxes matter? *Macroeconomics and Finance in Emerging Market Economies*, 11(1): 1–18.

Kolstad, I., and Wiig, A. (2013). Digging in the dirt? Extractive industry FDI and corruption. *Economics of Governance*, 14(4): 369–383.

Kraay, A., Kaufmann, D., and Mastruzzi, M. (2010). *The worldwide governance indicators: Methodology and analytical issues* (Washington, DC: World Bank).

Kukenova, M. and Monteiro, J.-A. (2009). Spatial Dynamic Panel Model and System GMM: A Monte Carlo Investigation *(MPRA (*Munich Personal RePEc Archive) *Paper*).

Lange, G.-M., Wodon, Q., and Carey, K. (2018). *The changing wealth of nations 2018: Building a sustainable future* (Washington, DC: World Bank).

Laporte, B., De Quatrebarbes, C., and Bouterige, Y. (2018). *Une base de données sur la fiscalité minière dans les pays africains*.

Lee, L. and Yu, J. (2010). Estimation of spatial autoregressive panel data models with fixed effects. *Journal of Econometrics*, 154(2): 165–185.

Lee, L.-F. (2004). Asymptotic distributions of quasi-maximum likelihood estimators for spatial autoregressive models. *Econometrica*, 72(6): 1899–1925.

LeSage, J., and Pace, R. K. (2009). *Introduction to spatial econometrics*. Chapman and Hall/CRC.

Lin, W.-Y., and Wang, J.-C. (2014). Do the changes in tax incentives encourage direct investment in China by Taiwanese enterprises? *Journal of Accounting and Taxation*, 6(2): 38.

Morisset, J. (1999). *Foreign direct investment in Africa: Policies also matter* (Washington, DC: World Bank).

N'guessan, E. K. and Esse, B. (2017). Yaoure Gold Mine Project: Narrative report. Open Oil. Retrieved from http://openoil.net/wp/wp content/uploads/2016/12/oo_ci_yaoure_narrative_v1.0_20170727_iv_2014_Reals.pd

Nickell, S. (1981). Biases in dynamic models with fixed effects. *Econometrica: Journal of the Econometric Society*, 49(6): 1417–1426.

Oates, W. E. (1972). Fiscal Federalism (Harcourt Brace Jovanovich). *New York*, *35*.

Obeng, C. K. (2014). *Effect of corporate tax on sector specific foreign direct investment in Ghana*.

OECD (2008) Tax Effects on Foreign Direct Investment, Policy Brief, Organisation for Economic Cooperation and Development. February.

Owens, J. (2004). Competition for FDI and the role of taxation: The experience of South Eastern European countries. *Centre for Tax Policy and Administration-OECD*.

Saidu, B. (2007). How taxes, royalties, and fiscal regime stability affect mining investment: A comparison of Niger and Indonesia. *The Journal of Structured Finance*, 13(3): 105–111.

Singh, H., and Jun, K. W. (1999). *Some new evidence on determinants of foreign direct investment in developing countries* (Washington, DC: World Bank).

Tavares-Lehmann, A. T., Coelho, Â., and Lehmann, F. (2012). Taxes and foreign direct investment attraction: A literature review. *New Policy Challenges for European Multinationals: Progress in International Business Research*, *7*: 89–117.

UNCTAD (1999). *Foreign Direct Investment in Africa: Performance and Potential* (New York and Geneva: United Nations), United Nations publication, UNCTAD/ITE/IIT/Misc. 15.

UNECA (2018). Natural Resource Governance and Domestic Revenue Mobilization for Structural Transformation. African

Governance Report (V). Economic Commission for Africa, Addis Ababa, Ethiopia.

UNU-WIDER Government Revenue Dataset, 2020, https://www.wider.unu.edu/project/government-revenue-dataset

Van Blerck, M. C. (1994). Mining and the environment: Tax incentives encourage orderly planning. *Journal of the Southern African Institute of Mining and Metallurgy*, *94*(6), 129-132.

Van Parys, S., and James, S. (2010). The effectiveness of tax incentives in attracting FDI: Evidence from the tourism sector in the Caribbean. *Universiteit Gent: Working*.

Vivoda, V. (2011). Determinants of foreign direct investment in the mining sector in Asia: A comparison between China and India. *Resources Policy*, 36(1): 49–59. https://ideas.repec.org/a/eee/jrpoli/v36y2011i1p49–59.html

Vivoda, V. (2017). Determinants of foreign direct investment in the mining industry. In T. O’Callaghan and G. Graetz (Eds.), *Mining in the Asia-Pacific: Risks, Challenges and Opportunities*, pp. 19–33 (Springer International Publishing). https://doi.org/10.1007/978-3-319-61395-6_2

Wilson, J. D. (1999). Theories of tax competition. *National Tax Journal*,52(2): 269–304.

World Bank (2005) *Towards a New Agenda for Growth: Organization of Eastern Caribbean States, Report No. 31863-LAC*.Washington, DC: World Bank.

Yu, J., De Jong, R., and Lee, L. (2008). Quasi-maximum likelihood estimators for spatial dynamic panel data with fixed effects when both n and t are large. *Journal of Econometrics*, 146(1): 118–134.

Zee, H. H., Stotsky, J. G., and Ley, E. (2002). Tax incentives for business investment: A primer for policy makers in developing countries. *World Development*, 30(9): 1497–1516.

Annex

List of countries

Burkina Faso, Côte d'Ivoire, Democratic Republic of the Congo, Ghana, Guinea, Kenya, Mali, Mauritania, Morocco, Niger, Nigeria, Senegal, Sierra Leone, South Sudan, Tanzania, Zimbabwe.

Table 3: Impact of tax policy on mining foreign investments: Controlling for the impact of manufacturing value-added

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Gold and silver FDI inflows (%GDP)	Estimates		Short-run marginal effects			Long-run marginal effects		
	Main	WX	Direct	Indirect	Total	Direct	Indirect	Tot

L. (Gold and silver FDI inflows)	0.0487**							
	(0.0205)							
CIT rate mining	-0.0361	0.1515	-0.0412	0.1409	0.0996	-0.0436	0.1474	0.1
	(0.0338)	(0.1893)	(0.0309)	(0.1383)	(0.1605)	(0.0325)	(0.1440)	(0.
Infrastructure	0.0304*	-0.0332	0.0345***	-0.0103	0.0242	0.0364***	-0.0106	0.0
	(0.0172)	(0.1683)	(0.0128)	(0.1324)	(0.1419)	(0.0134)	(0.1381)	(0.
Government stability	0.0232**	0.1373***	0.0184**	0.0949***	0.1133***	0.0192*	0.0982***	0.1
	(0.0113)	(0.0463)	(0.0094)	(0.0246)	(0.0310)	(0.0098)	(0.0253)	(0.
Exchange rate	0.0000	0.0024***	-0.0000	0.0026	0.0026	-0.0000	0.0027	0.0
	(0.0001)	(0.0006)	(0.0021)	(0.0229)	(0.0221)	(0.0023)	(0.0238)	(0.
Log (gold and silver reserves	0.1339***	0.7607***	0.1136***	0.5509***	0.6645***	0.1185***	0.5711***	0.6
	(0.0301)	(0.1499)	(0.0290)	(0.1379)	(0.1643)	(0.0305)	(0.1452)	(0.
Log (manufacturing)	1.1202**	4.2248***	0.9816**	2.8538***	3.8353***	1.0275**	2.9511***	3.9
	(0.4469)	(1.4129)	(0.4059)	(1.0712)	(1.3562)	(0.4251)	(1.1175)	(1.
rho	0.3940**							
	(0.1719)							
sigma2_e	1.3211***							
	(0.4456)							
Observations	192	192	192	192	192	192	192	192
Number of countries	16	16	16	16	16	16	16	16
Log likelihood	-586.2	-586.2	-586.2	-586.2	-586.2	-586.2	-586.2	-58

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

Notes: CIT rate mining: corporate income tax rate applied to mining companies. Sigma2_e is the standard deviation of idiosyncratic errors; rho is the coefficient of the spatial-lagged-dependent variable.

Table 4: Tax policy and FDI in gold and silver sectors: Controlling for the impact of corruption

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Gold and silver FDI inflows (%GDP)	Estimates		Short-run marginal effects			Long-run marginal effects		
	Main	WX	Direct	Indirect	Total	Direct	Indirect	Total
L.(gold and silver FDI inflows)	0.0462***							

	(0.0138)							
CIT rate mining	-0.0317	0.1808	-0.0370	0.1626	0.1256	-0.0391	0.1696	0.1306
	(0.0266)	(0.2075)	(0.0234)	(0.1549)	(0.1727)	(0.0244)	(0.1610)	(0.1795
Infrastructure	0.0379*	0.0259	0.0398**	0.0308	0.0705	0.0418**	0.0319	0.0736
	(0.0210)	(0.1689)	(0.0168)	(0.1324)	(0.1467)	(0.0174)	(0.1377)	(0.1526
Government stability	0.0187**	0.0892**	0.0158**	0.0627**	0.0785***	0.0165**	0.0648**	0.0813*
	(0.0088)	(0.0374)	(0.0074)	(0.0245)	(0.0281)	(0.0077)	(0.0253)	(0.0290
Exchange rate	0.0000	0.0020***	0.0008	0.0012	0.0020	0.0008	0.0012	0.0020
	(0.0001)	(0.0004)	(0.0236)	(0.0297)	(0.0366)	(0.0248)	(0.0309)	(0.0379
Log (gold and silver reserves	0.1622***	0.8475***	0.1398***	0.6153***	0.7551***	0.1457***	0.6368***	0.7825*
	(0.0256)	(0.1399)	(0.0253)	(0.1320)	(0.1561)	(0.0265)	(0.1385)	(0.1639
Control of corruption	0.0209	-1.3766	0.0739	-0.9645	-0.8906	0.0792	-0.9991	-0.9199
	(0.4463)	(1.0902)	(0.3985)	(0.6811)	(1.0245)	(0.4168)	(0.7027)	(1.0605
rho	0.3631**							
	(0.1412)							
sigma2_e	1.3483***							
	(0.4122)							
Observations	192	192	192	192	192	192	192	192
Number of countries	16	16	16	16	16	16	16	16
Log likelihood	-717.9	-717.9	-717.9	-717.9	-717.9	-717.9	-717.9	-717.9

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

Notes: CIT rate mining: corporate income tax rate applied to mining companies. Sigma2_e is the standard deviation of idiosyncratic errors; rho is the coefficient of the spatial-lagged-dependent variable.

Table 5: Tax policy and FDI in gold and silver sectors: Controlling for the impact of resource tax revenue

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Gold and silver FDI inflows (%GDP)	Estimates		Short-run marginal effects			Long-run marginal effect		
	Main	WX	Direct	Indirect	Total	Direct	Indirect	To
L. (gold and silver FDI inflows)	0.0406**							
	(0.0168)							

CIT rate mining	-0.0142	0.2349	-0.0214	0.1941	0.1727	-0.0225	0.2011	0.
	(0.0418)	(0.2265)	(0.0389)	(0.1674)	(0.1988)	(0.0405)	(0.1731)	(0
Infrastructure	0.0388**	0.0136	0.0413**	0.0203	0.0616	0.0432**	0.0209	0.
	(0.0179)	(0.1492)	(0.0189)	(0.1202)	(0.1307)	(0.0196)	(0.1246)	(0
Government stability	0.0162*	0.1023**	0.0120	0.0751*	0.0871**	0.0124	0.0774*	0.
	(0.0096)	(0.0520)	(0.0242)	(0.0397)	(0.0437)	(0.0252)	(0.0410)	(0
Exchange rate	0.0001	0.0030**	0.0001	0.0027	0.0028	0.0001	0.0028	0.
	(0.0001)	(0.0015)	(0.0304)	(0.0095)	(0.0216)	(0.0317)	(0.0102)	(0
Log (gold and silver reserves)	0.1798***	1.0062***	0.1522***	0.7316***	0.8838***	0.1577***	0.7542***	0.
	(0.0308)	(0.2021)	(0.0299)	(0.2003)	(0.2264)	(0.0311)	(0.2092)	(0
Resource tax revenue	-0.2386	-1.8703**	-0.1986	-1.4603*	-1.6589*	-0.2053	-1.5085*	-1
	(0.1905)	(0.9184)	(0.1784)	(0.7899)	(0.9637)	(0.1858)	(0.8206)	(1
rho	0.3736**							
	(0.1623)							
sigma2_e	1.3186***							
	(0.4094)							
Observations	192	192	192	192	192	192	192	19
Number of countries	16	16	16	16	16	16	16	16
Log likelihood	-835.6	-835.6	-835.6	-835.6	-835.6	-835.6	-835.6	-8

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.
Notes: CIT rate mining: corporate income tax rate applied to mining companies. Sigma2_e is the standard deviation of idiosyncratic errors; rho is the coefficient of the spatial-lagged-dependent variable.

Table 6: Tax policy and FDI in gold and silver: Results with minerals rents as weighting matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Gold and silver FDI inflows (%GDP)	Estimates		Short-run marginal effects			Long-run marginal effects		
	Main	WX	Direct	Indirect	Total	Direct	Indirect	Total
L. FDI inflows (%GDP)	0.0171							
	(0.0160)							
CIT rate mining	-0.0387	-0.1578***	-0.0355	-0.1430***	-0.1785***	-0.0361	-0.1452***	-0.181
	(0.0290)	(0.0315)	(0.0275)	(0.0282)	(0.0383)	(0.0279)	(0.0286)	(0.03

Infrastructure	0.0358***	-0.0005	0.0364***	-0.0042	0.0322***	0.0370***	-0.0043	0.032
	(0.0065)	(0.0128)	(0.0064)	(0.0119)	(0.0116)	(0.0065)	(0.0121)	(0.01
Government stability	0.0215***	-0.0077	0.0212***	-0.0095	0.0117	0.0215***	-0.0097	0.011
	(0.0076)	(0.0129)	(0.0070)	(0.0113)	(0.0151)	(0.0072)	(0.0114)	(0.01
Exchange rate	0.0004**	-0.0007***	0.0005**	-0.0007***	-0.0002	0.0005**	-0.0007***	-0.00
	(0.0002)	(0.0003)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.00
Log (gold and silver reserves)	0.0672***	-0.1174	0.0693***	-0.1152	-0.0459	0.0705***	-0.1172	-0.04
	(0.0100)	(0.0796)	(0.0096)	(0.0739)	(0.0785)	(0.0098)	(0.0751)	(0.07
rho	0.0999***							
	(0.0323)							
sigma2_e	1.4111***							
	(0.4474)							
Observations	192	192	192	192	192	192	192	192
Number of countries	16	16	16	16	16	16	16	16
Log likelihood	-341.8	-341.8	-341.8	-341.8	-341.8	-341.8	-341.8	-341.

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

Notes: CIT rate mining: corporate income tax rate applied to mining companies. Sigma2_e is the standard deviation of idiosyncratic errors; rho is the coefficient of the spatial-lagged-dependent variable.