Mining booms' effects : How booms from mining sector affect firms' performances.

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Abstract

Mining activities currently capitalize on the energy transition that fuels the demand for ores. However, the macroeconomics literature has extensively documented the adverse effects of booming sectors on the other sectors of the economy. This study uses firm-level data to examine the effects of mine activation on firm performance in developing countries. Drawing from the Dutch disease and the resource curse literature, we examine whether mining activities affect the manufacturing sector using a multilevel mixed model. We build an original dataset that merges data from the World Bank Enterprise Surveys data and the Minex database on mining activities. The dataset leaves us with a sample of 15,642 firms disseminated in 44 developing countries from 2006 to 2020. The results show that manufacturing firms underperform when mining activities grow, thus supporting the Dutch disease hypothesis. Our main finding is robust to several checks. We examine various transmission channels provided by the Dutch disease literature: competitiveness losses induced by the exchange rate appreciation, poor institutional quality, and labor force shifts. Our results highlight the potential conflict between energy transition and firm performance.

Keywords : • Resource booms • Dutch disease • Developing countries • Manufacturing firm performance • Mixed Multilevel Model

JEL Classifications: C21, Q33, Q32, D22, D24

1 Introduction

Mining is booming due to the need for certain minerals to support economic activity and the energy transition in particular (Gielen, 2021). This growth in the mining sector brings to light questions related to the impact of the exploitation of natural resources on economies. The literature reports the presence of a particular natural resource curse and the mechanism of Dutch disease. These two phenomena have the effect of slowing down economic activity and causing, in some cases, a weakening of the industrial sector and manufacturing firms (Van der Ploeg, 2011; Torvik, 2001).

Historically, economic development has always been associated with industrialization (Kaldor, 1957, 1966; Cornwall, 1980). When a country achieves a sustained rise in gross national product, the central part of that rise is from the growing national output in the industrial sector. Many authors have shown the positive relationship between economic development and industrialization Kaldor (1967); Fagerberg and Verspagen (1999); Szirmai and Verspagen (2015) and countries' development strategies feature plans to develop manufacturing. The private sector mainly leads this industrialization process, as do manufacturing firms, under the supervision of the central government.

This private sector is critical in developing countries' development process (Schulpen and Gibbon, 2002). For instance, it is a main driver in domestic investment and technical capabilities development. It is, therefore, a source of innovation and employment in countries with high unemployment. The efforts of this sector complement those of the public sector to ensure dynamic economic activity. In developing countries, in particular, the private sector is even the main driver of economic activity, given the quality of the institutional framework. The state's central role was abandoned in the 1980s, and the private sector became the key player in development policies in developing countries, as it is perceived as more efficient and productive than the public sector (Schulpen and Gibbon, 2002).

So, firms — mainly manufacturing ones — are crucial to the economies of developing countries since they are the primary driver of industrialization (Timmer and De Vries, 2009). Nevertheless, firms in developing countries face many difficulties that prevent them from participating fully in economic activity. These difficulties are, for exam-

ple, limited access to capital, infrastructure deficiencies, political instability, the limited skilled workforce, the poor regulatory environment, and the need for secure property rights.

Shocks in the mining sector are a main factor to consider when discussing firms' competitiveness, particularly in the manufacturing sector.According to the Dutch disease and natural resource curse phenomena, the competitiveness of an economy can be significantly reduced due to the abundance of natural resources or shocks in the natural resources sector. For instance, Looney (1990, 1991) examined the impact of Dutch disease on the economy's different sectors and found that it hampers sectors like agriculture, manufacturing, and mining.

Firms, especially those in manufacturing, can lose their competitiveness, which fosters deindustrialization (Buiter and Purvis, 1980; Corden and Neary, 1982; Corden, 1984; Krugman, 1987; Aizenman and Lee, 2010). Indeed, according to the Dutch disease theory, the shock originating in the natural resources sector results in a loss of competitiveness for the economy, and companies also lose competitiveness. Some articles like Corden and Neary (1982) and Corden (1984) show that the positive shock leads either to inflationary pressures that decrease exporting firms' competitiveness or relocation of production factors towards the mining sector from the manufacturing sector. This loss of competitiveness eventually hurts firm performance, of which activities plummet. According to the natural resources curse literature, a drop in institutional quality due to rent-seeking behavior accompanies booms in the mining sector. This degradation of institutional quality also leads to a drop in domestic firms' performance.

This study contributes to the literature on Dutch disease and the natural resource curse in several respects. Firstly, while the Dutch disease and natural resource curse literature usually focuses on macroeconomic indicators, we merge firm-level data from the World Bank Enterprise Surveys (WBES) with fine-scale mining data provided by the Minex database. The Dutch Disease and the Natural Resource Curse literature usually focuses on macroeconomic indicators. To our knowledge, only some studies explore their underlying mechanisms at the firm level. Secondly, we explore several channels through which mining booms affect firm performance. These are the exchange rate appreciation, poor institutional quality, and labor force shifts. Thirdly, we pay specific attention to

ores extracted by mining companies. Our results highlight the potential conflict between energy transition and macroeconomic performance.

We econometrically quantify the relationship between mining and firms' performance using a mixed multilevel model that controls for country, industry, and year-fixed effects and allows clustering at the country level (e.g., Kouamé and Tapsoba (2019)).

When it comes to shedding light on the mechanism that leads to the loss of performance following the start-up of a mine, chronology is essential. We looked at a window of three years after the mine opening to see how the mine start-up affects institutional quality, the exchange rate, and workforce distribution in the economy to test the different transmission channels highlighted by the literature to see which one could explain our results.

Alternative estimators, fixed effects, and entropy balancing do not qualitatively change our main result. Likewise, our results are robust to an alternative firm performance measure and additional controls.

Firms' characteristics affect the relationship between mining booms and firms' performances. Indeed, the oldest firms, the biggest ones, and those opened abroad are the most affected by mining booms. Finally, we tested the three transmission channels mentioned in the literature. We found that the degradation of institutional quality, exchange rate appreciation, and workforce shift explain our results.

The remainder of the paper is organized as follows: Section 2 provides a comprehensive literature review, covering the effects of mining sector booms on economic competitiveness and the relationship between economic competitiveness and firm performance. Section 3 presents the data and variables used in our analysis, along with the presentation of stylized facts. Section 4 details the robust methodology employed in our paper, while Section 5 presents our main results, the sensitivity of which will be discussed in section 6. Section 7 offers a deeper understanding of the mechanisms underlying our results, and Section 8 concludes after a discussion.

2 Literature review

Several factors can influence firm performance. Among these factors are booms in the mining sector. In this section, we present elements of the literature showing the relationship between mining sector booms and firm performance. In the first part (subsection 2.1), we present how mining sector booms affect economic activity and economic competitiveness in particular. Secondly (subsection 2.2), we highlight the literature talking about firm performance determinants and, mainly, the one linking economic competitiveness and firm performance.

2.1 Mining activities expansion and the economic activity

2.1.1 Macroeconomic effects of mining activities expansion

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The discovery and development of mines are seen as signals of future dynamic economic activity. However, these expectations are disappointed (Sachs and Warner, 1995, 2001; Kretzmann and Nooruddin, 2005; Ross, 2004, 2006; Collier and Hoeffler, 2005). Until the 1980s, economic orthodoxy viewed the presence and abundance of natural resources as promoting economic growth. Indeed, natural resources allow rich countries to increase their wealth and import purchasing power. This is said to have the effect of increasing investment and economic growth. Also, exploiting natural resources can lead to developing infrastructures and industries and developing and transferring technologies. Nevertheless, this hypothesis is challenged because of a paradox: Countries rich in natural resources experienced lower growth and poor institutional quality on average compared to countries with few natural resources.

Some economic papers such as Gelb (1988) have questioned growth based on natural resources. In the same vein, North (1991) points to the decline of the kingdom of Castile, which was rich in natural resources. It was not until 1993 that Richard Auty designated this paradox as the resource curse (Auty, 2002). Later, Sachs and Warner (1995) were the first to demonstrate at a global level the harmful effects of abundant natural resources on growth. The authors show a negative relationship between the

rate of economic growth and the ratio of exports of natural resources to GDP in a sample of 97 developing countries from 1971 to 1989. This result is robust even when controlling for the difference in income level, economic policy, and institutional quality. Subsequent research found the same conclusions: natural resource exploitation leads to an institutional destabilization, weak economic performances, appreciation of the interest rate and a loss of competitiveness (Sachs and Warner, 2001; Kretzmann and Nooruddin, 2005; Ross, 2004, 2006; Collier and Hoeffler, 2005; Corden and Neary, 1982). All these works generally focus on the repercussions of natural resource rents or ores price shocks. We expand on this literature by focusing on a shock that can influence the economy: mine openings, often called mining booms.

There is an extensive literature on the impact of mining booms on the economy. These mining booms can be the discovery of new mineral deposits or the start-up of mining operations (Bawumia and Halland, 2017; Khan et al., 2016). The advantage of studying such shocks is that they are practically exogenous, easing, the identification strategy. The other advantage of mine discoveries or activations is that we have a starting point, allowing again better identification, as we can track the evolution of the repercussions. They impact economic growth, the quality of institutions, the exchange rate, industrialization, access to financial markets, participation in the global value chain and, last but not least, countries' sovereign debt ratings (Kretzmann and Nooruddin, 2005; Harding et al., 2020; Khan et al., 2016; Doamba, 2024). For example, the literature highlights the negative impact of the discovery of mining deposits, particularly on fiscal policy and sovereign debt, with an increase in the risk of crises. According to the literature, these discoveries are also associated with a deterioration in institutional quality, giving rise to autocratic regimes (Lei and Michaels, 2014; Tsui, 2011) and increase of corruption until the local level (Knutsen et al., 2017). However, booms in the mining sector do not only have adverse effects, as some papers show a positive effect. For example, the literature shows that booms in oil and gas resources encouraged stable foreign direct investment in sectors not concerned by these resources (Van der Ploeg, 2011). Our paper seeks to support or reject this thesis.

2.1.2 Mining boom and economic competitiveness

The competitiveness of an economy is defined by a set of institutions, policies, and factors that determine the level of productivity in a given country. Thus, a country's level of competitiveness depends on a set of factors, all of which upon a closer look are impacted by shocks in the mining sector (Mien and Goujon, 2021; Paldam, 2013; Nülle and Davis, 2018). Indeed, it is clear from the literature that the mining sector has repercussions not only on institutional quality and the political sphere but also on macroeconomic variables such as the exchange rate (Sachs and Warner, 1995, 2001; Kretzmann and Nooruddin, 2005; Ross, 2004, 2006; Collier and Hoeffler, 2005; Doamba, 2024). This is summed up by the mechanisms of the Dutch disease, which can be defined as "the resource-induced revaluation of the real exchange rate" (Paldam, 2013) and that of the resources curse. For example, following gas reserves discoveries in the sixties, the Netherlands saw its exportation decline (The Economist, 1977). We can easily find a large body of economic literature highlighting the relationship between the mining sector and economic competitiveness. First, the literature on the resource curse shows us that a degradation of institutions and political institutions usually accompanies mining. According to the definition of the competitiveness of an economy given above, this reduces a country's competitiveness as the institutions are no longer favorable to economic activity. Also, booms in the mining sector lead to macroeconomic changes that impact a country's competitiveness. Indeed, income shocks from the mining sector lead to an appreciation of the real exchange rate. This appreciation of the real exchange rate, in turn, reduces the competitiveness of the country's exports affected by the shocks (Harding et al., 2020; Beverelli et al., 2011). This mechanism is known as Dutch disease. Nevertheless, in some cases, mining helps develop the country and increases institutional quality. In that case, mining can be a source of high competitiveness, as explained above (Van der Ploeg, 2011).

2.2 Economic competitiveness and firm performance

2.2.1 Firms' performance in the literature

There are several definitions of firm performance (Taouab and Issor, 2019). Initially, the performance of a firm was defined as its organizational efficiency, which refers to the ability of a firm to achieve its objectives using limited resources (Georgopoulos and Tannenbaum, 1957). Then, this definition evolved, and authors like Siminică et al. (2008) define a firm's performance as its ability to be both effective and efficient. For Bartoli and Blatrix (2015), a firm's performance refers to notions of growth, profitability, efficiency, and productivity.

The literature has two main schools of thought about factors affecting firm performance. The first emphasizes external market factors defining corporate success, giving little weight to internal factors. The second stream of thought sees organizational factors and their fit with the environment as the determinants of firm performance. However, these two schools of thought should not be seen as contradictory since each explains part of a firm's performance (Hansen and Wernerfelt, 1989). The literature includes theoretical models that explain the factors behind firm performance. Despite the multitude of models, most show that the main determinants are the characteristics of the sector in which the firm operates, the firm's position relative to its competitors, and, finally, the quantity or quality of the firm's resources (Hansen and Wernerfelt, 1989; Sosnick, 1970).

A comparison between firms in the most competitive areas of the world and those in the least competitive areas allows us to have an idea of the factors at the origin of these differences and therefore explains the performance of firms. Already, we can note that the success of East Asian countries shows us that labor-intensive sectors can drive growth and are, therefore, competitive in the early stages of a country's growth. Also, economic studies show that the slow growth of productivity is the source of the stagnation of African firms, particularly those in the industrial sector. They show that these firms still use obsolete technologies and machines. Additionally, African firms have less advanced know-how than other areas, notably Asia (Pack, 1987; Biggs et al., 1995; Lall, 1999). Thus, due to globalization, the accumulated delay in technical know-how and technology has led to the decline of African firms internationally and domestically. Another factor

in the competitiveness of firms is the environment in which they operate, as already shown above. Indeed, most developing countries' firms operate in a risky environment, with high production and transport costs and great macroeconomic uncertainty (Collier and Gunning, 1999).

The empirical literature, thanks to the availability of data on firms, has studied the determinants of productivity, growth, and, therefore, the competitiveness of firms. Results show that characteristics such as the size of the firm, its age, the ethnicity of the manager, and finally the orientation of the market are the main factors at the origin of the difference in productivity (Bigsten et al., 2000; Fafchamps, 2001; Mazumdar and Mazaheri, 2003; Söderbom and Teal, 2004; Van Biesebroeck, 2005).

2.2.2 Economic competitiveness and firm performance

There is a link between economic competitiveness and firm performance (Goldszmidt et al., 2011). A competitive economy is the sign of competitive firms, but Choi and Pyun (2020) show that a depreciation of the real exchange rate leading to a loss of competitiveness can incite firms in innovation to be more competitive. The competitiveness of an economy also refers to the productivity of its agents and, therefore, of firms. Indeed, successful firms abroad are a sign of a competitive economy. Similarly, firms that perform well in the domestic market are firms that are competitive with other companies in the rest of the world present in that market. In this vein, Aron (2000) and Yasar et al. (2011) show that the competitiveness of an economy refers to the quality of the environment in which firms operate, more particularly the property rights. Property rights enforcement mitigates bureaucratic red tap and rent-seeking activities. Pioneering work has been done to highlight domestic institutions' role in firms' competitiveness (North, 1990; Wright et al., 2005). Quality institutions reduce transaction and transformation costs. For Loayza et al. (2005) high-quality institutions increase productivity by allowing knowledge transfer and investment in technologies. Later, Dixit (2009) highlights the supportive role of functioning legal institutions. However, this competitiveness depends on the type of good, and the response of that competitiveness depends on it.

As we discussed above, booms in the mining sector have repercussions on economic competitiveness. In this particular case, the start-up of a mine can make an economy

less competitive, mainly due to exchange rate appreciation and the move of the workforce from the manufacturing sector to the mining sector in the short term and in the long term by a deterioration of institutional quality. This loss of competitiveness has repercussions on firms' performance. For example, sales fall as exchange rate appreciation makes exports more expensive, so the goods produced by local firms become less competitive abroad. In the domestic market, imports have become cheaper, making foreign firms more competitive in the local market. However, in the local market, the loss of price competitiveness does not necessarily translate into weaker performance since this depends on the degree to which sales respond to this loss of competitiveness. Consumers' national preferences or policies can make firms more efficient. So, through this paper, we plan to verify whether the booms lead to an increase or a decrease in firms' performance.

2.3 Our assumptions

We, therefore, see a need for more empirical work testing the mechanisms of Dutch disease and the natural resource curse at the disaggregated level in the literature. In this regard, we can formulate a set of testable hypotheses :

- Following the literature on Dutch Disease and the natural resources curse, a boom from the mining sector can result in a drop in the manufacturing sector. That means that manufacturing firms must see their performances reduced. So, when we test the relationship between mining booms and firms' performance, there must be a negative and significant relationship between the two variables.

- Our research recognizes the importance of considering the diverse characteristics of different types of firms and mines in understanding the relationship we are investigating. Factors such as a firm's size, age, and level of international engagement, as well as the type of mine, location, and production capacity, could significantly influence their response to mining booms. By incorporating these factors into our analysis, we aim to provide a comprehensive understanding of the dynamics at play.

3 Data and descriptive statistics

In this section, we first present the variables used in the study, followed by the descriptive statistics and stylized facts of these variables.

The final database from 2006 to 2022 merges two different sources: the World Bank Enterprise Survey (WBES) database (retrieved September 27, 2021) and the Minex database. Firm-level variable comes from the WBES database [1] [2] that has been widely used to study firms' reactions to economic events (Bigsten and Söderbom, 2006; Xiao et al., 2022; Eifert et al., 2008). This database brings together representative firms from 154 countries including developing and developed countries. It contains some information on the firms themselves, such as their age and size, as well as indicators of firm competitiveness, such as the growth of sales, the quality of the workforce, the orientation of the market, and eventually, the level of innovation and technology of each firm. Since we are working on the Dutch disease mechanism, we have focused on manufacturing firms, excluding primary sector firms since their activity strongly correlates to the mining sector. Firms excluded represent approximately 6.34 percent of the original sample.

The Minex database[3] gives information on the deposits discovered and mining activation information (Sosnick, 1970). This database gives the geolocalized position of each mine, the date of discovery of each mining deposit, and especially the date of the start of activity of the deposit and ts date of closure where applicable.

Considering the missing data in the various databases, we are left with 15,642 observations spanning 44 developing countries from 2006 to 2020. Since the WBES database does not geolocate firms, we consider the effect of mining activities on the performance of firms in the country experiencing a mining activity, regardless of their location. In addition, the WBES database does not allow us to create a panel, as a firm is not surveyed over time—the original database pools firms from 2006 to 2020.

[1] https://www.enterprisesurveys.org/en/data

[2] https://www.worldbank.org/content/dam/enterprisesurveys/documents/methodology/Enterprise%20Surveys_Manual%20and%20Guide.pdf

[3] https://minexconsulting.com

3.1 Definition of variables

Dependent variable

The dependent variable used in this study is firm performance. Profitability, growth, productivity, and sales are often used to measure a firm's performance (Chauvet and Jacolin, 2017; Chauvet and Ehrhart, 2018; Kouamé and Tapsoba, 2019; Bambe et al., 2022). WBES database provides annual sales, annual value-added, and the quality of each firm's workforce. The firms' sales allow us to capture their performance through sales growth. These sales can be made in the domestic or international market, which allows us to effectively capture the level of performance following a loss of competitiveness in the economy.

Sales growth ($Salesgrowth$) is our primary measure of firm performance. Following Iarossi et al. (2009) and Bambe et al. (2022), we computed the firms' performance as follows, with $Salesgrowth_{it}$ the sales growth of the firm i computed for the year t.

$$Salesgrowth_{it} = \frac{1}{2} * \frac{Sales_{t-1} - Sales_{t-3}}{\frac{Sales_{t-1}+Sales_{t-3}}{2}} \tag{1}$$

with $Sales_{t-1}$ the level of sales of firm i at period $t-1$ and $Sales_{t-3}$ the level of sales of firm i at period $t-3$.

We will use another measure of firm performance used in the literature (Kouamé and Tapsoba, 2019), labor productivity growth (LPG), in a robustness test. This variable is described as follows, with LPG_{iy} the labor productivity growth of the firm i computed for the year t.

$$LPG_{it} = \frac{1}{2} * \frac{LP_{t-1} - LP_{t-3}}{\frac{LP_{t-1}+LP_{t-3}}{2}} \tag{2}$$

with LP_{t-1} the level of labor productivity at period $t-1$ and LP_{t-3} the level of labor productivity at period $t-3$ obtained by the ratio between the sales and the number of workers.

Variable of interest

The variable of interest is the activation of the mine. Based on the Minex database, we constructed our mine activation variable $Activity_{ic(t-3)}$, a binary variable with 1 for

observations when at least a mine is activated in year $t-3$ in country c and 0 otherwise. For example, for a given country, *Activity* is equal to zero until the year a mine is activated, and after that year, it returns to zero, until another mine is activated. This delay $t-3$ is explained by the need to adequately capture the performance dynamics due to the activation of mines. Thus, we match the activation of mines to the base period for measuring firm performance.

Variables of control

We controlled for the age (Age_{ict}), and size ($Size_{ict}$) of the firm, and its ability to access credit ($Creditline_{ict}$) following the literature (Chauvet and Jacolin, 2017; Chauvet and Ehrhart, 2018; Kouamé and Tapsoba, 2019; Bambe et al., 2022). These variables are critical to a firm's ability to adapt to shocks by having more access to credit or subsidies, for example. The firm's age (Age_{ict}) measures the years since the firm opened. The size ($Size_{ict}$) is a qualitative variable. It is equal to 1 if the firm has less than 20 employees; in that case, the firm is considered small.It is equal to 2 for medium firms with between 20 and 99 employees. Finally, the variable is equal to 3 for large firms with more than 99 employees. We also control for the participation in the capital of firms, since it is a factor that can influence a firm's ability to respond to shocks. We then added the share of national participation ($Domesticcapital_{ict}$) in the capital between our control variables, expressed in the percentage of the total capital. Also, to control for the firm human capital, which also impacts its response and adaptation to a shock, we use a variable that captures the level of skilled workers in the firm ($Ratioskill_{ict}$). It is computed as the share of workers of the firms that are skilled compared to the total number of workers in each firm. To capture the initial conditions of each firm, we added the level of sales in $t-3$, which is the variable $Sales3years$ since firms' performances are computed from $t-3$. Finally, we controlled for the local level of demand and the agglomeration effect[4] by considering the size of the city in which the firm is located (Kouamé and Tapsoba, 2019). The variable *Demand* takes the unit value if the firm is located in a city with a population over one million and 0 otherwise.

In addition to these firm-level control variables, we also include three macroeconomic variables following Beck et al. (2005); Harrison et al. (2014); Chauvet and Jacolin

[4]See Allcott and Keniston (2018)

(2017); Chauvet and Ehrhart (2018); Kouamé and Tapsoba (2019); Bambe et al. (2022). These variables are critical determinants of firms' performance since external factors also impact its performance (Hansen and Wernerfelt, 1989). The first variable is the manufacturing sector valued-added as part of GDP ($Manufact_{ct}$) to capture the economy's structure. The second variable we included is the country's level of growth ($Growth_{ct}$). This variable helps to consider the economic conditions in which the firms evolve. The last macroeconomic variable included in the analysis is the level of institutional quality ($Institution_{ct}$).

3.2 Descriptive statistics and stylized facts

The descriptive statistics (Table 1) give a first contact with the variables, and Table 7 gives complete information about all variables used in the analysis. Regarding the firm-level variables, firms have positive sales growth on average across the sample, while productivity growth is negative on average. They are, on average, 21 years old and of rather average size (1.97). Domestic investors own a large part of the firms in our sample, and around 48% of the workers in the firms in our sample are qualified. Macroeconomic variables at the country level show us that, on average, value-added from the manufacturing sector represents 17% of GDP in our sample countries. Also, growth is high enough (5%), thus confirming the growth dynamics of developing countries.

We can see the difference between the different performance indicators in the event of the activation of a mine in the table 2. At first glance, observations with mines activated have positive sales growth, which can be disconcerting since we expected an inverse relationship. This result can be explained by the agglomeration effect (Allcott and Keniston, 2018) induced by mining booms, which can be the source of a positive effect of mines on firms at the local level. However, when we look at this difference in the growth of labor productivity, it is lower in the event of the activation of a mine, which is more in line with our expectations. Therefore, it is vital to see whether the agglomeration effect overrides the mechanism of Dutch disease and the resource curse.

Table 1: Descriptive statistics table

	Description	Observations	Mean	Min	Max	SD
Firm-level variables						
Salesgrowth	Percentage	15,642	0.01	-1.00	1.00	0.32
LPG	Percentage	15,642	-0.03	-1.00	1.00	0.33
Age	Years	15,642	21.45	0.00	341.00	16.21
Firm Size	Ordinal	15,642	1.97	1.00	3.00	0.78
Creditline	Percentage	15,642	0.46	0.00	1.00	0.50
Domestic capital	% of total capital	15,642	88.59	0.00	100.00	29.47
Sales 3 years	Countinious	15,642	9.06	-9.73	21.54	2.88
Demand	Binary	15,642	0.40	0	1	0.49
Ratioskill	% of total workers	15,642	48.12	0.00	100	27.13
Country-level variables						
Manufact	% GDP	15,642	17.00	2.42	31.60	6.43
Growth	% GDP	15,642	5.00	-1.24	11.99	2.40
Institution	Continuous	15,642	6.72	1.17	10	2.39

Table 2: Difference in performance variables

	Observations	Mean	Min	Max	SD
With mine activating					
Salesgrowth	7,124	0.02	-1.00	1.00	0.30
LPG	7,124	-0.03	-1.00	1.00	0.31
Without mine activating					
Salesgrowth	8,518	-0.01	-1.00	1.00	0.34
LPG	8,518	-0.02	-1.00	1.00	0.35

This table represents the difference in firm performance between firms that have experienced mine activation and those that have not.

4 Methodology

Several papers have already questioned the effects of macroeconomic factors on firm performance (Chauvet and Jacolin, 2017; Chauvet and Ehrhart, 2018; Kouamé and Tapsoba, 2019; Bambe et al., 2022). They all agree on the challenge of capturing the real effects of such macroeconomic factors on the performance of individual agents such as firms. The first challenge comes from the data structure since macroeconomic and microeconomic data are combined. As Kouamé and Tapsoba (2019) pointed out, within a single country, firms share the same characteristics, such as the institutional environment, the macroeconomic framework, and economic policies that can affect firm productivity and performance. Thus, using classical econometric tools would lead to a

downward bias in standard deviations.

The second challenge in this analysis relates to a potential endogeneity bias arising from the simultaneous relationship between firm performance and mine activation. Indeed, work such as Cust and Harding (2020) shows that exploration and exploitation depend highly on the institutional environment that conditions firm performance. Above all, efficient firms may lead to greater exploration and extraction of mineral deposits because of the need for minerals to finance this sustained economic activity. Mining activity can, in turn, impact firm performance through the Dutch disease and natural resources curse mechanisms.

We address these two challenges by using the multilevel mixed model. This approach introduced by Fuller and Battese (1973) is used in social sciences as presented by Bryk and Raudenbush (1992) to account for the hierarchical data structures. Indeed, this model allows us to consider the clustering effect of firms belonging to the same country by allowing the intercept to vary between countries. Above all, in our estimations, we include both firm-level and country-level variables; this model allows for the simultaneous addition of these different-level variables. Concerning the question of endogeneity due to reverse causality, an adapted data matching method as used by Kouamé and Tapsoba (2019) limits the risk of firm performance impacting mine development. This is achieved by using mine activation at $t-3$. It ensures that the mine activation episodes correspond to the firm's performance benchmark. We further use the entropy balancing methodology in robustness to deal with this endogeneity problem.

The mixed two-level econometric model writes as follows:

$$Level1 : Salesgrowth_{ict} = \alpha_{0c} + \beta Activity_{c,(t-3)} + \eta X_{ict} + \gamma Y_{ct} + \varepsilon_{ict}\ ,\ \varepsilon_{ict} \sim N\left(0, \sigma^2\right) \tag{3}$$

$$Level2 : \alpha_{0ct} = \alpha_{00t} + \vartheta_{ct}, \vartheta_{ct} \sim N\left(0, \delta^2\right)\ ,\ \vartheta_{ct} \perp \varepsilon_{ict} \tag{4}$$

In this case, $Salesgrowth_{ict}$ is the measure of each firm's performance following the activation of a mine. $Activity_{c,(t-3)}$ refers to the activation of the mine as specified above. X_{ict} refers to the set of firm-level control variables and Y_{ct} refers to the country-

level control variables. Finally, ε_{ict} represents the firm-level error term. Subscripts i refers to the firm, c refers to the country, and t refers to the year.

The final estimated model is the equation 5, which is a combination of equations 3 and 4.

$$Salesgrowth_{ict} = \alpha_{00t} + \beta Activity_{c,(t-3)} + \eta X_{ict} + \gamma Y_{ct} + \vartheta_{ct} + \varepsilon_{ict} \tag{5}$$

We have also included year, country, and sector fixed effects to control for possible factors that could influence firm performance and differences in survey waves. Standard deviations are clustered at the country level.

5 Results

The main results are presented in column 1 of Table 3. The results show that the coefficient associated with the firm performance variable is negative and significant at the 1% level. According to this result, mines opening reduces firms' performance by 6.03 percentage points.

The above results are undoubtedly significant, but they do not give any information of economic significance, i.e., what the loss in firm performance following the activation of a mine represents. To do this, we will compare the loss of firm performance with the standard deviation of the firm performance variable. So, the coefficient -0.0603 corresponds to $18,84$ percent of the sample standard deviation, which is 0.32. Looking closely, we see that the performance indicator standard deviation is greater than the mean. This means there is a significant heterogeneity among firms hit by the mining boom. The result is reasonable since the economic effect must be significant to bring down a country's manufacturing sector, corroborating the literature.

6 Sensitivity analysis

We first test the robustness of our results. Then, we test their heterogeneity to see how they vary according to the characteristics of the firms or mines. This approach

Table 3: Main results and robustness analysis

	(1) Main	(2) Government	(3) International	(4) Inputs	(5) MCO	(6) Entropy	(7) LPG
Activity	-0.0603***	-0.0599***	-0.0576***	-0.0430**	-0.0603***	-0.0526***	-0.0768***
	(0.0167)	(0.0171)	(0.0173)	(0.0202)	(0.0167)	(0.0177)	(0.0180)
Age	0.0000	0.0000	-0.0000	0.0000	0.0000	0.0001	0.0012***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Size	0.1451***	0.1451***	0.1431***	0.1443***	0.1451***	0.1410***	0.1139***
	(0.0110)	(0.0110)	(0.0102)	(0.0106)	(0.0110)	(0.0136)	(0.0114)
Credit line	0.0383***	0.0383***	0.0392***	0.0374***	0.0383***	0.0419***	0.0228***
	(0.0064)	(0.0064)	(0.0065)	(0.0065)	(0.0064)	(0.0066)	(0.0075)
Demand	0.0117	0.0117	0.0118	0.0089	0.0117	0.0162	0.0141*
	(0.0075)	(0.0075)	(0.0074)	(0.0069)	(0.0075)	(0.0107)	(0.0073)
Sales 3yrs	-0.0734***	-0.0734***	-0.0742***	-0.0739***	-0.0734***	-0.0743***	-0.0699***
	(0.0054)	(0.0054)	(0.0056)	(0.0052)	(0.0054)	(0.0055)	(0.0060)
Domestic capital	-0.0006***	-0.0006***	-0.0006***	-0.0005***	-0.0006***	-0.0007***	-0.0007***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0001)
Ratioskill	-0.0003***	-0.0003***	-0.0003***	-0.0003**	-0.0003***	-0.0004***	-0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Growth	0.0353***	0.0352***	0.0347***	0.0340***	0.0353***	0.0334***	0.0428***
	(0.0032)	(0.0033)	(0.0033)	(0.0037)	(0.0032)	(0.0034)	(0.0035)
Institution	0.3154***	0.3153***	0.3244***	0.3255***	0.3154***	0.3232***	0.1952***
	(0.0388)	(0.0388)	(0.0407)	(0.0383)	(0.0389)	(0.0388)	(0.0456)
Manufact	-0.0855***	-0.0855***	-0.0865***	-0.0834***	-0.0855***	-0.0857***	-0.0673***
	(0.0052)	(0.0052)	(0.0054)	(0.0050)	(0.0052)	(0.0054)	(0.0056)
Government capital		-0.0001					
		(0.0003)					
Inter			0.0767***				
			(0.0279)				
National inputs				-0.0005***			
				(0.0001)			
Observations	15600	15599	15600	15439	15600	15600	15600
Countries	44	44	44	44	44	44	44
R^2	0.3703	0.3703	0.3717	0.3679	0.2950	0.3385	0.3287
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

This table reports main results and robustness analysis. The first column reports main result. The columns **[2]-[4]** show results of robustness by adding control variables. Column **[5]** reports the result when using simple FE estimator, and **[6]** presents it when using Entropy balancing methodology. Finally, the last column presents robustness when using labor productivity growth as the dependent variable. Robust standard errors are reported in parentheses. The constant is included, but not reported in the table. * p < 0.1, ** p < 0.05, *** p < 0.01

allows us to confirm our results and better understand the factors conditioning them.

6.1 Robustness analysis

The first series of sensitivity tests we carry out aims to demonstrate the robustness of our results.

Additional control variables: First, we want to show that our coefficients are stable. To do so, we introduced a series of control variables as a further test of the robustness of the results. We introduced a variable that captures the government's share of the firm's capital ($Government\,capital_{ict}$). The intuition behind adding this variable is that firms with significant government shareholding can access subsidies or additional capital more quickly than other firms. Also, firms with a significant government shareholding are often social-profit firms with high entry costs and, therefore, protected from competition. In line with our intuition, the results remain robust to the addition of the government equity variable (column **[2]** of Table 3). The second variable we have introduced captures the firm's openness to the rest of the world. The $Inter$ variable shows whether the firm has international certification in terms of quality (column **[3]** of Table 3). The last variable we added is the firm's share of national inputs ($Nationalinputs$). Firms using mare national inputs can be differently touched by the mine opening since prices on the domestic market can be influenced by a mine activation. Our results remain stable when adding the share of national inputs for each firm (column **[4]** of Table 3).

Using a simple fixed-effects estimation: We use the mixed multilevel estimator as the primary model in our estimation. Although this model best suits our case, we re-estimated our first equation using a simple ordinary least squares model. The results are presented in the fifth column of the table 3. Chauvet and Ehrhart (2018) used this model as the primary model when trying to estimate the effect of aid on a firm's performance but took care to cluster the standard errors at the country level. Due to the potential clustering effect from firms in the same country, all the standard errors have been clustered at the country level. Results remain the same as the main ones using this model, showing their robustness. Moreover, our primary model better explains the firm's performance dynamic since the R^2 is more significant than this one of FE estimation.

Using the entropy balancing methodology: With this in mind, we set out to

re-test our main results using an impact analysis methodology, in this case, entropy balancing. The choice of the entropy balancing method was motivated by several reasons described in works such as Hainmueller (2012), Neuenkirch and Neumeier (2016) and Bambe et al. (2022). First, this method is a non-parametric method, unlike classical matching methods. It reduces the risk of having biased estimates because this method does not require the specification of a functional form. Also, it allows us to have numerous characteristics before treatment among the different groups (treated and untreated), even with small samples or a limited number of untreated units. Therefore, the control group will comprise units as identical as possible to the treated group. Finally, this method allows us to control for fixed effects. It is essential to consider heterogeneity between countries, and over time, that does not depend on our treatment. In our case, the treatment variable is the mining activity variable. We, therefore, have the value 1 in the year when at least one mine comes into operation and 0 otherwise, and the study units are firms. The results of this methodology are presented in column [**6**] of Table 3 to support our main findings. Indeed, the coefficients are qualitatively similar to those of the main results, confirming the robustness of our findings.

Using Labor Productivity Growth (LPG) as firm performance measure: Another robustness test we have undertaken concerns the measurement of firm performance. Indeed, there are several measures of firm performance. In our primary model, we used sales growth to measure performance. Here, we propose using labor productivity growth (LPG) to measure firm performance. The method of calculating the variable is given above in equation 2.

This robustness test allows us to see to what extent the activation of a mine impacts the productivity of firms. According to the literature, mining activity can be the origin of a structural change in the economy, and manufacturing firms can find themselves with an unskilled workforce due to their movement toward the booming sector: the mining sector, for example. Thus, activating a mine can negatively impact firms' productivity in our system. Again, the main results are corroborated, as we see in the last column of the table 3.

Replicating the main table with the Labor Productivity Growth variable: A last test of robustness we undertook is the re-estimation of all the first result tables,

by using this time, the labor productivity growth (LPG) as the dependent variable. This choice can be explained by the fact that in the literature, some authors preferred using LPG as the firm performance measure (Kouamé and Tapsoba, 2019). The results are presented in table 8 and confirm the drop in the firm performance following mines' activation.

6.2 Conditioning factors at firm level

This section shows how our result varies depending on certain key variables. Columns [**1**] and [**2**] concern the heterogeneity concerning the age of the firm. Columns [**3**] and [**4**] are about the firm's size heterogeneity. Columns [**5**] and [**6**] are about the firm's openness to the rest of the world heterogeneity. Finally, [**7**] and [**8**] deal with heterogeneity about the local or foreign owner of the firm.

Depending on the firm's age: Being an old firm can be an advantage or a disadvantage when adapting to shocks. Indeed, an old firm can have the experience to adapt to these shocks compared to a young one. However, the old firms can also have difficulties adapting to these shocks due to bureaucracy slowness, and particularly, due to their experience, they can have more chances to be oriented abroad, so they are affected by the competitiveness loss. We decided to test the heterogeneity of our results according to the firm's age. Old firms are those above the median firms' age, which is 17, and young ones are those below the median. Results presented in columns [**1**] and [**2**] of Table 4 show that old firms are the more affected.

Depending on the firm's size: We also test the sensitivity of our result as a function of firm size. The firms' size refers to the number of workers in these firms. Indeed, firm size plays a key role in a firm's ability to adapt to a shock since larger firms have more capital or easier access to credit. Small firms are those below the median firms' size, which is 36.25, and big ones are those above the median. The result is shown in columns [**3**] and [**4**] of the heterogeneity table (Table 4). Big firms are those that are hit by the mine's activation. Small firms see their performance increase following a mine activation. This last result can be explained by the fact that the small firms are mainly local.

Table 4: Heterogeneity analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Age		Size		Openness		Ownership	
	Young	Old	Small	Big	Not opened	Opened	Local	Foreign
Activity	0.0110	-0.2688***	0.1793***	-0.3620***	0.0942***	-0.2684***	-0.0559***	-0.2496**
	(0.0252)	(0.0181)	(0.0243)	(0.0299)	(0.0187)	(0.0275)	(0.0163)	(0.0979)
Age	-0.0021**	0.0004*	-0.0013***	0.0003*	-0.0003	0.0000	-0.0000	0.0002
	(0.0011)	(0.0002)	(0.0003)	(0.0002)	(0.0002)	(0.0003)	(0.0002)	(0.0005)
Size	0.1410***	0.1445***	0.1033***	0.1116***	0.1466***	0.1234***	0.1459***	0.1381***
	(0.0114)	(0.0116)	(0.0072)	(0.0140)	(0.0103)	(0.0137)	(0.0113)	(0.0208)
Creditline	0.0562***	0.0199***	0.0346***	0.0363***	0.0414***	0.0321***	0.0422***	-0.0002
	(0.0086)	(0.0071)	(0.0095)	(0.0067)	(0.0081)	(0.0074)	(0.0067)	(0.0118)
Demand	0.0083	0.0143*	0.0145**	0.0046	0.0068	0.0259***	0.0109	0.0002
	(0.0112)	(0.0085)	(0.0073)	(0.0095)	(0.0082)	(0.0092)	(0.0083)	(0.0262)
Sales 3yrs	-0.0824***	-0.0634***	-0.0873***	-0.0671***	-0.0820***	-0.0611***	-0.0748***	-0.0606***
	(0.0054)	(0.0050)	(0.0049)	(0.0048)	(0.0052)	(0.0055)	(0.0056)	(0.0089)
Domestic capital	-0.0008***	-0.0004**	-0.0003	-0.0006***	-0.0004**	-0.0004**	-0.0004*	-0.0005
	(0.0001)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0006)
Ratioskill	-0.0005***	-0.0001	-0.0005***	-0.0002	-0.0004***	-0.0002	-0.0003**	-0.0008***
	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0001)	(0.0002)	(0.0001)	(0.0002)
Growth	0.0185***	0.0688***	0.0025	0.0836***	0.0033	0.0646***	0.0412***	-0.0326
	(0.0052)	(0.0035)	(0.0049)	(0.0066)	(0.0039)	(0.0050)	(0.0033)	(0.0228)
Institution	0.3329***	0.5571***	0.0607	0.6115***	0.3580***	0.3852***	0.3284***	1.1419***
	(0.0384)	(0.0473)	(0.0408)	(0.0518)	(0.0587)	(0.0452)	(0.0439)	(0.0980)
Manufact	-0.0911***	-0.0811***	-0.0923***	-0.0838***	-0.0959***	-0.0778***	-0.0849***	-0.1169***
	(0.0050)	(0.0052)	(0.0048)	(0.0053)	(0.0057)	(0.0065)	(0.0054)	(0.0102)
Observations	7990	8175	7796	7813	10863	4737	14394	1298
Countries	44	44	44	44	44	44	44	44
R^2	0.3832	0.3407	0.4132	0.3103	0.3844	0.3243	0.3716	0.3509
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

This table reports results to highlight the heterogeneity of our results. Columns **[1]** and **[2]** concern the heterogeneity in relation to the age of the firm. Columns **[3]** and **[4]** are about the firm's size. Columns **[5]** and **[6]** are about the firm's openness to the rest of the world. Finally, **[7]** and **[8]** deal with heterogeneity in relation to the local or foreign owner of the firm. Robust standard errors are reported in parentheses. The constant is included, but not reported in the table. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Depending on the openness to the rest of the world: The level of openness of a firm to the rest of the world can seriously impact how it reacts to the domestic economy's competitiveness loss. Indeed, the loss of competitiveness mainly concerns firms that sell abroad since the exchange rate appreciation due to mining booms makes exportation more expensive. So, firms oriented abroad must be more affected by the mining boom effect. To confirm this intuition, we split the main sample into two: the

first includes firms only oriented to the local market, while the second includes firms oriented abroad. The results are presented in columns **[5]** and **[6]** of Table 4. They meet our expectations since, as we can see, firms opened to the rest of the world are negatively affected by the booms in the mining sector.

Depending on the firm's ownership: The domestic or local ownership of the firm can also impact its ability to adapt to shocks. We tested this intuition, and results are presented in the two last columns (**[7] and [8]**) of table 4. Locally owned firms have less than 50% of their capital owned by foreign economic agents, contrary to foreign-owned firms. Nevertheless, we found no heterogeneity depending on the firm's domestic or foreign ownership. That means that the level of openness and not the ownership explains the ability to adapt to shocks.

7 Transmission channels

In this section, we aim to identify the crucial mechanisms that underpin our findings. As a reminder, our study revealed a significant drop in firm performance accompanying a mine activation. Drawing from the existing literature, we identify three key channels through which a mine activation can impact a firm's performance. The first channel is linked to the resource curse. The development of the mining sector can lead to a degradation of institutional quality, leading to uncertainty and an unfavorable business environment. From this point of view, the relation between mining or mine activation and a firm's performance is clear.

The second channel is the appreciation of the exchange rate, a phenomenon known as the Dutch disease. This leads to a decrease in export competitiveness, a crucial factor for firms' performance.

The third channel refers to the shift of the workforce from the manufacturing sector to the mining sector. The development of the mining sector leads to an increase in wages compared to the other sectors, so the workforce has moved from the manufacturing sector to the mining sector. The flight of labor, especially qualified workers, makes firms less efficient.

Table 5: Transmission channels

	(1)	(2)	(3)	(4)
	Institution		Exchange rate	
	Below the median	Above the median	Below the median	Above the median
Activity	-0.1084***	0.0418*	0.0079	-0.2548***
	(0.0330)	(0.0251)	(0.0249)	(0.0633)
Age	-0.0001	-0.0000	-0.0001	0.0001
	(0.0004)	(0.0002)	(0.0002)	(0.0003)
Size	0.1476***	0.1383***	0.1232***	0.1644***
	(0.0121)	(0.0171)	(0.0141)	(0.0129)
Creditline	0.0446***	0.0335***	0.0373***	0.0383***
	(0.0076)	(0.0099)	(0.0068)	(0.0103)
Demand	0.0267**	-0.0010	0.0112	0.0113
	(0.0107)	(0.0101)	(0.0078)	(0.0130)
Sales 3yrs	-0.0791***	-0.0663***	-0.0664***	-0.0779***
	(0.0069)	(0.0060)	(0.0082)	(0.0060)
Domestic capital	-0.0008***	-0.0003**	-0.0006***	-0.0005**
	(0.0002)	(0.0002)	(0.0001)	(0.0002)
Ratioskill	-0.0003*	-0.0004***	-0.0005***	-0.0002
	(0.0002)	(0.0002)	(0.0001)	(0.0002)
Growth	-0.0163***	0.0124***	0.0872***	0.0785***
	(0.0040)	(0.0027)	(0.0022)	(0.0147)
Institution	-0.3074***	-0.2527***	-0.2124***	0.2078***
	(0.0253)	(0.0310)	(0.0138)	(0.0055)
Manufact	-0.1545***	-0.0137***	-0.0324***	-0.0603***
	(0.0119)	(0.0027)	(0.0049)	(0.0042)
Observations	7658	7942	8387	7213
Countries	22	22	22	22
R^2	0.4348	0.293	0.2361	0.4541
Sector FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

This table reports results to highlight the transmission channels of our results. Columns **[1]** and **[2]** concern the institutional quality channel. Columns **[3]** and **[4]** are about the exchange rate channel. Robust standard errors are reported in parentheses. The constant is included, but not reported in the table. * p < 0.1, ** p < 0.05, *** p < 0.01

We tested these three channels, and the results are presented in Tables 5 and 9. The first channel tested is the institutional quality channel. We split the sample into two depending on the countries' institutional quality level at period t. So, we have two groups of firms: those in countries with low institutional qualities and those in countries with high levels of institutional quality. From $t-1$ to t, the effect of the mining boom on the institutions has time to occur, and we expect countries with low institutional quality to see their firms experience a performance drop. Results are presented in columns **[1]** and **[2]** of table 5, and they meet our expectations. The result in the first column of Table 9 confirms the institutional quality channel, as mining booms in $t-3$ lead to low levels of institutional quality in t.

The Table 9 in the appendix also shows an appreciation of the exchange rate in t following a mine activation in $t-3$. This conforms to the literature. Moreover, the columns **[3]** and **[4]** show that countries with high levels of exchange rates are those that see their firms lose performance following a mine activation. These two results confirm the exchange rate appreciation as a transmission channel of our result in the first column of Table 3.

According to the literature, booms from the mining sector lead to a shift of qualified workforce from the manufacturing sector to the booming mining sector. Already, we found that a drop in labor productivity growth accompanied the mining boom. This result can be explained by the fact that there is indeed a shift of qualified workforce toward the mining sector and the replacement of that shifted workforce by a less qualified one. The last column of Table 9 shows us a growth of the share of employment in the manufacturing sector following the mine opening. This can be explained by the need to compensate for the move of the qualified workforce.

8 Discussion and conclusion

A shock in the mining sector can lead to a change in the economy's structure, which in turn, leads to a loss of competitiveness in specific sectors and for the firms in those sectors. While work has been carried out at the macroeconomic level, with theoretical models developed for this purpose, studies have yet to be carried out at the firm level

to understand the mechanism behind these results highlighted by the literature. This gap underscores the need for more disaggregated research in this area. Therefore, we propose to take our study to a more detailed level than that proposed by the literature by carrying out a study at the firm level. The mechanism of Dutch disease, for instance, originates at the level of firms, which are those that lose competitiveness due to exchange rate appreciation. In this way, using disaggregated data from 44 developing countries, we estimate the effect of booms in the mining sector (mine activations) on firm performance. Our results confirm the loss of firm performance following activation, further emphasizing the need for more detailed research in this area.

Our study's significance lies in the fact that we have tested, in a highly detailed and specific manner, the loss of competitiveness of countries following shocks in the mining sector. This detailed study has allowed us to better understand the factors that contribute to this loss. We have thus been able to highlight a direct relationship between mine start-ups and the loss of firm performance. This result, obtained using mixed multilevel levels as the primary methodology, was robust to the addition of further control variables and the use of an alternative measure of firm performance. Factors like firms' size, age, and openness level are factors conditioning our results. Another significant contribution is that we have been able to identify the mechanism underlying our result. Among the different channels proposed by the literature, exchange rate appreciation and workforce shift are the mechanisms that drive our results.

In line with Chauvet and Jacolin (2017) and Chauvet and Ehrhart (2018), working at a disaggregated level enables us to highlight better the mechanisms involved. We have thus been able to highlight the heterogeneity of the factors explaining these results. Firm-specific factors, more precisely, age, size, and openness to the rest of the world, condition the relationship we highlighted.

This study paves the way for several other questions linked to the impact of economic shocks on economies by going to a more disaggregated level to quantify better and capture the underlying mechanisms. In this way, several macroeconomic questions already visited at the macro level can be revisited with a focus on firms. Also, the geolocalized nature of the firms may enable us to study more precisely the interaction between the relationship between mine start-up and firm performance. Indeed, the natural resources

curse can be neutralized locally by an effect of population agglomeration as pointed out by Allcott and Keniston (2018). The accuracy of the Minex database in terms of mine activation dates makes it possible to study the impact of these shocks on the economy. Finally, a significant limitation of this paper is that the Minex database does not include oil mines. However, this limitation allows us to focus on other types of natural resources. Much of the literature has focused on the impact of oil industry shocks on the economy. Future work could exploit this limitation, depending on the data available.

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9 Annexe

Table 6: Countries representativity in the sample

Country	Freq.	Percent	Cum.	Country	Freq.	Percent	Cum.
Albania	47	0.30	0.30	Mali	34	0.22	50.70
Angola	81	0.52	0.82	Mexico	942	6.02	56.72
Argentina	578	3.70	4.51	Mongolia	218	1.39	58.11
Bangladesh	1.071	6.85	11.36	Morocco	116	0.74	58.85
Brazil	723	4.62	15.98	Namibia	47	0.30	59.15
Cameroon	106	0.68	16.66	Nicaragua	94	0.60	59.76
Chile	627	4.01	20.67	Nigeria	546	3.49	63.25
China	1.314	8.40	29.07	Panama	43	0.27	63.52
Colombia	610	3.90	32.97	Papua New Guinea	21	0.13	63.66
Costa Rica	144	0.92	33.89	Paraguay	82	0.52	64.18
Dominican Republic	84	0.54	34.43	Peru	605	3.87	68.05
Ecuador	97	0.62	35.05	Philippines	1.245	7.96	76.01
El Salvador	94	0.60	35.65	Poland	170	1.09	77.09
Ghana	248	1.59	37.23	Russian Federation	922	5.89	82.99
Honduras	89	0.57	37.80	Senegal	135	0.86	83.85
Hungary	136	0.87	38.67	Sri Lanka	278	1.78	85.63
Indonesia	874	5.59	44.26	Thailand	453	2.90	88.52
Jamaica	51	0.33	44.59	Tunisia	295	1.89	90.41
Jordan	236	1.51	46.09	Turkey	824	5.27	95.68
Kazakhstan	209	1.34	47.43	Uganda	189	1.21	96.89
Kenya	312	1.99	49.42	Ukraine	209	1.34	98.22
Lebanon	165	1.05	50.48	Zambia	278	1.78	100.00

This table reports countries representativeness in our sample. It gives for each country the number of firms present in the sample (in the column **[Freq]**).

Table 7: Variables and sources

Variable	Nature	Definition	Source
Firm-level			
Activity	Dummy	Mine activation variable	Minex database and author's calculation
Salesgrowth	bounded between - 1 and 1	Firm's sales growth over last three years	Author' calculation
LPG	bounded between - 1 and 1	Firm's productivity growth over last three years	Author' calculation
Age	Continuous	Firm's age variable	World Bank Enterprise Survey
Size	Ordinal	Firm's size variable	World Bank Enterprise Survey
Creditline	Dummy	Firm's access to credit	World Bank Enterprise Survey
Domestic capital	Percentage	Share of capital owned by domestic private agents	World Bank Enterprise Survey
Foreign capital	Percentage	Share of capital owned by foreign private agents	World Bank Enterprise Survey
Ratioskill	Percentage	Share of workers that are skilled	World Bank Enterprise Survey
Government capital	Percentage	Share of capital owned by Government	World Bank Enterprise Survey
Inter	Dummy	Firm's level of openness to the world	Author' calculation
National Inputs	Percentage	Share of inputs having domestic origin	World Bank Enterprise Survey
Country-level			
Manufact	Continuous	Value added of Manufacture sector as part of GDP	World Development Indicator
Instit	Bounded continuous	Institutional quality variable	International Country Risk Guide
Growth	Continuous	Real GDP per Capita Growth	World Developement Indiacator

This table reports the sources our the different variables used. It gives the name of variables as used in the paper, the nature of these variables, a short explanation of the variables and their sources.

Table 8: Results using Labor Productivity Growth (LPG) as dependent variable

	(1) Main	(2) Government	(3) International	(4) Inputs	(5) MCO	(6) Entropy
Activity	-0.0768***	-0.0760***	-0.0743***	-0.0633***	-0.0768***	-0.0771***
	(0.0180)	(0.0175)	(0.0187)	(0.0212)	(0.0180)	(0.0254)
Age	0.0012***	0.0012***	0.0012***	0.0012***	0.0012***	0.0013***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Size	0.1139***	0.1139***	0.1121***	0.1133***	0.1139***	0.1103***
	(0.0114)	(0.0114)	(0.0105)	(0.0111)	(0.0114)	(0.0124)
Credit line	0.0228***	0.0227***	0.0236***	0.0222***	0.0228***	0.0240**
	(0.0075)	(0.0074)	(0.0077)	(0.0075)	(0.0075)	(0.0099)
Demand	0.0141*	0.0141*	0.0142*	0.0121*	0.0141*	0.0119
	(0.0073)	(0.0073)	(0.0073)	(0.0069)	(0.0074)	(0.0073)
Sales 3yrs	-0.0699***	-0.0699***	-0.0706***	-0.0702***	-0.0699***	-0.0680***
	(0.0060)	(0.0060)	(0.0062)	(0.0058)	(0.0060)	(0.0064)
Domestic capital	-0.0007***	-0.0007***	-0.0007***	-0.0006***	-0.0007***	-0.0008***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0002)
Ratioskill	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001	-0.0002
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Growth	0.0428***	0.0426***	0.0423***	0.0415***	0.0428***	0.0429***
	(0.0035)	(0.0034)	(0.0036)	(0.0040)	(0.0035)	(0.0051)
Institutions	0.1952***	0.1950***	0.2036***	0.2068***	0.1952***	0.1830***
	(0.0456)	(0.0455)	(0.0477)	(0.0452)	(0.0457)	(0.0506)
Manufact	-0.0673***	-0.0673***	-0.0682***	-0.0652***	-0.0673***	-0.0655***
	(0.0056)	(0.0056)	(0.0059)	(0.0054)	(0.0057)	(0.0062)
Government capital		-0.0001				
		(0.0004)				
Inter			0.0714**			
			(0.0295)			
National inputs				-0.0004***		
				(0.0001)		
Observations	15600	15599	15600	15439	15600	15600
Countries	44	44	44	44	44	44
R^2	.3287	.3287	.3299	.3253		
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

This table reports replication of main table test using labor poductivity growth as dependent variable. Robust standard errors are reported in parentheses. The constant is included, but not reported in the table. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Channels

	(1) Institution	(2) ER	(3) Workforce
Activity	-0.0911***	8.6573***	3.0991***
	(0.0289)	(0.3667)	(0.0863)
N	15642	15642	12657
R^2	.6212	.5031	.6311

Notes: N=12657, t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01