Mining Matters: Natural Resource Extraction and Firm-Level Constraints*

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Abstract

We estimate the impact of local mining activity on the business constraints experienced by 22,150 firms across eight resource-rich countries. We find that the presence of active mines deteriorates the business environment in the immediate vicinity (<20 km) of firms while it relaxes business constraints of more distant firms. The negative local impact of mining is concentrated among firms in tradeable sectors whose access to inputs and infrastructure becomes more constrained. This deterioration of the local business environment adversely affects firm growth and is in line with a natural resource curse at the sub-national level.

JEL codes: L16; L25; L72; O12; O13; Q30

Keywords: Mining; natural resources; business environment

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* The authors thank Martin Acht, Francesca Dalla Pozza, Alex Stepanov, and Teodora Tsankova for excellent research assistance and Simon Commander, Sergei Guriev, Beata Javorcik, Juan Pablo Rud, Helena Schweiger, Pablo Selaya, Paul Pelzl, Rick van der Ploeg, Pierre-Louis Vezina, Yuanyuan Yi and participants at the World Bank-OxCarre-Natural Resource Governance Institute Workshop on the Sub-National Resource Curse, the 2016 CSAE Conference (Oxford), the European Association of Environmental and Resource Economics Conference (Zurich), the 31st Annual Congress of the European Economic Association (Geneva), DEGIT XXI in Nottingham, the Dutch Economists Day 2016, and seminars at the Tinbergen Institute, Vrije Universiteit Amsterdam, EBRD, Norwegian School of Economics, University of Oxford and University of Sydney for useful comments. The views expressed are those of the authors and not necessarily of the institutions they are affiliated with.

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1. Introduction

The last two decades have witnessed an extraordinary expansion in global mining activity. A surge in commodity demand from industrialising countries pushed up the price of metals and minerals. This in turn led to substantial new mining investment, an increasing share of which is concentrated in emerging markets (Humphreys, 2010). This geographical shift reflects that many American and European mineral deposits have by now been depleted and that the long-distance transport of minerals by sea has become less costly. As a result, the world's largest mines can nowadays be found in Africa, Asia and Latin America.

The mining boom has also reinvigorated the debate about the impact of mining on economic activity and welfare. Some regard mines simply as stand-alone enclaves without a notable local impact (Hirschman, 1958). Others point to the potentially negative consequences of natural resource dependence such as real exchange rate appreciation, economic volatility, deindustrialization and corruption (see van der Ploeg (2011) for a comprehensive survey). Mines can also pollute and threaten the livelihoods of local food producers. They often require vast amounts of water, electricity, labour and infrastructure, for which they may compete with local manufacturers. Yet others stress the potential for *positive* spillovers to firms and households as mining operators may buy local inputs and hire local employees.[1] Local wealth can also increase if governments use taxable mining profits to invest in regional infrastructure or to make transfers to the local population.

Our paper informs this debate by estimating the impact of active mines on nearby firms across eight countries with large manufacturing and mining sectors: Brazil, Chile, China, Kazakhstan, Mexico, Mongolia, Russia and Ukraine. Our detailed data allow us to get around the endogeneity issues that plague country-level studies as well as the limitations to external validity of well-identified country-specific papers. Our empirical analysis is motivated by the "Dutch disease" model of Corden and Neary (1982) which sets out how a resource boom drives up wage costs for firms in the traded (manufacturing) sector as they compete for labour with firms in the resource and non-traded sectors. We hypothesise that mining companies and manufacturing firms also compete for other inelastically supplied inputs and public goods—such as transport infrastructure and electricity—and that this hurts tradeable-sector firms, which are price takers on world markets.

We test this hypothesis by combining two main data sets. First, we use detailed data on 22,150 firms from the EBRD-World Bank Business Environment and Enterprise Performance

[1] For example, Wright and Czelusta (2007) argue that "linkages and complementarities to the resource sector were vital in the broader story of American economic success".

Survey (BEEPS) and the World Bank Enterprise Survey. These data contain the responses of firm managers to questions on the severity of various constraints to the operation and growth of their business, including access to transport infrastructure, electricity, land, educated workers and finance. A growing literature uses such survey data to gauge whether access to public goods affects firm performance.[2] Firms' perceptions of the importance of various external constraints on their activity can be used to find out which constraints affect economic activity the most (Carlin, Schaffer and Seabright, 2010). These constraint variables measure competition for inputs directly, as they reflect firms' intended rather than actual use of inputs, and can therefore be interpreted as the shadow prices of public inputs. We exploit variation across firms in the reported severity of external input constraints to assess how local mining activity, by affecting the quality and quantity of public input provision, influences the ability of local firms to grow.

Second, we use the proprietary SNL Metals & Mining data set, which contains comprehensive information on the geographical location, operating status and production data for individual mines. We identify the latitude and longitude of 3,793 mines producing 31 different metals and minerals in our country sample. Depending on the year, we observe the operating status of between 1,526 and 2,107 mines.

Merging these firm and mine data allows us to paint a precise and time-varying picture of the mines that open, operate and close around each firm. Since local mining activity is plausibly exogenous to the performance of individual firms—as it largely depends on local geology and world mineral prices—we can identify the impact of mining on local business constraints and firm performance. To the best of our knowledge, ours is the first paper to estimate this impact of mining activity on firm performance and to do so across a variety of countries.

Two core results emerge from our analysis, both consistent with a sub-national version of the seminal Corden and Neary (1982) model. First, in line with a "resource-movement effect", we uncover heterogeneous mining impacts in the immediate vicinity (≤ 20 kilometers) of active mines that depend on whether a firm produces tradeable or non-tradeable goods. Only producers of tradeables that are close to active mines report tighter business constraints (as compared with similar firms that are not close to mines). These firms are especially hampered in their ability to access transport infrastructure and educated workers. Importantly, mining-

[2] See, for instance, Commander and Svejnar (2011) and Gorodnichenko and Schnitzer (2013). Appendix B contains the questions we use in this paper and www.enterprisesurveys.org provides additional background information. The surveys also provide a rich array of firm covariates, such as industry, age, sales, employment, and ownership structure.

induced business constraints hurt firm performance in terms of total employment and to a lesser extent also in terms of assets and sales. Our results indicate that moving a producer of tradeables from an area without mines to an area with average mining intensity would reduce the number of employees by 2.7% on average, reduce sales by up to 2.8 percent, and assets by up to 6.3 percent. In sharp contrast, up- or downstream firms in the natural resource sector itself and firms in the construction and non-traded sector *benefit* from local mining activity.

Second, in line with a sub-national "spending effect" we find that firms report an improvement in the provision of public goods if current mining activity increases in a distance band of between 20 and 150 km around firms. This indicates that while mines can cause infrastructure bottlenecks in their immediate vicinity and crowd out other firms, they may improve the business environment on a wider geographical scale.

All our main results are based on regression specifications that include regional fixed effects so that we effectively compare, within one and the same region, firms with and without nearby mines. In robustness tests, we vary the distance bands around firms; exclude young firms which may self-select into locations close to mines; exclude firms that have plants in multiple locations; examine coal mines separately; control for oil and gas fields; and measure mining activity using satellite imagery of night-time light intensity. None of this affects the main results. Importantly, for a sub-set of firms we also analyse panel data. These regressions, which include firm fixed effects, confirm and hence strengthen our cross-sectional findings.

This paper contributes to a growing literature on the economic impact of natural resource abundance. Early contributions point to a negative cross-country correlation between resource exports and long-term economic growth (Sachs and Warner, 1997 and Auty, 2001). Various mechanisms have been proposed for why resource-rich countries appear unable to convert natural resources into productive assets. These include an appreciation of the real exchange rate which turns non-resource exports uncompetitive (the Dutch disease); worsening institutions and governance (Besley and Persson, 2010; Dell, 2010); rent seeking (Mehlum, Moene and Torvik, 2006; Beck and Laeven, 2006) and increased conflict (Collier and Hoeffler, 2004; Miguel, Satyanath and Sergenti, 2004). The cross-country evidence remains mixed—reflecting thorny endogeneity issues—and the very existence of a resource curse continues to be heavily debated (van der Ploeg and Poelhekke, 2010; James, 2015).

To strengthen identification, recent papers exploit micro data to estimate the impact of natural resource discoveries on local living standards.[3] Aragón and Rud (2013) show how the Yanacocha gold mine in Peru improved incomes and consumption of nearby households. Their findings indicate that mining can have positive local equilibrium effects if backward linkages are strong enough.[4] Loayza, Mier y Teran and Rigolini (2013) and Lippert (2014) also document positive impacts on living standards for Peru and Zambia, respectively. For the case of Ghana, Fafchamps, Koelle and Shilpi (2016) find that gold mining has led to agglomeration effects that benefit non-farm activities.[5] Consistent with these country studies, Von der Goltz and Barnwall (2014) show for a sample of developing countries that mining boosts local wealth but often comes at the cost of pollution and negative health impacts.

We contribute to this nascent literature in two ways. First, we shift the focus from households to firms to gain insights into the mechanisms through which mining affects local economic activity (and ultimately household incomes).[6] We not only observe firm-level outcomes (such as employment) but also the mechanisms through which mining activity hampers some sectors but benefits others. Second, using harmonised micro data from a diverse set of countries with large mining and manufacturing sectors adds to the internal as well as external validity of our results.

Our paper also relates to a small parallel literature on local oil and gas booms in the United States. Michaels (2011) and Allcott and Keniston (2014) show that historical hydrocarbon booms benefited county-level economic growth through positive agglomeration effects, backward and forward linkages, and lower transport costs.[7] In contrast, Jacobson and Parker (2014) find that the US oil and gas boom of the 1970s led to negative long-term

[3] See Cust and Poelhekke (2015) for a survey. Others estimate impacts on health and behavioral outcomes such as female empowerment and infant morbidity (Tolonen, 2015) and risky sexual behavior (Wilson, 2012). Sub-national data have also been used to reassess claims based on cross-country data, such as that natural resources cause armed conflict and violence (Dube and Vargas, 2013; Arezki, Bhattacharyya and Mamo, 2015; Berman, Couttenier, Rohner and Thoenig, 2017).

[4] Backward linkages exist if mines purchase local inputs like food, transportation services and raw materials. Forward linkages include the downstream processing of mineral ores such as smelting and refining.

[5] Aragón and Rud (2016) show the flipside of Ghanaian gold mining: increased pollution, lower agricultural productivity and more child malnutrition and respiratory diseases.

[6] Glaeser, Kerr and Kerr (2015) show how proximity to mining deposits led US cities to specialise in scaleable activities, such as steel production, at the cost of fewer start-ups. This negative impact on local entrepreneurship can become entrenched if entrepreneurial skills and attitudes are transmitted across generations (Chinitz, 1961).

[7] Caselli and Michaels (2013) show that revenue windfalls from Brazilian offshore oil wells (where backward and forward linkages are less likely) led to more municipal spending but not to improved living standards. Brollo, Nannicini, Perotti and Tabellini (2013) show that this may reflect an increase in windfall-induced corruption and a decline in the quality of local politicians. Likewise, Asher and Novosad (2016) show how mining booms in India result in the election of criminal politicians.

income effects. They suggest that contrary to booms in the more distant past (as studied by Michaels, 2011) the persistent negative effects of the 1970s boom offset any long-term positive agglomeration effects. We assess whether our results are sensitive to the presence of oil and gas production by extending our regressions with the number of oil and gas fields (if any) around each firm.

We also contribute to work on the relationship between the business environment and firm performance. This literature has moved from using country-level proxies for the business environment (Kaufmann, 2002) to firm-level, survey-based indicators of business constraints. Dethier, Hirn and Straub (2011) point to the typically strong correlation between firms' subjective assessments of the severity of business constraints and more objective indicators. For instance, Pierre and Scarpetta (2004) show that in countries with strict labour regulations there is a higher share of firms that report labour regulations as a problem. While various papers find negative correlations between firm-level indicators of business constraints and firm performance, endogeneity concerns linger.[8] Commander and Svejnar (2011) link firm performance in 26 transition countries to firms' own assessments of aspects of the business environment. They conclude that once country fixed effects are included, firms' perceptions of business constraints add little explanatory power. Our contribution is to use exogenous shocks that stem from the opening of large-scale mines to help mitigate the endogeneity concerns that continue to plague this literature.

Lastly, a related literature investigates the negative externalities (congestion) and positive externalities (agglomeration) of geographically concentrated economic activity.[9] Congestion occurs when firms compete for a limited supply of infrastructure or other public goods.[10] Agglomeration effects emerge when spatially proximate firms benefit from deeper local labour markets, the better availability of services and intermediate goods, and knowledge spillovers (Marshall, 1920). In line with agglomeration benefits, Greenstone, Hornbeck and

[8] For instance, Johnson, McMillan and Woodruff (2002); Beck, Demirgüc-Kunt and Maksimovich (2005); Dollar, Hallward-Driemeier and Mengistae (2006); Hallward-Driemeier, Wallstein and Xu (2006) and Bah and Fang (2015). Some papers use industry or city averages of business constraints as either regressors or instruments to reduce endogeneity concerns.

[9] See Combes and Gobillon (2015) for a survey of the agglomeration literature.

[10] A recent literature investigates the spatial impact of infrastructure on economic activity. Donaldson (2017) shows how new railways in colonial India integrated regions and boosted welfare gains from trade. In a similar vein, Bonfatti and Poelhekke (2017) show how purpose-built mining infrastructure across Africa determined long-term trading patterns between countries. In China, the construction of trunk roads and railways reinforced the concentration of economic activity and increased economic output (Faber, 2014 and Banerjee, Duflo and Qian, 2012). In the United States, Chandra and Thompson (2000) and Michaels (2008) exploit the construction of interstates to document agglomeration effects.

Moretti (2010) show that US firms close to new large plants experience positive productivity spillovers. We assess whether newly opened mines mainly lead to positive agglomeration or negative congestion effects for nearby firms.

The paper is organised as follows. Section 2 develops a simple theoretical model and derives our main hypotheses. Sections 3 and 4 then describe our data and empirical strategy, after which Section 5 presents our results. Section 6 concludes.

2. Theory and Hypotheses

To build intuition on how a mining boom affects both local and more distant firms, we adapt a multiregional de-industrialization model (Allcott and Keniston, 2014). This framework is closely related to earlier Dutch disease models (Corden and Neary, 1982; Van Wijnbergen, 1984). The distinctive features of our model are that there are multiple regions across which labour is (imperfectly) mobile and that redistribution of natural resource rents may take place between regions.[11]

We model each region as a small open economy where each consumer supplies one unit of labour. Consumers work in one of three sectors: the manufacturing sector m, which produces goods that are tradeable internationally and across regions; services n, which are non-tradeable across regions; or the tradeable natural resource sector r. The prices of both manufacturing goods p_m and minerals p_r are set on world markets and therefore exogenous. Only the price of non-traded services p_{nd} is endogenous and varies by region *d*. Each sector s produces $X_{sd} = A_{sd} F_s(l_{sd})$ where A_{sd} is productivity. A_{sd} has a local component due to a sector's reliance on region-specific inputs such as agglomeration economies or natural resource deposits. F_s is a production function common to sector s with $F_s(0) = 0$, $F_s'(\cdot) > 0$ and $F_s''(\cdot) < 0$, and l_{sd} is labour employed by sector s in region *d*.

Employment is perfectly substitutable across sectors and is mobile between regions such that total labour supply L_d is an increasing function of both wages and transfers received by workers: $L_d = L(w_d + b_d)$. With full employment we have:

$$l_{md} + l_{rd} + l_{nd} = L(w_d + b_d) \tag{1}$$

[11] We do not model firm heterogeneity or firm entry and exit as we cannot measure firm-level productivity.

Per capita transfers b are an increasing function of national resource rents $R = \sum_d \left(p_r X_{rd} - w_d l_{rd} \right)$ but ultimately depend on the country's welfare function and the exogenous weights attached to individuals in the extracting region. For example, if local consumers own the mining land (which resembles the institutional setting in the United States) then transfers in the form of royalty payments can be substantial. Conversely, if the state owns the mining rights (as is the case in most other countries) then fewer mining rents are redistributed to the producing region and rents are instead spread across regions.

Labour input l can also be interpreted as being used in a fixed proportion to public good inputs, such as infrastructure. A higher demand for l then translates into a higher demand for public goods as well. We assume that such public goods are not mobile across regions, exogenously provided by a higher layer of government, and increasing in national natural resource rents R. Crucially, the supply of such goods does not endogenously adjust to higher shadow prices for their use. For example, increased congestion on rail and roads will drive up delays and transportation costs, but it is up to the (national) government to invest more in these public goods (which are non-excludable *but* rivalrous in consumption). Congestion of public goods and competition for private goods will show up as higher self-reported business constraints when firms intend to use more of these inputs but cannot do so due to congestion or because the cost of using an input rises. These costs can be monetary in the case of private goods and both monetary and time related (due to delays) in the case of public goods.

We assume that all minerals are directly or indirectly exported.[12] Aggregate income in region or district d then equals consumption of manufacturing goods and services from which consumers with Cobb-Douglas preferences derive utility U :

$$\left(w_d + b_d \right) L_d = p_m C_{md} + p_{nd} C_{nd} \tag{2}$$

where C_{md} includes imports from other regions and countries. Demand is given by:

$$p_{nd} C_{nd} = L_d \alpha \left(w_d + b_d \right) \tag{3}$$

$$p_m C_{md} = L_d \left(1 - \alpha \right) \left(w_d + b_d \right) \tag{4}$$

[12] Downstream sectors may use minerals as inputs and subsequently export all downstream products.

The term b_d is the spending effect in the terminology of Corden and Neary (1982). If these transfers are zero, then an increase in the profitability of the natural resource sector will raise wages and non-traded prices proportionally. Transfers may be such that a natural resource boom in region *d* can introduce a spending effect in region $\not{d}$, for example in the state or province to which the region belongs.

The services and traded manufacturing goods market equilibria follow as:

$$C_{nd} = X_{nd} = A_{nd} F_n \left(l_{nd} \right) \tag{5}$$

$$C_{md} = X_{md} + IM_{md} = A_{md} F_m \left(l_{md} \right) + IM_{md} \tag{6}$$

where IM_m are net imports of manufactured goods. Finally, perfect sectoral labour mobility equalises wages across sectors to their marginal product:

$$w_d = p_m A_{md} F'_m \left(l_{md} \right) = p_r A_{rd} F'_r \left(l_{rd} \right) = p_{nd} A_{nd} F'_n \left(l_{nd} \right) \tag{7}$$

We model a local resource boom as an exogenous shock to the natural resource sector in region *d* such that this sector becomes more productive. This can either be achieved through a rise in p_r, the world price of minerals, or through a rise in A_{rd}, which can be thought of as an improvement in extraction technology or the discovery of new deposits in region *d*.[13] In both cases local profits increase, which also increases transfers b_d.

The impact of the local resource boom $p_r A_{rd}$ will be fourfold. First, the demand for labour and public goods in the mineral sector rises and wages increase (equation 7). To the extent that labour supply L_d is not perfectly inelastic, immigration from other regions dampens this increase in wages.[14] For perfectly elastic supply, the increase in labour demand in the mineral sector is completely met by supply from other regions.[15] Moreover, to the

[13] New discoveries are assumed to be exogenous as exploration is spatially homogeneous within country-years in the sense that it is uncorrelated with pre-existing economic activity and other local characteristics.

[14] Since labour and public goods are used in fixed proportions, immigration will not dampen the wage increase unless more public goods are supplied as well. These may be financed by natural resource rents.

[15] An increase in $p_r A_r$ raises the marginal product of labour in the resource sector and thus wages in (7). It also decreases employment in the other two sectors (rewrite (7) for sector *m* (an equivalent for *n*) as $n_{md} = F'^{-1}_m \left(\frac{p_r A_{rd}}{p_m A_{md}} F'_r \left(l_{rd} \right) \right)$). Labour reallocates from sectors *m* and *n* to sector *r*. However, through combining

extent that supply chains are local, firms with strong upstream linkages to mines may benefit from an increased demand for intermediate inputs (Moretti, 2010).

Second, the boom in $p_r A_{rd}$ raises services prices p_{nd} and thus induces a real appreciation in region *d*. The production of non-traded services increases too. Higher wages (if labour demand is not fully met through immigration) are passed on to higher non-traded prices through a rise in local aggregate demand. Moreover, a rise in $p_r A_{rd}$ raises mineral rents and thereby regional transfers b_d. This also raises local aggregate demand and further drives up prices p_{nd} and services production X_{nd}.[16]

Third, if wages increase, profitability in the manufacturing sector declines because the traded sector is a price taker on world markets. From the marginal product of labour in the manufacturing sector it follows that l_{rd} and X_{rd} decrease, which is the resource-movement effect in Corden and Neary (1982). Manufacturing consequently contracts as firms compete with establishments in non-resource regions that did not suffer from an increase in input costs (Moretti, 2011).

Fourth, to the extent that labour is mobile between regions and rents are redistributed across regions, we should expect spillover effects. The immigration of labour into the boom region results in excess labour demand in origin regions and possibly a shrinking of services and manufacturing sectors in these regions. Unless labour is highly mobile, this effect attenuates with distance.

The increase in aggregate demand in the producing region spills over into higher demand for manufactured goods, which must be supplied through imports from other regions or

equations 1 and 7, the upward pressure on wages and subsequent reallocation is muted to the extent that total labour supply is elastic. Wages increase as long as total regional labour supply is not fully elastic.

[16] We assume that an exogenous fraction ω of national rents is spent in the producing region. Total local income from rents is equal to $\omega_d \sum_d p_r A_{rd} \left(F_r(\cdot) - F_r'(\cdot) l_{rd} \right)$, such that local rents are increasing in $p_r A_{rd}$. This relaxes the consumer budget constraint (3) and increases demand for non-traded goods, raising prices p_{nd}. Combining equations 3, 5 and 7 yields $p_{nd} A_{nd} F_n(l_{nd}) = L_d \alpha (w_d + b_d) = w_d \frac{F_n(l_{nd})}{F_n'(l_{nd})}$, and provides an expression for non-traded services production as a function of population and natural resource production: $L_d \alpha + \omega_d \alpha \sum_d \left(\frac{F_r(l_{rd})}{F_r'(l_{rd})} - l_{rd} \right) = \frac{F_n(l_{nd})}{F_n'(l_{nd})}$. Taking the derivative to $p_r A_{rd}$ and using the fact that F is concave, $\partial L_d / \partial p_r A_{rd} \geq 0$, and $\partial l_{rd} / \partial p_r A_{rd} \geq 0$ yields that an increase in $p_r A_{rd}$ raises both non-traded labour input and production. This results from an increase in wages and thus population L_d and through increased demand due to the transfer of rents. Finally, non-traded prices increase.

countries. In the former case, the demand for manufacturing goods in non-booming regions increases. This effect is particularly strong if no redistribution of rents takes place and local income increases by the full amount of rents. In our sample of countries, it is more likely that the increase in national mineral rents spreads to non-booming regions through transfers. Transfers thus introduce a spending effect in non-booming regions as well. From the perspective of the traded sector, the positive trade and spending effects are likely to be attenuated less by distance than the wage effect (which reflects regional competition for relatively immobile labour).

This theoretical discussion suggests two main testable hypotheses regarding the impact of mining on the business constraints faced by nearby firms:

1. Negative resource-movement effects near mines are associated with a deterioration of the business environment experienced by local firms. At a greater distance from mines, these negative effects are (more than) compensated by positive spending effects as the provision of public goods expands and the business environment improves.
2. In line with local resource-movement effects in the immediate vicinity of mines, firms in tradeable sectors experience tighter business constraints (in terms of access to labour and public goods such as infrastructure) than firms in non-tradeable sectors or in the natural resource sector. Positive spending effects benefit firms across all sectors.

3. Data

For our purposes, we need data on the business constraints experienced by individual firms as well as detailed information on the presence of mines near each firm. We therefore merge our firm-level survey data from eight emerging markets—Brazil, Chile, China, Kazakhstan, Mexico, Mongolia, Russia and Ukraine—with the geographical coordinates of the near universe of minerals (including coal) and metal mines in these countries. All of these countries are geographically large, have a substantial mining sector and participated in one or more business environment surveys.[17]

3.1 Mining Data

We download data from the leading provider of mining information, SNL's Metal & Mining (formerly Raw Materials Group). The data set contains for each mine annual information on

[17] The value of natural resource extraction at world prices as a share of GDP in 2008—not taking into account production costs—was 8% in Brazil; 25% in Chile; 15% in China; 56% in Kazakhstan; 12% in Mexico; 35% in Mongolia; 40% in Russia; and 17% in Ukraine (source: World Bank, Adjusted Net Savings Data).

the production levels for every mineral as well as the GPS coordinates of its center point. We also know the mine's operation status at each point in time. This allows us to distinguish between active (operating) and inactive mines and to count the number of active mines near each firm. This status is typically driven by exogenous world prices: when prices rise, more mines (re-)open. We assemble this information for the 3,794 mines scattered across the eight countries. For a subset of active mines, we also know metal production and for a small subset ore production, measured in millions of tons (metric megaton, Mt) of ore mined per year.[18] Although a measure of ore produced (which includes both rocks and metals and minerals with varying grades) may be a better gauge of how many inputs the mine requires, this is unfortunately only recorded for one in ten mine-year observations. We also experiment with using night-time lights recorded by satellites to gauge the intensity of mining activity directly around the mine coordinates.

We focus on mines rather than the extraction of oil and gas as hydrocarbon production has a different structure in terms of environmental, social and economic impacts (World Bank, 2002). For instance, oil and gas tend to occur in larger concentrations of wealth than metals and other minerals and this might lead to larger spending effects. Hydrocarbon production is also more capital intensive and may therefore affect labour demand to a lesser extent. Moreover, in our sample, oil and gas fields are very remote from almost all manufacturing activity. We return to the issue of hydrocarbon production in Section 5.6.

3.2 Firm Data

To measure firms' business constraints, we use various rounds of the EBRD-World Bank Business Environment and Enterprise Performance Survey (BEEPS) and the equivalent World Bank Enterprise Surveys. Face-to-face interviews were held with 22,150 firms in 2,144 locations across our country sample to measure to what extent particular aspects of the business environment hold back firm performance. The surveys were administered using a common design and implementation guidelines.

Firms were selected using random sampling with three stratification levels to ensure representativeness across industry, firm size and region. The sample includes firms from all main industries (both manufacturing and services) so that we can use industry fixed effects in

[18] Mines typically produce ore that contains several minerals with varying grades. Appendix Table A2 provides a frequency table of the minerals in our data set. All minerals and metals are point-source resources: unlike diffuse natural resources such as coffee and tobacco, they are produced in geographically concentrated locations. Limited information on reserves is also available but we focus on actual mining activity as unmined subsoil assets should not affect firm performance directly.

our regression framework. While mines are not part of the surveys, upstream and downstream natural resource firms are included. The first four columns of Appendix Table A3 summarise the number of observations by year and country (all regressions include country-year-sector fixed effects) while Table A4 gives a detailed sector breakdown. We have data for the fiscal years 2005, 2007, 2009 and 2011.

As part of the survey, owners or top managers evaluated aspects of the local business environment and public infrastructure in terms of how much they constrain the firm's operations. For instance, one question asks: *"Is electricity "No obstacle", a "Minor obstacle", a "Moderate obstacle", a "Major obstacle" or a "Very severe obstacle" to the current operations of your establishment?*". Similar information was elicited about the following business constraints: inadequately educated workforce; access to finance; transportation infrastructure; practices of competitors in the informal sector; access to land; crime, theft and disorder; business licenses and permits; political instability; corruption; and courts. Crucially, these questions allow us to measure competition for inputs directly because they reflect a firm's intended use of inputs as opposed to their actual use. Moreover, we do not have to rely on price data which often do not exist for non-market public goods. Because the scaling of the answer categories differs across survey rounds (either a five- or a four-point Likert scale) we rescale all measures to a 0-100 scale using the conversion formula (value – minimum value)/(maximum value – minimum value).

For each firm we construct *Average business constraints,* which measures the average of the above-mentioned 12 constraint categories. Like the underlying components, this average ranges between 0 and 100. Appendix A contains a histogram of the distribution of this variable. In addition, we create the measures *Input constraints* (access to land, access to an educated workforce, and access to finance); *Infrastructure constraints* (electricity and transport); and *Institutional constraints* (crime, informal competitors, access to business licences, corruption, political instability and court quality). These measures again range between 0 and 100. The average constraint intensity is 30.2 but there is wide variation across firms; the standard deviation is 27.3. The most binding constraints are those related to access to inputs (34.7), followed by infrastructure (29.5) and institutional constraints (23.4).

We also create firm-level covariates. These include firm *Age* in number of years and dummies to identify *Small firms*, *Medium-sized firms* and *Large firms*; *International exporters* (firms whose main market is abroad); *Foreign firms* (foreigners own 10% or more of all equity); and *State firms* (state entities own at least 10% of the firm's equity). Moreover, we create log *Employment, Sales* and *Assets* as firm-level outcomes and construct the following

sector dummies: *Manufacturing*; *Construction*; *Retail and wholesale*; *Real estate, renting and business services;* and *Others*.[19] For each firm we know the name and geographical coordinates of its location (city or town). We exclude firms in capital cities because limited fiscal redistribution may keep rents disproportionately in the capital. Table A1 in the Appendix provides all variable definitions while Table 1 provides summary statistics.

[Insert Table 1 here]

3.3 Combining the Mining and Firm Data

A final step in our data construction is to merge—at the local level—information on individual firms with information on the mines that surround them. We identify all mines within a radius of 20 km (12.4 miles) and within a distance band of between 21 and 150 km (13.0 and 93.2 miles, respectively) around each firm. Figure 1 provides a data snapshot for two sample countries, Ukraine and Kazakhstan. The top panel shows the location of firms and mines and indicates that geographical coverage is comprehensive. Firms are not concentrated in only a few cities nor are mines clustered in just a few regions. Zooming in to the squares in the bottom panel reveals substantial variation in distances between firms and mines. There are both firms with and without mines in their immediate vicinity (within a 20 km radius). Throughout most of our analysis, we include regional fixed effects so that we compare firms with and without local mines within one and the same geographical region within a country.

[Insert Figure 1 here]

We are agnostic about the spatial range within which mines affect firms and therefore start by exploring spatial rings used in the literature.[20] We assess distance circles of radius 20, 50, 100, 150, 300 and 450 km. Exploratory regressions show noisy effects at 10 km and positive effects on firms' constraints up to 20 km, after which the sign switches to negative effects up

[19] Once we categorise firms into traded, non-traded, construction and natural resource related sectors, we replace sector dummies with dummies for these categories.

[20] Kotsadam and Tolonen (2016) and Tolonen (2015) show that the impact of African gold mines on labour markets is strongest within a radius of 15 to 20 km. Cust (2015) finds that labour market impacts are concentrated within a 15 km radius around Indonesian mines. Aragón and Rud (2016) use a 20 km radius to study agricultural productivity near African gold mines while Goltz and Barnwall (2014) take a 5 km cutoff based on prior evidence on the spatial extent of pollution. Aragón and Rud (2013) analyse longer-distance impacts (100 km) of the Peruvian mine they study. Finally, Glaeser, Kerr and Kerr (2015) examine distances of up to 500 km between historical coal deposits and US cities. Papers that focus on district-level impacts due to fiscal channels typically also use longer distances (Loayza *et al.*, 2013 and Allcott and Keniston, 2014).

to 150 km (see Appendix Table A5). After 150 km the effects become very small. This is visualised in the graph on the left-hand side of Figure 2 in which each point represents a separate regression. We therefore group mines into three distance bands: up to 20 km, 21-150 km and 151-450 km and find that only the first two bands show significant and economically meaningful results (see the right-hand side graph in Figure 2 in which each panel is the result of a single regression).[21] Our results are robust to redefining these two distance bands by reducing or expanding them by 10 percent.

[Insert Figure 2 here]

Using our merged data, we then create variables that proxy for the extensive and intensive margin of mining activity in each of these two distance bands. At the extensive margin, we create dummy variables that indicate whether a firm has at least one active mine in its direct or its broader vicinity (*Any active mine*). In our sample, 24% of all firms have at least one mine within a 20 km radius while 77% have at least one mine within a 21-150 km radius (see Table 1). At the intensive margin, we measure the number of mines around firms (*№ active mines*). On average, each firm has 0.6 active mines within a 20 km radius but there is wide variation: this variable ranges between 0 and 19 mines. Within a 21-150 km distance band, the number of active mines is on average 7.6 and again ranges widely between zero and 152 mines. We also create similar variables that measure inactive mines and mines with an unknown operating status and use these as control variables in our analysis.

4. Empirical Strategy

We consider the following empirical model to estimate the impact of mining on firms' business constraints within a certain distance band:

$$Y_{fsdct} = \beta M_{fsdc,t-2} + \gamma X_{fsdct} + S_{sct} + D_{dc} + \varepsilon_{fsdct} \tag{8}$$

where Y_{fsdct} indicates for firm f in sector s in region d of country c in year t the local *Average business constraints* it experienced on a scale of 0 to 100 or, more specifically, its *Input constraints*, *Infrastructure constraints* or *Institutional constraints*. $M_{fsdc,t-2}$ contains a number

[21] The same pattern emerges when including sector interactions in Panel B of Table A5. Comparing column (2) with (8) and (9) in both panels of Table A5 also shows that the results of the number of mines within 20 km on (traded) firms do not depend on inclusion of the outer band(s). Although there is some positive spatial correlation between the number of mines across the distance rings, this does not cause severe multicollinearity.

of two-year lagged indicators of local mining activity within a 0-20 or 21-150 km spatial band around firm *f*.[22] X_{fsdct} is a matrix of covariates related to firm age, size and ownership.

We saturate the model with country-year-sector fixed effects—S_{sct}—to wipe out (un)observable variation at this level and to rule out that our results reflect industry-specific demand shocks or country-specific production structures. These fixed effects also take care of any (unintended) differences in survey implementation across countries, years and sectors. In addition, in most specifications we include (within-country) regional fixed effects—D_{dc}—so that we consistently compare—within one and the same geographical region of a country—firms with and without nearby mines. These fixed effects absorb time-invariant geographical and other differences (such as in the business climate) between resource-rich and resource-poor regions in a country that may correlate with both resources and firm constraints. Lastly, we cluster robust standard errors by country-year-sector (Table 10 shows that our results are robust to alternative clustering strategies). We are interested in the OLS estimate of β, which we interpret as the impact of local mining intensity on firms' business constraints.[23]

Our data allow us to test whether the impact of mines on firm constraints differs across sectors. As discussed in Section 2, theory suggests that the impact of local mining may be positive for non-tradeable sectors and construction but negative for firms in tradeable sectors. We therefore also estimate:

$$Y_{fsdct} = \beta M_{fsdc,t-2} \times N_s + N_s + \gamma X_{fsdct} + S_{sct} + D_{dc} + \varepsilon_{fsdct} \quad (9)$$

where N_s is one of four dummies that identify whether a firm is in a *Tradeable* sector, the *Construction* sector, a *Non-traded* sector or the *Natural resource* sector. We discuss this sector classification in more detail in Section 5.2.

Our identification exploits that the local presence of mining deposits is plausibly exogenous and reflects random "geological anomalies" (Eggert, 2001; Black, McKinnish and Sanders, 2005). The only assumption we need is that spatial exploration intensity within

[22] While it may take time for mining to affect local firms, impacts and employment generation may already be substantial during the investment phase (Tolonen, 2015). Appendix Table A6 shows that our results are robust to changing the time lag to zero, one or three years. Because we do not know for each mine how long it has been active or closed (due to incomplete recording of the history before the year 2000) we do not attempt to separate short-run from medium or long-run effects.

[23] Alternatively, one can estimate (8) with ordered logit to reflect that our constraints measure is the average of rescaled business constraints. However, after rescaling and averaging, the resulting business-constraints measure takes 327 different values, which makes logit results less straightforward to interpret. All our results are nevertheless robust to ordered logit estimation or to using a Tobit model with a lower (upper) limit of 0 (100).

country-years is homogeneous in the sense that it is uncorrelated with pre-existing business constraints and other local characteristics and instead only depends on national institutions such as expropriation risk (Bohn and Deacon, 2000). We can then treat the local presence of mines as a quasi-experimental setting that allows us to identify the general equilibrium effects of exogenous geologic endowments on local businesses. To the extent that exploration intensity is driven by institutional quality, openness to FDI or environmental regulation, such effects will be taken care of by our country-year-sector fixed effects.

5. Results

5.1 Baseline Results

Table 2 reports our baseline results on the impact of mining on local business constraints. The dependent variable is the average of the business constraints as perceived by a firm. We present different functional forms of our main independent variables: the number of active mines in the 0-20 km and 21-150 km spatial bands around each firm. In the first four columns, we use a count variable—the number of active mines—to measure local mining activity. In the fourth column, we impute the operational status (active or inactive) based on night-time light emissions in the direct vicinity (1 km radius) of the mine.[24] In column 5 we take the log of the number of mines plus one to allow for possible concavity in mining impacts.

In line with our discussion in Section 2, we find that nearby mining activity increases the business constraints experienced by firms. In contrast, mining activity relaxes constraints at a longer distance: between 21 and 150 km we find mostly beneficial mining impacts.[25] This holds regardless of the functional form of our mining variables and regardless of whether we saturate the model with country-year fixed effects (column 1), country-year-sector fixed effects (all other columns), exclude our standard set of firm covariates (column 3) or impute missing mining statuses (column 4). Column 5 shows that concavity in the mining impact

[24] Source: Earth Observation Group. Night-time light intensity (luminosity) as captured by satellite imagery is increasingly used to measure economic activity at disaggregated geographical levels (Henderson, Storeygard and Weil, 2011). To impute the missing operating status for mines, we run a probit regression of mine operating status on the luminosity within a 1 km radius of the mine interacted with an open-pit (versus underground) dummy, and country-year fixed effects. The coefficient on lights is positive and highly significant for both types of mines with coefficients of 0.015 and 0.008, respectively, and this difference is significant. Open-pit mines therefore emit almost twice as much night-time light. We then use this model to predict missing operating statuses and assume that a mine is operating if the predicted probability is above the median. This affects 119 (2,520) observations in the 0-20 (21-150) km band.

[25] The unreported covariate coefficients show that larger firms are more and foreign-owned firms less constrained on average. Firm age does not matter much.

does not change the baseline impacts. In column 6 we measure mining activity by the sum of night-time light emitted within a 1 km radius around mines. It is reassuring that this alternative way to calculate mining activity yields qualitatively similar impacts.[26] We therefore measure mining activity by the count of mines in the remainder of the paper.

In column 7 the mining count variables are expressed as the log of the number of active mines where zero values are set to missing. We now also add two dummy variables that separate out localities with and without mining activity in the two distance rings. This effectively splits the earlier effect into impacts along the extensive and intensive margin. The economic and statistical significance of our earlier results hardly changes. That is, even when we control for the fact that locations with mining activity may be different from locations without mining, we find that—conditional on mines being present—more mining activity leads to tighter business constraints nearby and fewer constraints further away.

Unobservable within-country shocks may influence both local mining activity and firm constraints. To mitigate such concerns, columns 8-10 provide an IV framework in which we instrument the number of *active* mines around each firm. To construct our instrument *Total mining output*, we first multiply the world price of the main metal produced by each mine with the median mine size (annual amount of metal produced) of the other mines in the same country that produce the same metal. We do this because the volume of ore produced—and its mineral content—is only recorded for a subset of mines.[27] We then take the sum of this variable for all mines near a firm. If the operational status of mines is indeed driven by exogenous world prices, then the prices of locally available commodities should be a strong predictor of whether mines are open or not. This turns out to be the case: the first stages for the number of active mines in the 0-20 km and 21-150 km bands yield F-statistics that are comfortably above 10 (column 8 and 9).[28] In the second stage (column 10), we replicate both the strong adverse effects in the 0-20 distance band and the strong beneficial effects in the wider 21-150 band.

In sum, Table 2 shows that mining activity is robustly associated with a deterioration of the business environment in the immediate vicinity of firms but with an improvement at a longer distance. Conditioning on the presence of any mines, we find that this effect is stronger

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[26] The marginal effect of a one standard deviation increase in mines' night-time light is 0.5 percentage points.

[27] Some metals tend to occur in smaller quantities than others such that a high price per metric ton on the world market has a larger effect on larger (and thus more valuable) deposits. For instance, a typical lead mine only produces 1 Mt of ore per year while the average copper mine produces 14.5 Mt.

[28] The sample size is reduced here since we cannot estimate the mine size when output information is missing for other mines that produce the same metal or mineral in the same country.

when there are more mines and when mines are larger in terms of total ore output. These results are in line with negative local resource-movement effects and positive regional-spending effects. A one standard deviation increase in nearby mining increases the average business constraint by 0.6 percentage points (compared with an average of 30.2) while more distant mining activity reduces constraints by 3.4 percentage points. The effect of mining on the local business environment hence appears modest for the *average* firm. However, theory predicts that the sign of the impact will depend on the sector of the firm. In Section 5.2 we therefore split the average effect by sector while in Section 5.3 we estimate the real effects of increased business constraints and find that these are substantial.

[Insert Table 2 here]

5.2 The Impact of Mining on Tradeable versus Non-Tradeable Sectors

Our second hypothesis states that local mining activity affects tradeable and non-tradeable sectors in different ways. To test this prior, we need to decide whether firms belong to a tradeable or a non-tradeable sector. This split is not entirely straightforward as many goods can both be consumed locally and traded (inter)nationally. For example, a leather tannery may sell exclusively to a local downstream clothing manufacturer or may (also) sell internationally. To deal with this issue, we apply two methods to classify sectors and show that our results are robust to either method.

First, we follow Mian and Sufi (2014) and classify the retail sector, restaurants, hotels and services of motor vehicles as non-tradeable (*NT*). Construction is classified separately (*C*), while non-metallic mineral products plus basic metals are labelled as natural resource sectors (*R*). All other sectors are then considered tradeables (*T*). In a slightly different version of this baseline classification, we further restrict tradeables to include only those sectors that export on average at least 5% of output (either directly or indirectly through intermediaries). In a third version, we exclude retail from non-tradeables and combine all excluded sectors in a separate *Other* category.

Second, we define tradeables and non-tradeables according to their geographical concentration, following Ellison and Glaeser (1997). The idea is that producers of traded goods do not have to locate close to consumers and can therefore agglomerate, while producers of non-traded goods spread across space to serve nearby consumers. A measure of agglomeration is then informative of the degree of tradeability. We construct Ellison and Glaeser's index that is a measure of excess concentration with respect to a random

distribution of sectors across space. Let G be a measure of geographic concentration, where s_{sd} is the share of industry s's employment in region d and x_d the share of aggregate employment in region d:

$$G_s = \sum_d (s_{sd} - x_d)^2$$

Furthermore, let H be the Herfindahl-Hirschmann index of industry concentration, where z_{sf} is establishment f's employment share by industry s:

$$H_s = \sum_f {z_{sf}}^2$$

G and H can now be combined into the following Ellison-Glaeser agglomeration index:

$$\gamma_s = \frac{G_s - (1 - \sum_d {x_d}^2)H_s}{(1 - \sum_d {x_d}^2)(1 - H_s)}$$

As H_s approaches zero (at high levels of aggregation, when the number of plants is large, or for an increasing number of equally sized establishments) γ_s approaches $G_s/(1 - \sum_d {x_d}^2)$ and is a rescaled measure of raw concentration. The index is unbounded on both sides, but $E(\gamma_s)=0$ when no agglomerative spillovers or natural advantages exist. Positive values suggest more concentration than a random distribution would predict, while negative values suggest that establishments locate themselves relatively diffusely. We calculate γ_s for each country-sector-year to allow for different development stages of each country over time, which may translate into changing agglomeration patterns. As in Mian and Sufi (2014), we classify sectors as non-traded if they are within the first decile (most dispersed) of the country-sector γ_s distribution.

Appendix Table A7 lists the number of firms by classification method. Firms in construction and natural resources never change sector by definition. At the margin, different methodologies cause firms to switch between tradeable and non-tradeable status, but the differences in terms of sample size by classification do not change a lot. The average index value of the Ellison-Glaeser index is close to zero (-0.018) for tradeable sectors, but much more negative (-1.183) for the non-tradeable sectors, indicating more dispersion.

In Table 3 we first use our baseline classification based on Mian and Sufi (2014). Using this split, columns 1 to 3 show that only traded firms, which take world or national output prices as a given, suffer from nearby mining activity while natural resource and non-traded

firms benefit. These opposite impacts are consistent with the predictions of the standard Corden and Neary (1982) model as well as our model of Section 2. A one standard deviation increase in the number of active mines within a radius of 20 km leads to a 1.1 percentage point increase in the average business constraints for firms in tradeable sectors. This holds independent of whether we exclude firm controls (column 2) or impute mining status with night-time lights (column 3). Each additional active mine within 20 km of a tradeable-sector firm increases business constraints by an additional 0.6 percentage points. In contrast, an increase in local mining activity reduces business constraints by 2.1 percentage points for firms in non-tradeable sectors and by 0.4 percentage points for natural resource firms (see column 1 in Table 6, where we report the marginal effects).

At a longer distance, *all* firm types benefit from local mining activity although this effect is imprecisely estimated for firms in the non-traded sectors. A one standard deviation increase in mining activity in the 21-150 km band leads to a decline in business constraints of 3.8, 4.6 and 5.0 percentage points for firms in the traded, construction and natural resource sectors, respectively.

Robustness checks in Appendix Table A8 indicate that the findings based on the Mian and Sufi (2014) classification are robust to applying other classification methods. In particular, the effect of mines in the direct vicinity of tradeable-sector firms is reassuringly similar across all specifications. In the rest of our analysis, we therefore use our baseline classification.

In column 4 of Table 3 we measure local mining activity as the night-time light emitted within 1 km around mines. The results are similar to the earlier regressions based on counting the number of mines: a one standard deviation increase in mining leads to an 0.8 percentage point increase in business constraints for tradeable firms. Appendix Table A9 shows that this result, as well as our previous findings, also holds when we control for general local economic activity as measured by night-time light emitted in a 20 km radius around firms.

In column 5 we exclude the 10% largest and youngest companies. Excluding younger firms (established 4 years ago or less) reduces the risk that firms have moved to or from newly established mines thus undermining our assumption of exogenous mining activity. Excluding the largest firms disregards firms that are least sensitive to the local business environment. When we exclude these two types of firms, our results continue to hold. The negative effect of local mining on the business constraints of natural resource companies now disappears. This reflects that some of the largest and youngest firms in our data set are mining-related companies as well as newly established upstream and downstream companies. Removing these firms makes it difficult to precisely estimate the impact of mining on the

business environment as perceived by these firms. Note also that if some traded firms moved away due to the opening of mines, we would underestimate the negative effect on traded-sector firms.

In column 6 we exclude firms that operate as multi-plant establishments and that have their headquarters in another region than where the interview took place. Our findings continue to hold here as well. Next, in column 7 we add region fixed effects to our country-year-sector fixed effects. We now compare firms with and without local mines in the same geographical region within a country. Our main results go through in this very restrictive specification, which we will use as our baseline specification in the remainder of the paper.[29]

Lastly, in columns 8 and 9 we split the mine count near firms according to whether mines are inside (8) or outside (9) the administrative region in which the firm is located. Column 10 then provides an F-test for the equality of the estimated coefficients. This shows that within the 21-150 km band, there is not much difference between the impact of intra-region and extra-region mines: their presence reduces business constraints in both cases. As expected, this impact is more precisely estimated for mines that are not only nearby but also within the same administrative region.

Within the 20 km circle, we find two important effects. First, traded firms are not only negatively affected by nearby mines in their own region but even more so by nearby mines that are just across the administrative border. This indicates that the negative impact of mining on the producers of tradeable goods does not simply reflect worsening institutions at the local administrative level. Second, the sign of the impact on non-traded firms depends on whether the mines are within or outside the administrative region. Nearby mines *inside* the same administrative region benefit non-trading firms (probably reflecting positive spending effects at the administrative level) whereas nearby mines just *outside* the administrative boundary hurt non-traded firms (just like they hurt nearby traded firms).

[Insert Table 3 here]

Next, we unpack the average business constraint variable to understand *how* local mining affects firms in different sectors. To get at the underlying mechanisms we create three sub-indices of business constraints related to inputs (access to land, an adequately educated

[29] As regions we use the highest administrative level in each country: states in Brazil and Mexico (*estado*), regions in Chile (*región*), mainland provinces in China, oblasts in Kazakhstan and Ukraine, provinces in Mongolia and federal subjects in Russia.

workforce and finance), infrastructure (electricity and transport) and institutions (crime, competition from the informal sector, ease of obtaining an operating license, corruption, political instability, court quality). Each of these indices is an unweighted average of the underlying constraints and ranges between 0 and 100.

The results in Table 4 indicate that firms in traded sectors suffer from mines in their immediate vicinity due to increased difficulties in accessing inputs (column 1) and infrastructure (column 2). To a lesser extent they also experience more institutional constraints (column 3). Perhaps not surprisingly, firms in the natural resource sector suffer significantly *less* from a constrained access to inputs when they are near mines.

Figure 3 further disaggregates these firm impacts. The top-left graph shows that the increased input and infrastructure constraints experienced by tradeable-sector firms mainly reflect problematic access to transportation infrastructure, qualified employees, finance and electricity. In line with recent findings by Couttenier, Grosjean and Sangnier (2017) and Berman *et al*. (2017) there is also a small increase in crime. The upper right chart of Figure 3 shows some quite large beneficial effects of nearby mines on non-traded firms. However, only few of these effects are estimated precisely and for this reason they do not show up significantly in the aggregate constraint measures in Table 4.

The beneficial (though generally smaller) effects of mining at a larger distance manifest themselves mainly in the form of fewer problems in accessing inputs (Table 4, column 1). This is due to better access to an educated workforce, finance and land (Figure 3, bottom left graph). To a lesser extent more distant firms also complain less about competition from the informal sector. The fact that we do not find strong effects with regard to infrastructure provision at this larger distance (column 2) suggests that governments in our country sample do not use natural resource revenues to invest heavily in regional public infrastructure.

[Insert Table 4 and Figure 3 here]

Firms that experience a negative effect of one or several nearby mines might fully or partially see this offset by the more positive effect of one or several distant mines. In Appendix Table 10 we therefore also provide results for the impact of nearby mines conditional on not having any mines in the 20-150 distance band (columns 1-3) and for the impact of more distant mines conditional on no nearby mines being present (columns 4-6). These regressions confirm the negative effects of nearby mines on firms and the positive effect of more distant mines.

5.3 Real Effects

An important empirical question is whether the impact of mining on local business constraints also translates into measurable effects on firm performance. To analyse this, we follow Commander and Svejnar (2011, henceforth CS) who examine the impact of local business constraints on firm performance using BEEPS data for 26 European transition countries. They find that country fixed effects absorb nearly all the variation in business constraints across firms within countries and hence conclude that country-level institutions (and other characteristics) are responsible for holding back firms.

We first replicate their findings based on our sample, which includes a larger number of BEEPS/Enterprise Survey rounds and a smaller but more diverse set of countries. It is therefore worthwhile to examine if this additional variation leads to different results. Contrary to CS, we use a 2SLS approach where in the first stage we instrument business constraints with local mining activity (and the interaction terms of mining activity with economic sector dummies). In the second stage we then treat firm-level business constraints as the endogenous variable that explains firm performance. This approach deals with possible endogeneity that arises when firms report higher constraints due to an increased demand for their products in booming mining regions. It also reduces concerns related to measurement error and possible cultural biases in self-reported statistics. We focus on firm performance as measured by total employment (while controlling for other firm characteristics). Alternative financial measures such as firm assets or sales are only available for a small subset as only few firms report these numbers (for instance, the 2005 survey wave did not include questions about assets or sales in China, Kazakhstan, Russia and Ukraine).

Table 5 summarises our results. Column 1 reports our first-stage regression, which also includes interaction terms between local mining activity and the four main economic sectors. The specification contains country-year-sector fixed effects, region fixed effects, as well as our standard firm-level covariates. We exclude firm size as it is likely a "bad control" that is affected by mining activity itself.

As before, we find that mining activity in a 21-150 km band around firms reduces average business constraints for firms whereas mining in the immediate vicinity (<20 km) hurts firms in tradeable sectors but benefits those in the natural resource sector. Local mining activity is overall a strong predictor of average business constraints. This is confirmed by the robust first stage F-test on the excluded instruments, which is comfortably above the rule-of-thumb of 10. Our instruments (mining activity and the sectoral interaction terms) appear valid according to a Hansen's J-test for overidentifying restrictions.

In the second stage, we regress the log of employment on the average of reported constraints (columns 2-7).[30] As before, we include firm covariates related to ownership and age and we saturate the model with both country-year-sector fixed effects and regional fixed effects (this is more restrictive than the OLS regressions of CS that include country-year fixed effects). Including this rich set of controls and fixed effects allows us to examine whether constraints as predicted by local mining activity matter when controlling for national institutions as well as region-specific characteristics.

The results show that predicted business constraints reduce employment and that the associated effect is economically quite large: a one standard deviation increase in local mining activity reduces employment by almost 3% for a producer of tradeables.[31] Of course the exclusion restriction may not hold: for some firms mining activity might have a direct effect on demand and hence employment. We therefore also show various sub-samples where we drop firms for which the risk of an invalid exclusion restriction is the highest: large firms and downstream firms. Interestingly, the real effects sequentially become more precisely estimated when we exclude the largest 2.5 percent; 5 percent; or 10% of all firms (columns 3-5).[32] They also become larger when focusing on smaller tradeable sector firms only (column 6) or smaller tradable firms that are not in sectors downstream of the mining sector (column 7, see Appendix Table A4 for an overview of the tradable and downstream sectors). In the latter category, which comprises just over 20% of our data, a one standard deviation increase in local mining reduces unemployment by 7 percent. In contrast, there are sizeable positive impacts of mining on employment of firms producing non-tradeables and firms in the natural resource sector. Table 6 summarises all marginal effects.

In Appendix Table A11 we also investigate effects on sales and assets (the latter are measured as the replacement cost of machines, buildings and land). These outcomes are unfortunately only available for a small subset of firms, and not all countries and years, which substantially reduces variation in the data. We therefore report results both with and without region fixed effects (in the latter case we still include a dummy for whether a region has any

[30] Employment is the sum of permanent full-time employees plus the number of part-time or temporary employees at the end of the last fiscal year.

[31] These negative real impacts also indicate that an increase in self-reported business constraints does not simply reflect a booming local economy in which firms struggle to meet demand. If this drove our results in Tables 2 and 3, then we should find that lower reported business constraints lead to positive instead of negative real effects. In other words, instrumenting firm-level constraints reduces concerns about the endogeneity of firms' demand for inputs in the sense that more productive firms need more inputs and thus feel more constrained.

[32] Top-10 firms have over 50,000 employees whereas the median firm in our dataset has 123 employees.

mines). Overall, the pattern and magnitude of the decline in sales and assets is consistent with the negative effects on employment, although the precision of the estimates varies.

[Insert Tables 5 and 6 here]

5.4 Panel Data Regressions

While our main firm data set consists of repeated but independently sampled rounds of cross-sectional survey data, about 5% of all firms were interviewed at least twice (in separate survey rounds) in Chile, Kazakhstan, Mexico, Russia and Ukraine. We can use this panel to observe the same firms at different points in time and to compare firms that experienced an increase in local mining activity with firms that did not. Importantly, this difference-in-differences framework allows us to include firm fixed effects to control more tightly for time invariant firm and locality characteristics.

Table 7 shows the results. Controlling for firm fixed effects, we continue to find an impact of mining on firms' business constraints (columns 1 and 2). The sample is much smaller (798 observations versus 20,857) and covers only 29 country-year-sectors versus 44 when using the repeated cross-sections. Nevertheless, we now find a much larger effect: a one standard deviation increase in mining activity is associated with a 14.4 percentage point increase in constraints for the average firm (column 1). Column 2 confirms our earlier finding that this negative impact is driven by firms in the tradeable sector, in line with local resource movement effects. The beneficial spending effects in the wider area are less clear cut, reflecting the smaller sample size in these panel regressions.

Columns 3-6 present a similar IV framework as in Table 5 (we use the specification in column 2 as the first stage). It is reassuring that when using this much smaller panel data set, we find negative impacts of business constraints on firm growth that are very similar in size and statistical significance as those derived from the cross-sectional regressions in Table 5.

[Insert Table 7 here]

5.5 Cross-Country Heterogeneity

Since our data set spans eight very different countries, we investigate in Table 8 whether our main results—a negative impact of local mining on nearby tradable firms that contrasts with a beneficial impact on more distant firms—are stronger in some countries as compared to others. To do so, we rerun our baseline regression eight times, each time further interacting

our *Traded* x *No. active mines* term with a country dummy, both for the 0-20 and 21-150 distance bands.[33] In addition to these triple interaction terms, we fully saturate the model with (unreported) bilateral interaction terms between the various country dummies, *Traded* and *No. active mines*. The size of the estimated impacts may differ across countries for a variety of reasons. These include geographical differences that make our standard distance bands less applicable (as distance decay differs) and the size of the administrative units over which distribution (if any) of mineral revenues takes place.

We find that the negative impact of mining on nearby tradable firms is particularly strong in Brazil, Chile, Kazakhstan and Russia but less so in China. At a longer distance, the beneficial impact of mining appears stronger in Brazil, Kazakhstan, Mongolia and Ukraine but again less so in China. Overall, Table 8 therefore indicates that while the strength of our results differs across countries, both the negative short-distance and positive long-distance mining impacts are remarkably common across countries (with both effects less strong in China).

[Insert Table 8 here]

5.6 Robustness: Controlling for Oil and Gas Fields

One may be concerned that our results are confounded by mining localities that also produce oil and gas. Oil and gas tend to occur in higher concentrations of wealth than metals and other minerals, which may lead to larger local spending effects. On the other hand, production tends to be more capital intensive and this may imply smaller effects on local labour demand.

To assess whether our results are sensitive to the local presence of large-scale hydrocarbon production, we extend our regressions with the number of oil and gas fields within distance bands of each firm. We use data from Horn (2003) who reports both the geographic coordinates and the size of 874 giant onshore and offshore oil and gas fields (with a minimum pre-extraction size of 500 million barrels of oil equivalent).[34]

In Table 9 we report our baseline regressions while adding the number of active oil and gas fields (column 1), total oil and gas reserves (column 2) or the remaining oil and gas reserves (column 3). In each case we include these variables both measured within a 20 km distance of the firm and for a 21-150 km spatial distance ring. Controlling for giant oil and

[33] The first interaction coefficient for Mexico is missing as there are no mines within 20 km of traded firms.

[34] Oil, condensate and gas are summed using a factor of 1/.006 to convert gas trillion cubic feet to oil equivalent million barrels.

gas fields does not alter our main result that nearby mining activity constrains firms in tradeable sectors but helps firms in the non-tradeable sector as well as firms downstream and upstream of natural resource companies. We also find that the presence of oil and gas fields decreases reported business constraints. However, closer inspection of the data reveals that only few firms have any oil and gas fields nearby (Table A12). While there is on average 0.5 mines within 20 km of a firm, there is only 0.01 oil and gas fields within that distance. In fact, no firms in Brazil, Chile, Kazakhstan, Mexico or Mongolia have any fields within 20 km. This suggests that most fields are in remote regions and that the negative effect is driven by very few observations.

[Insert Table 9 here]

5.7 Robustness: Clustering Standard Errors

Our data is a repeated cross-section of country-sectors. In such cases, Bertrand, Duflo and Mullainathan (2004) recommend clustering at the country level when estimating country-level interventions. Yet, in our case the treatment happens at the firm level and is heterogeneous within countries. It is therefore not obvious that autocorrelation is an issue. Arbitrary spatial correlation is more likely and this is taken care of by clustering at the country-year-sector level (without assuming a particular distance decay function). In Table 10, we show that our baseline results—here replicated in column 1—are robust to alternative clustering methods.

In column 2, we replace the country-year-sector fixed effects with region-year-sector fixed effects where (within-country) regions are either mining rich or poor. We now also cluster the standard errors at this level and find that our results are robust. Next, in column 3 we cluster standard errors by the highest administrative level in each country. Alternatively, in columns 4 and 5, we cluster at regions defined by grids of 2.5 by 2.5 degrees (which equals 275 by 275 km at the equator) and 5 by 5 degrees (550 by 550 km), respectively. The grids are defined within country borders. In all cases, our results remain precisely estimated.

[Insert Table 10 here]

6. Conclusions

We estimate the local impact of mining activity on the business constraints of 22,150 firms in eight resource-rich countries. We exploit spatial variation in local mining activity within these countries to facilitate causal inference in both a cross-sectional and a panel setting. To the best

of our knowledge, ours is the first paper to estimate this impact of mining activity on firm performance across a variety of countries. Our results are clearly at odds with views that consider mines as “enclaves” without any tangible links to local economies. Instead we find that the presence of active mines deteriorates the business environment of firms in close proximity (<20 km) to a mine but relaxes business constraints for more distant firms. The negative local impacts are concentrated exclusively among firms in tradeable sectors. In line with mining-related congestion effects and infrastructure bottlenecks, the ability of these firms to access inputs, skilled labour and infrastructure is hampered. This mining-induced deterioration of the local business environment also stunts the growth of these firms and they generate less employment. In sharp contrast, firms in the services sector and in upstream and downstream natural resource sectors benefit from local mining.

In line with the Dutch disease model of Corden and Neary (1982), our results provide evidence for negative-resource movement effects in the immediate vicinity of mines (a “local curse”) as well as positive spending effects in a wider geographical area (a “regional blessing”). We believe that these findings can contribute to a better understanding of why studies of the local impact of mining often find positive effects on household income, while many aggregate studies find adverse effects on national income growth. Our results suggest that only traded sector manufacturing firms suffer from mining, and only at a localised level, while the non-traded and construction sectors benefit. Because many firms are traded we find that the net average effect is negative at the local level. Yet, a discussion of the welfare implications of our findings also needs to take into account the value added by various economic sectors. Even if tradeable firms are more numerous and therefore generate an average negative impact of mining at the local level, these firms’ contribution to economic activity may nevertheless be smaller than their numerical presence would suggest. A back-of-the-envelope calculation, based on a decomposition of country-level value added (Appendix Table A13), suggests that this is indeed the case. In our country sample, the tradable sector makes up an important, but not a majority, of all value added (the exception is China, where 57% of all value added is created by the tradable sector). This underlines that the overall welfare effect of mining activity in these countries may be positive.

From a policy perspective, our results suggest that to minimise localised negative effects on the business environment, policy makers should ensure that local firms can share the infrastructure that is privately built as part of the exploitation process. Already when negotiating infrastructure contracts, authorities can request that new infrastructure will allow for multiple uses and users. This may reduce the infrastructure bottlenecks and congestion

effects that are apparent in our data. Improving transport, electricity, water and other enabling infrastructure may not only help firms in tradeable sectors but also further stimulate local services sectors and clusters of downstream and upstream industries that are related to mines. To maximise positive spillovers, policy-makers can also help firms to become fit to supply local mining-related supply chains. These measures can help meet the preconditions for a resource boom to trigger agglomeration and positive long-term impacts.

Finally, the geographical and sector distribution of the economy at the time of natural resource discoveries also matters for whether resource booms have aggregate negative growth effects or not. Moreover, to what extent any negative effects persist over time depends on whether the contraction of tradeable sectors during the boom will be reversed once it ends. Tradeable sectors may remain depressed for a protracted period if during the boom local residents specialise in resource-related skills that are not easily transferable to other sectors. Policy has a clear role to play here as well.

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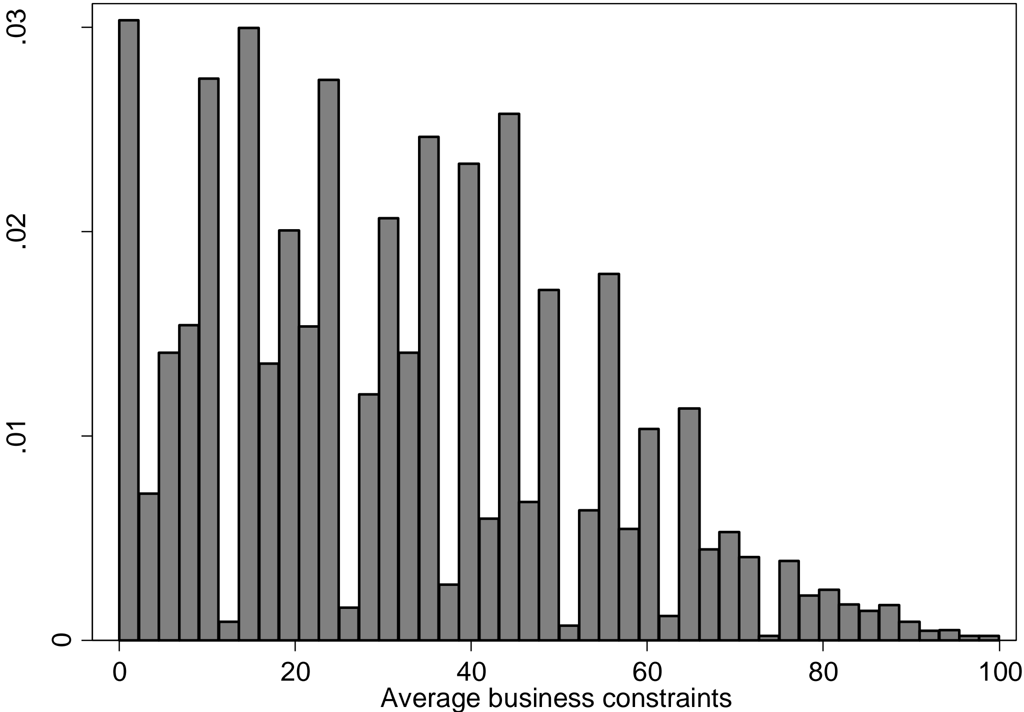
Appendix A. Histogram of *Average business constraints*



Appendix B. Survey questions

We use the following BEEPS V survey questions to measure firm-level business constraints. In each case the following answer categories were offered: *No obstacle*, *Minor obstacle*, *Moderate obstacle*, *Major obstacle*, *Very severe obstacle*, *Don't know*, *Does not apply*. For earlier survey rounds and for the World Bank Enterprise Surveys we use equivalent questions.

Question C.30a: Using the response options on the card, to what degree is ***electricity*** an obstacle to the current operations of this establishment?

Question D.30a: Using the response options on the card, to what degree is ***transport*** an obstacle to the current operations of this establishment?

Question E.30: Using the response options on the card, to what degree are ***practices of competitors in the informal sector*** an obstacle to the current operations of this establishment?

Question G.30a: Using the response options on the card, to what degree is ***access to land*** an obstacle to the current operations of this establishment?

Question I.30: Using the response options on the card, to what degree is ***crime, theft and disorder*** an obstacle to the current operations of this establishment?

Question K.30: Using the response options on the card, to what degree is ***access to finance*** an obstacle to the current operations of this establishment?

Question J.30c: Using the response options on the card, to what degree are ***business licencing and permits*** an obstacle to the current operations of this establishment?

Question J.30e: Using the response options on the card, to what degree is ***political instability*** an obstacle to the current operations of this establishment?

Question J.30f: Using the response options on the card, to what degree is ***corruption*** an obstacle to the current operations of this establishment?

Question H.30: Using the response options on the card, to what degree are ***courts*** an obstacle to the current operations of this establishment?

Question L.30b: Using the response options on the card, to what degree is an ***inadequately educated workforce*** an obstacle to the current operations of this establishment?

Table 1
Summary statistics

	Obs.	Mean	Median	St. dev.	Min	Max
Dependent variables:						
Average business constraints	22,150	30.22	20.69	27.27	0	100
Input constraints	20,808	34.68	33.33	24.33	0	100
Infrastructure constraints	20,810	29.54	25.00	27.40	0	100
Institutional constraints	20,808	23.38	25.00	24.81	0	100
Independent variables:						
№ active mines 0-20 km	22,150	0.58	0	1.79	0	19
№ active mines 21-150 km	22,150	7.56	4	13.98	0	152
Any active mine 0-20 km	22,150	0.24	0	0.43	0	1
Any active mine 21-150 km	22,150	0.77	1	0.42	0	1
Total mining output 0-20 km (ln)	5,054	18.57	18.47	0.99	15.11	21.69
Total mining output 21-150 km (ln)	5,054	20.22	20.21	1.15	16.33	22.74
№ oil and gas fields 0-20 km	22,150	0.01	0	0.14	0	2
№ oil and gas fields 21-150 km	22,150	0.27	0	0.70	0	4
Oil and gas reserves 0-20 km (ln)	22,150	0.05	0	0.62	0	8.21
Oil and gas reserves 21-150 km (ln)	22,150	1.20	0	2.68	0	9.49
Oil and gas remaining reserves 0-20 km (ln)	22,150	0.03	0	0.40	0	5.63
Oil and gas remaining reserves 21-150 km (ln)	22,150	0.86	0	1.95	0	9.47
Sum of NTL active mines 0-20 km	22,150	19.53	0	58.79	0	694.23
Sum of NTL active mines 21-150 km	22,150	146.39	61.47	242.77	0	2476.13
Small firm	22,150	0.20	0	0.40	0	1
Medium-sized firm	22,150	0.29	0	0.46	0	1
Large firm	22,150	0.48	0	0.50	0	1
Firm age	22,150	15.38	11	15.04	0	203
Foreign firm	22,150	0.15	0	0.35	0	1
State firm	22,150	0.17	0	0.37	0	1
Firm competes internationally	22,150	0.13	0	0.33	0	1
Employment (ln)	20,820	4.89	4.81	1.68	0.69	13.5
Assets (ln)	4,952	12.52	12.53	2.32	2.22	22.68
Sales (ln)	9,741	13.77	13.74	2.23	2.74	25.03

Notes: This tables provides summary statistics for all variables used in the analysis. Table A1 in the Appendix contains all variable definitions.

Table 2
Local mining and business constraints

Dependent variable →	Average business constraints							№ active mines 0-20 km	№ active mines 21-150	Average business constraints
								1st stage		2nd stage
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
№ active mines 0-20 km	0.349**	0.348**	0.376**	0.353**	1.031**	0.008*	0.912**	-	-	0.374***
	(0.134)	(0.135)	(0.144)	(0.153)	(0.461)	(0.004)	(0.355)	-	-	(0.118)
№ active mines 21-150 km	-0.247**	-0.247**	-0.239**	-0.248**	-2.370***	-0.009**	-2.388***	-	-	-0.292***
	(0.113)	(0.113)	(0.113)	(0.110)	(0.810)	(0.005)	(0.833)	-	-	(0.093)
Any active mine 0-20 km							0.739*			
							(0.441)			
Any active mine 21-150 km							1.170*			
							(0.661)			
Total mining output 0-20 km (ln)								2.164***	0.937***	
								(0.505)	(0.183)	
Total mining output 21-150 km (ln)								-0.057	7.382***	
								(0.042)	(0.573)	
Definition "№ active mines"	Count	Count	Count	Count NTL	Log(n+1)	NTL	Log(n)	Count	Count	Count
Country-Year-Sector FE	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Year FE	Yes	No	No	No	No	No	No	No	No	No
Firm controls	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for inactive mines	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1st stage F-test								12.17	86.43	
Observations	22,150	22,150	23,045	22,150	22,150	22,150	22,150	5,050	5,050	5,050
R-squared	0.269	0.272	0.295	0.272	0.273	0.271	0.274	-	-	0.224

Notes: This table shows OLS (columns 1-7) and IV (columns 8-10) regressions to estimate the impact of local mining activity on firms' business constraints. In columns 1-2-3 *No. active mines 0-20 km (21-150 km)* are count variables. Column 3 excludes our standard set of firm covariates. In column 4 above-ground mines with missing operating status are given an imputed status based on night-time light (NTL) predictions. In column 5 the *No. active mines* variables are expressed as the log of the number of active minus plus 1. In column 6 mining activity is measured by NTL emitted within a 1 km radius around mines. In column 7 the *No. active mines* variables are expressed as the log of the number of active mines where missing values are set to zero (while adding separate dummy variables *Any active mine 0-20 km (21-150 km)*). In columns 8-10 we instrument the number of active mines with the median amount of metal or mineral produced by other mines within each country-mineral/metal cell multiplied by the world price of the mineral/metal. Robust standard errors are clustered by country-year-sector and shown in parentheses. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively. All specifications include country-year-sector fixed effects (except column 1), firm controls (size, age, international exporter and ownership; except column 3), controls for inactive mines in the vicinity of firms and a dummy for whether a mine of any status exists in the administrative region of the firm. Sectors are Manufacturing; Construction; Retail and wholesale; Real estate, renting and business services; Other. Table 1 contains summary statistics and Appendix Table A1 contains variable definitions and data sources.

Table 3
Local mining and business constraints: Sector heterogeneity

	Dependent variable →	Average business constraints									
		Baseline	Baseline: No firm controls	Mines: NTL corrected count	Mines: NTL	Excl. largest and youngest firms	Excl. multi-establishment firms	Region FE	Baseline with regional split		
									Mines inside region	Mines outside region	F-test
	Interaction with ↓	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
№ active mines 0-20 km	x Traded	0.588***	0.611***	0.602***	0.013***	0.573***	0.596***	0.375***	0.432***	1.210***	19.17***
		(0.158)	(0.183)	(0.174)	(0.005)	(0.209)	(0.151)	(0.127)	(0.135)	(0.290)	
	x Construction	-0.322	-0.287	-0.312	-0.021**	-0.418	-0.415	0.067	-0.269	-0.127	0.01
		(0.378)	(0.389)	(0.398)	(0.008)	(0.367)	(0.391)	(0.393)	(0.363)	(0.924)	
	x Non-traded	-1.171**	-0.642*	-1.122**	-0.019	-1.346**	-1.058**	-0.685	-1.610***	0.750**	11.85***
		(0.527)	(0.343)	(0.511)	(0.013)	(0.652)	(0.500)	(0.649)	(0.461)	(0.346)	
	x Natural resources	-0.209***	-0.193***	-0.199***	-0.007***	-0.083	-0.208***	-0.311***	-0.211**	-0.336	0.11
		(0.034)	(0.041)	(0.044)	(0.001)	(0.070)	(0.033)	(0.088)	(0.085)	(0.292)	
№ active mines 21-150 km	x Traded	-0.275**	-0.272**	-0.280**	-0.010**	-0.250**	-0.278**	-0.088*	-0.303**	-0.235**	0.66
		(0.115)	(0.115)	(0.110)	(0.005)	(0.113)	(0.115)	(0.053)	(0.122)	(0.111)	
	x Construction	-0.332**	-0.336**	-0.346***	-0.011**	-0.278**	-0.333**	-0.166**	-0.422**	-0.213	0.68
		(0.132)	(0.134)	(0.127)	(0.005)	(0.125)	(0.133)	(0.081)	(0.209)	(0.153)	
	x Non-traded	-0.132	-0.129	-0.142	-0.003	-0.091	-0.124	-0.006	-0.199*	-0.054	1.02
		(0.093)	(0.093)	(0.086)	(0.003)	(0.080)	(0.092)	(0.051)	(0.108)	(0.107)	
	x Natural resources	-0.360***	-0.340***	-0.366***	-0.016***	-0.367***	-0.363***	-0.134**	-0.325***	-0.388***	2.98*
		(0.089)	(0.089)	(0.087)	(0.006)	(0.114)	(0.087)	(0.057)	(0.096)	(0.083)	
Country-Year-Sector FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Region FE		No	No	No	No	No	No	Yes	No		
Firm controls		Yes	No	Yes	Yes	Yes	Yes	Yes	Yes		
Controls for inactive mines		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Observations		20,812	21,704	20,812	20,812	15,847	20,305	20,812	20,812		
R-squared		0.288	0.310	0.288	0.285	0.329	0.285	0.351	0.290		

Notes: This table shows OLS regressions to estimate the impact of local mining activity on firms' business constraints. In column 3 above-ground mines with missing operating status are given an imputed status based on night-time light (NTL) predictions. In column 4 mining activity is measured by the sum of NTL emitted within a 1 km radius around mines. The sample used in column 5 excludes the 10 percent largest and youngest firms while the sample in column 6 excludes multi-establishment firms. Column 7 includes sub-national administrative region fixed effects. There are 145 regions in total. In columns 8 and 9 local mine counts are split according to whether they are inside (8) or outside (9) the administrative region of the firm. Column 10 shows F-statistics for a test of equal coefficients in columns 8 and 9. Robust standard errors are clustered by country-year-sector and shown in parentheses. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively. All specifications include country-year-sector fixed effects, firm controls (size, age, international exporter, and ownership), and controls for inactive mines in the vicinity of firms. Constant included but not shown. Table 1 contains summary statistics and Appendix Table A1 contains variable definitions and data sources.

Table 4
Local mining and business constraints: Inputs, infrastructure and institutions

Dependent variable →		Average business constraints related to:		
		Inputs	Infrastructure	Institutions
	Interaction with ↓	[1]	[2]	[3]
№ active mines 0-20 km	x Traded	0.412**	0.328*	0.280***
		(0.186)	(0.171)	(0.084)
	x Construction	-0.981	0.865	0.269
		(0.617)	(0.624)	(0.564)
	x Non-traded	-0.157	-1.050	-0.897
		(0.504)	(1.296)	(0.564)
	x Natural resources	-0.349*	-0.341**	-0.142*
		(0.195)	(0.168)	(0.073)
№ active mines 21-150 km	x Traded	-0.212***	0.025	-0.015
		(0.068)	(0.130)	(0.052)
	x Construction	-0.239***	-0.026	-0.126
		(0.065)	(0.128)	(0.114)
	x Non-traded	-0.203***	0.131	0.083
		(0.056)	(0.101)	(0.050)
	x Natural resources	-0.207***	-0.112	-0.027
		(0.029)	(0.116)	(0.052)
Country-Year-Sector FE		Yes	Yes	Yes
Region FE		Yes	Yes	Yes
Firm controls		Yes	Yes	Yes
Controls for inactive mines		Yes	Yes	Yes
Observations		20,808	20,810	20,808
R-squared		0.220	0.229	0.416

Notes: This table shows OLS regressions to estimate the impact of local mining activity on firms' business constraints related to inputs (access to land, access to adequately educated workforce, access to finance), infrastructure (electricity and transport) and institutions (crime, competition from informal sector, ease of obtaining an operating licence, corruption, political instability, court quality). Robust standard errors are clustered by country-year-sector and shown in parentheses. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively. All specifications include country-year-sector fixed effects, region fixed effects, firm controls (size, age, international exporter, and ownership) and controls for inactive mines in the vicinity of firms. Constant included but not shown. Table 1 contains summary statistics and Appendix Table A1 contains variable definitions and data sources.

Table 5
Local mining, business constraints and firm performance

		1st stage	2nd stage					
	Dependent variable →	Average business constraints	Employment (ln)					
	Sample →		All	Exclude 2.5% largest firms	Exclude 5% largest firms	Exclude 10% largest firms		
						All	Traded only	Traded only and not downstream
		[1]	[2]	[3]	[4]	[5]	[6]	[7]
			-0.023	-0.027*	-0.025**	-0.027***	-0.030*	-0.069***
	Interaction with ↓		(0.018)	(0.014)	(0.012)	(0.009)	(0.015)	(0.019)
№ active mines 0-20 km	x Traded	0.382***						
		(0.122)						
	x Construction	0.071						
		(0.393)						
	x Non-traded	-0.674						
		(0.660)						
	x Natural resources	-0.328***						
		(0.083)						
№ active mines 21-150 km	x Traded	-0.075						
		(0.053)						
	x Construction	-0.153*						
		(0.081)						
	x Non-traded	0.007						
		(0.051)						
	x Natural resources	-0.113**						
		(0.056)						
Country-Year-Sector FEs		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FEs		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm and inactive mine controls		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations		20,857	20,821	20,204	19,588	18.377	14,262	4,408
№ clusters		44	44	44	44	44	11	11
Kleibergen-Paap F-statistic		67.94						
Hansen J-test p-value		0.449						

Notes: This table shows 2SLS regressions to estimate the impact of local mining activity on firm performance. Robust standard errors are shown in parentheses and clustered by country-year-sector. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively. All specifications include country-year-sector fixed effects, region fixed effects, firm controls and controls for inactive mines in the vicinity of firms. Constant included but not shown. Table 1 contains summary statistics and Appendix Table A1 contains variable definitions and data sources.

Table 6
Marginal effect of a one standard deviation increase in mining

	Interaction with ↓	Average constraints [1]	Employment [2]
№ active mines 0-20 km	All sectors	0.6 **	-1.7% **
	x Traded	1.1 ***	-2.8% ***
	x Construction	-0.6	1.6%
	x Non-traded	-2.1 **	5.7% **
	x Natural resources	-0.4 ***	1.0% ***
№ active mines 21-150 km	All sectors	-3.5 **	9.3% **
	x Traded	-3.8 **	10.4% **
	x Construction	-4.6 **	12.5% **
	x Non-traded	-1.8	5.0%
	x Natural resources	-5.0 ***	13.6% ***

Notes: This table shows marginal effects of a one standard deviation increase in mining by main sector types. Coefficients for column 1 are taken from Table 2 column 2 ('all sectors') and Table 3 column 1 (by sector). Coefficients for column 2 are taken from Table 5 column 5. ***, **, *, correspond to the 1%, 5%, and 10% level of significance, respectively. For column 2 the significance level is the minimum of the direct and the indirect effect. For example, mines within 20 km have no significant effect on constraints reported by the construction sector. We therefore conclude that employment of the construction sector is also not significantly affected by mining.

Table 7
Changes in local mining activity and business constraints: Panel data regressions

		OLS		IV (2nd stage)			
	Dependent variable →	Av. business constraints		Employment			
	Sample →	*All*		*All*	*Exclude 2.5% largest firms*	*Exclude 5% largest firms*	*Exclude 10% largest firms*
	Interaction with ↓	[1]	[2]	[3]	[4]	[5]	[6]
				-0.016**	-0.019**	-0.021**	-0.020*
				(0.008)	(0.009)	(0.010)	(0.010)
№ active mines 0-20 km		8.001*					
		(4.063)					
№ active mines 21-150 km		-0.196					
		(0.468)					
№ active mines 0-20 km	x Traded		11.305**				
			(4.465)				
	x Construction		-3.345				
			(4.470)				
	x Non-traded		8.289				
			(13.182)				
	x Natural resources		[-]				
№ active mines 21-150 km	x Traded		-0.141				
			(0.532)				
	x Construction		-0.876				
			(2.318)				
	x Non-traded		-1.290				
			(1.741)				
	x Natural resources		-0.132				
			(6.247)				
Country-sector-year FE		Yes	Yes	Yes	Yes	Yes	Yes
Firm FE		Yes	Yes	Yes	Yes	Yes	Yes
Firm size dummies		Yes	Yes	No	No	No	No
Firm controls		Yes	Yes	Yes	Yes	Yes	Yes
Controls for inactive mines		Yes	Yes	Yes	Yes	Yes	Yes
Observations		798	798	794	788	786	776
Kleibergen-Paap F-statistic		-	21.66	21.66	19.63	17.07	18.63
Hansen J-test p-value		-	0.194				
R-squared		0.802	0.803				

Notes: This table shows OLS (columns 1-2) and IV (columns 3-6) panel regressions, based on a subset of firms that were surveyed in at least two years, to estimate the impact of (increased) local mining activity on firms' business constraints. Column 2 provides the first-stage regression for the 2nd stage IV results in columns 3-6. Robust standard errors are clustered by country-year-sector and shown in parentheses. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively. All specifications include country-year-sector fixed effects, firm fixed effects and time-varying firm controls (age, international exporter, and ownership). Constant included but not shown. Table 1 contains summary statistics and Appendix Table A1 contains variable definitions and data sources.

Table 8
Local mining and business constraints: Country heterogeneity

	Dependent variable →	Average business constraints							
	Country dummy →	*Brazil*	*China*	*Chile*	*Kazakhstan*	*Mexico*	*Mongolia*	*Russia*	*Ukraine*
	Interaction with ↓	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
№ active mines 0-20 km	x Traded	0.378***	1.116**	0.376***	0.362***	0.375***	0.375***	0.343**	0.364***
		(0.128)	(0.479)	(0.127)	(0.128)	(0.127)	(0.127)	(0.133)	(0.122)
	x Traded x Country dummy	0.926**	-0.801*	1.673**	15.684***	-	-6.638	4.791***	0.346
		(0.396)	(0.423)	(0.784)	(2.813)		(8.936)	(0.668)	(0.325)
№ active mines 21-150 km	x Traded	-0.088	-0.336***	-0.089*	-0.084	-0.088*	-0.088*	-0.075	-0.070
		(0.053)	(0.106)	(0.053)	(0.050)	(0.053)	(0.053)	(0.052)	(0.045)
	x Traded x Country dummy	-0.837***	0.304***	0.689	-1.112***	-0.197	-2.199**	-0.148	-0.165*
		(0.272)	(0.104)	(0.571)	(0.356)	(1.029)	(0.981)	(0.094)	(0.095)
Country-Year-Sector FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm controls		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for inactive mines		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations		20,812	20,812	20,812	20,812	20,812	20,812	20,812	20,812
R-squared		0.351	0.352	0.351	0.352	0.351	0.351	0.351	0.351

Notes: This table shows OLS regressions to estimate cross-country heterogeneity in the impact of local mining activity on firms' business constraints. Robust standard errors are clustered by country-year-sector and shown in parentheses. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively. All specifications include country-year-sector fixed effects, region fixed effects and firm controls (size, age, international exporter, and ownership) . Constant included but not shown. Table 1 contains summary statistics and Appendix Table A1 contains variable definitions and data sources.

Table 9
Robustness: Controlling for giant oil and gas fields

Dependent variable →		Average business constraints		
	Interaction with ↓	[1]	[2]	[3]
№ active mines 0-20 km	x Traded	0.372***	0.378***	0.376***
		(0.126)	(0.120)	(0.120)
	x Construction	0.050	0.052	0.054
		(0.403)	(0.403)	(0.404)
	x Non-traded	-0.674	-0.653	-0.648
		(0.659)	(0.669)	(0.669)
	x Natural resources	-0.316***	-0.309***	-0.317***
		(0.089)	(0.084)	(0.085)
№ active mines 21-150 km	x Traded	-0.089*	-0.087*	-0.091*
		(0.052)	(0.050)	(0.050)
	x Construction	-0.164**	-0.161*	-0.165**
		(0.081)	(0.080)	(0.079)
	x Non-traded	-0.007	-0.007	-0.012
		(0.052)	(0.052)	(0.053)
	x Natural resources	-0.136**	-0.136**	-0.140**
		(0.056)	(0.056)	(0.056)
№ oil and gas fields 0-20 km		-4.844***		
		(0.569)		
№ oil and gas fields 21-150 km		-0.366		
		(0.409)		
Oil and gas reserves 0-20 km (ln)			-1.127***	
			(0.073)	
Oil and gas reserves 21-150 km (ln)			-0.165	
			(0.109)	
Oil and gas remaining reserves 0-20 km (ln)				-1.651***
				(0.096)
Oil and gas remaining reserves 21-150 km (ln)				-0.262*
				(0.151)
Country-Year-Sector FE		Yes	Yes	Yes
Region FE		Yes	Yes	Yes
Firm controls		Yes	Yes	Yes
Controls for inactive mines		Yes	Yes	Yes
Observations		20,812	20,812	20,812
R-squared		0.351	0.351	0.351

Notes: This table shows OLS regressions to estimate the impact of local mining activity on firms' business constraints while controlling for the local presence of giant oil and gas fields. Oil and gas reserves measure the total size of fields by their ultimate recovery equivalent, which is the original size of the field as it was known in 2003. Oil and gas remaining reserves is an estimate of the current field size by applying a half-life time of 10 years, which corresponds to the average half-life of fields in North America, Europe, and the former Soviet Union. See Horn (2003) for details. Robust standard errors are clustered by country-year-sector and shown in parentheses. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively. All specifications include country-year-sector fixed effects, firm controls (size, age, international exporter, and ownership) and controls for inactive mines in the vicinity of firms. Constant included but not shown. Table 1 contains summary statistics and Appendix Table A1 contains variable definitions and data sources.

Table 10
Robustness: Clustering of standard errors

		Baseline with country-year-sector FE and clusters	Mining rich/poor region-year-sector FE and clusters	Administrative region clusters	2.5x2.5 degree region clusters	5x5 degree region clusters
	Dependent variable →	Average business constraints				
	Interaction with ↓	[1]	[2]	[3]	[4]	[5]
№ active mines 0-20 km	x Traded	0.375***	0.377***	0.375*	0.375*	0.375**
		(0.127)	(0.126)	(0.196)	(0.225)	(0.178)
	x Construction	0.067	-0.103	0.067	0.067	0.067
		(0.393)	(0.352)	(0.320)	(0.345)	(0.314)
	x Non-traded	-0.685	-0.751	-0.685	-0.685	-0.685
		(0.649)	(0.682)	(0.596)	(0.451)	(0.623)
	x Natural resources	-0.311***	-0.312***	-0.311**	-0.311	-0.311**
		(0.088)	(0.088)	(0.132)	(0.257)	(0.127)
№ active mines 21-150 km	x Traded	-0.088*	-0.092*	-0.088	-0.088	-0.088
		(0.053)	(0.053)	(0.079)	(0.077)	(0.068)
	x Construction	-0.166**	-0.127*	-0.166*	-0.166*	-0.166**
		(0.081)	(0.073)	(0.089)	(0.100)	(0.067)
	x Non-traded	-0.006	0.001	-0.006	-0.006	-0.006
		(0.051)	(0.053)	(0.072)	(0.076)	(0.055)
	x Natural resources	-0.134**	-0.131**	-0.134	-0.134	-0.134
		(0.057)	(0.058)	(0.092)	(0.108)	(0.084)
Country-Year-Sector FE		Yes	No	Yes	Yes	Yes
Mining rich/poor region-Year-Sector FE		No	Yes	No	No	No
Region FE		Yes	Yes	Yes	Yes	Yes
Firm controls		Yes	Yes	Yes	Yes	Yes
Controls for inactive mines		Yes	Yes	Yes	Yes	Yes
Clusters		44	87	145	194	110
Observations		20,812	20,812	20,812	20,812	20,812
R-squared		0.351	0.353	0.351	0.351	0.351

Notes: This table shows OLS regressions to estimate the impact of local mining activity on firms' business constraints. Column 1 replicates our baseline result of Table 3, column 7. Column 2 contains regional-year-sector fixed effects where regions indicate whether (within-country) regions are mining rich or poor. Standard errors are clustered at the same level. Column 3 clusters standard errors by the highest administrative level in each country. Columns 4 and 5 cluster standard errors at regions defined by grids of 2.5 by 2.5 degrees (which equals 275 by 275 km at the equator) and 5 by 5 degrees (550 by 550 km), respectively. The grids are defined within country borders. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively. All specifications include firm controls (size, age, international exporter, and ownership) and controls for inactive mines in the vicinity of firms. Constant included but not shown. Table 1 contains summary statistics and Appendix Table A1 contains variable definitions and data sources.

Figure 1
Geographical distribution of firms and mines

These graphs depict the geographical distribution of the firms and mines in our dataset for Ukraine (left) and Kazakhstan (right). Scale varies by country. Similar maps are available for Brazil, Chile, China, Mexico, Mongolia and Russia in the online Appendix. Red triangles (blue dots) indicate individual firms (mines). The lower maps zoom in to the area highlighted by the red rectangles in the upper maps. The circles around firms have a 20 km radius. Source: EBRD-World Bank BEEPS Surveys and SNL Metals and Mining.

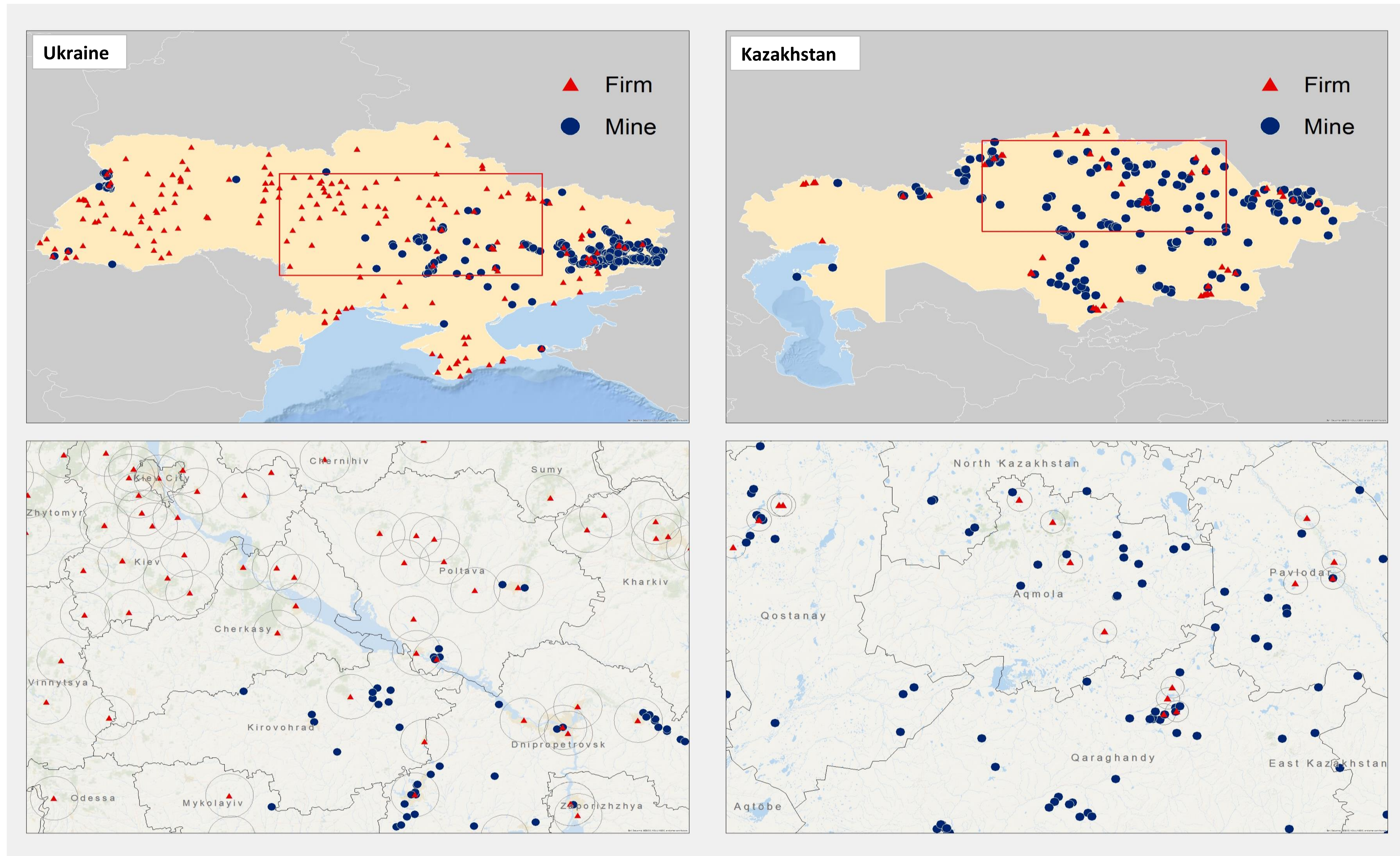


Figure 2
Local mining and business constraints: Distance decay

These graphs show correlations between local mining activity (measured as *№ active mines*) and the average business constraints as perceived by nearby firms. The left-hand graph shows the estimated coefficients from separate regressions where *№ active mines* counts all mines within a circle with a radius of 20, 50, 100, 150, 300 or 450 kilometres around individual firms. The right-hand graph shows the estimated coefficients when using three distance rings (<20km, 20-150 km, 150-450 km) or two distance rings (<20km and 20-150km) simultaneously in one regression. All specifications include country-year-sector fixed effects, firm controls (size, age, international exporter, and ownership), controls for inactive mines measured within the same distance from firms as the number of active mines, and a dummy for whether a mine of any status exists in the administrative region of the firm.

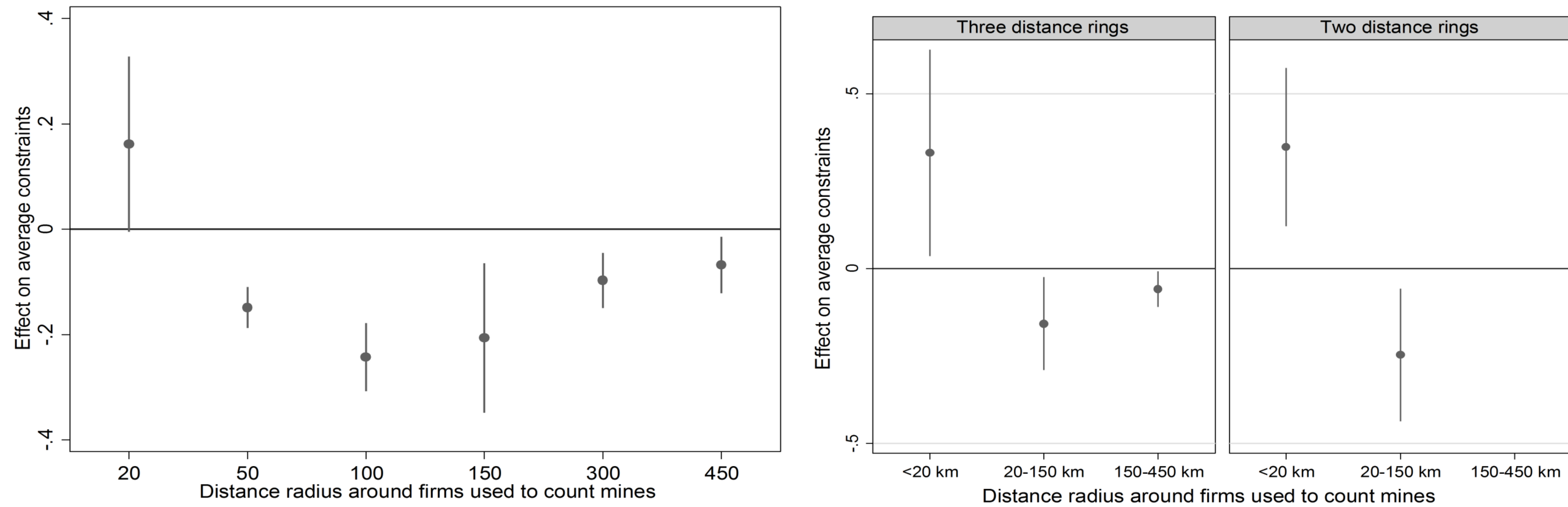


Figure 3
Local mining and individual business constraints

These graphs depict the point estimates (dots) and 90 per cent confidence intervals (horizontal lines) from OLS regressions to estimate the impact of local mining activity on firms' business constraints in tradable (left) and non-tradable (right) sectors. In the underlying regressions, robust standard errors are clustered by country-year-sector and all specifications include country-year-sector fixed effects, firm controls (size, age, international exporter, and ownership), controls for inactive mines in the vicinity of firms, and a dummy for whether a mine of any status exists in the administrative region of the firm. Table 1 contains summary statistics and Appendix Table A1 contains variable definitions and data sources.

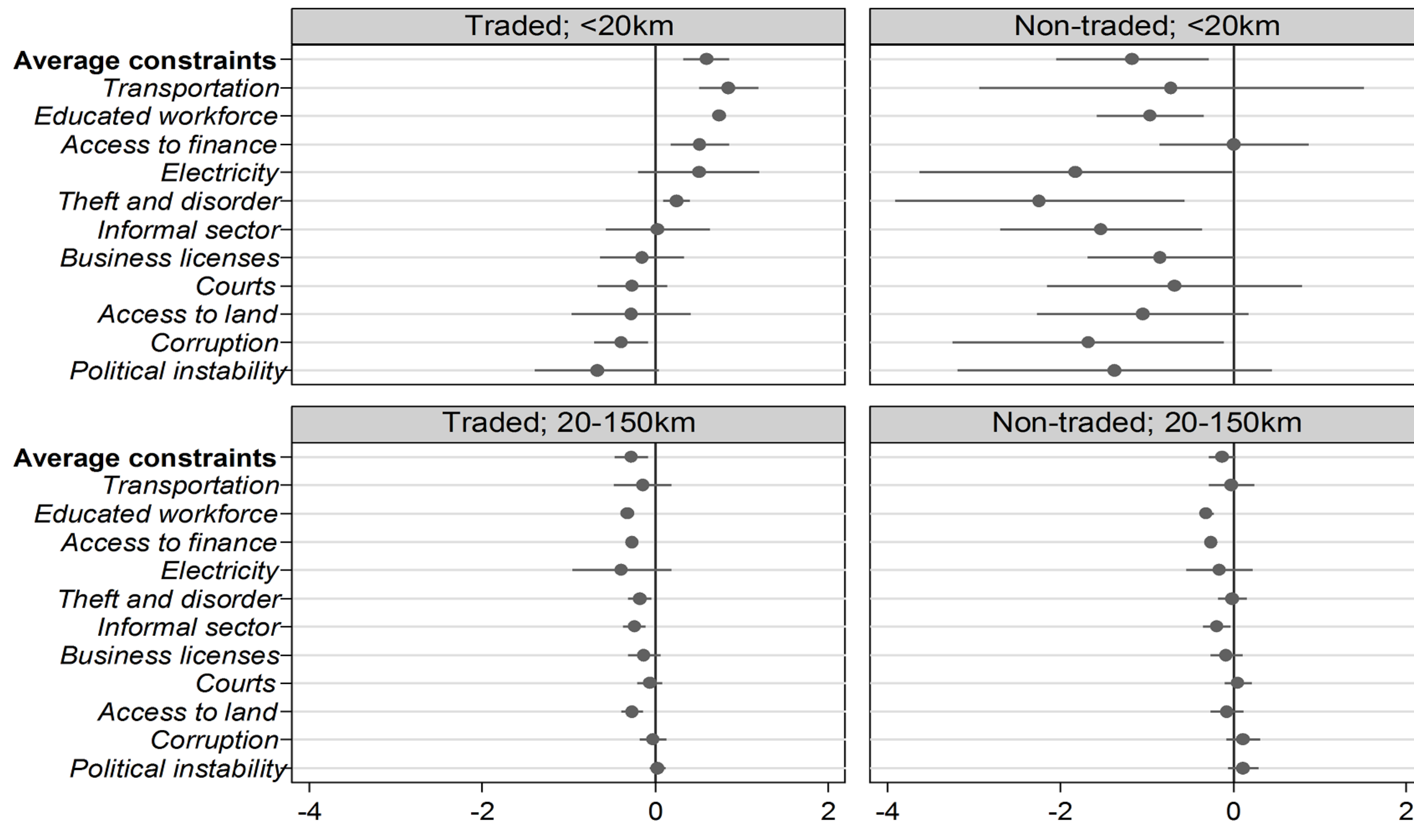


Table A1
Variable definitions and data sources

	Definition	Source	Unit
Dependent variable:			
Average business constraints	Firm's perception of severity of business constraints (rescaled to 0, 100)	Enterprise Surveys	-
Input constraints	Firm's perception of severity of constraints related to access to land, an educated work force and finance (rescaled to 0, 100)	Enterprise Surveys	-
Infrastructure constraints	Firm's perception of severity of constraints related to electricity and transport (rescaled to 0, 100)	Enterprise Surveys	-
Institutional constraints	Firm's perception of severity of constraints related to crime, informal competitors, access to business licences, corruption, political instability and court quality (rescaled to 0, 100)	Enterprise Surveys	-
Independent variables:			
№ active mines 0-20 km	Number of open mines around the firm within a circle with a 20 km radius	SNL	-
№ active mines 21-150 km	Number of open mines around the firm between concentric circles with a 20 km and 150 km radius	SNL	-
Any active mine 0-20 km	Dummy variable that is '1' if there is at least one open mine around the firm within a circle with a 20 km radius; '0' otherwise.	SNL	0/1
Any active mine 21-150 km	Dummy variable that is '1' if there is at least one open mine around the firm between concentric circles with a 20 km and 150 km radius; '0' otherwise	SNL	0/1
Total mining output 0-20 km (ln)	Value of mining production (log of mining production times world price) around the firm within a circle with a 20 km radius. For each mine, independent of its operating status, the median metal production by country-metal is taken and multiplied with the world price.	SNL	-
Total mining output 21-150 km (ln)	Value of mining production (log of mining production times world price) around the firm between concentric circles with a 20 km and 150 km radius. For each mine, independent of its operating status, the median metal production by country-metal is taken and multiplied with the world price.	SNL	-
№ oil and gas fields 0-20 km	Number of oil and gas fields with a minimum pre-extraction size of 500 barrels of oil around the firm within a circle with a 20 km radius	Horn (2003)	-
№ oil and gas fields 21-150 km	Number of oil and gas fields with a minimum pre-extraction size of 500 barrels of oil around the firm between concentric circles with a 20 km and 150 km radius	Horn (2003)	-
Oil and gas reserves 0-20 km (ln)	Log '1' plus total oil and gas reserves around the firm within a circle with a 20 km radius. Reserves measure the total size of fields by their ultimate recovery equivalent, which is the original size of the field as it was known in 2003.	Horn (2003)	-
Oil and gas reserves 21-150 km (ln)	Log '1' plus total oil and gas reserves around the firm between concentric circles with a 20 km and 150 km radius. Reserves measure the total size of fields by their ultimate recovery equivalent, which is the original size of the field as it was known in 2003.	Horn (2003)	-
Oil and gas remaining reserves 0-20 km (ln)	Log '1' plus total oil and gas remaining reserves around the firm within a circle with a 20 km radius. Remaining reserves are estimated on the basis of current field size by applying a half-life time of 10 years, which corresponds to the average half-life of fields in North America, Europe, and the former Soviet Union.	Horn (2003)	-
Oil and gas remaining reserves 21-150 km (ln)	Log '1' plus total oil and gas remaining reserves around the firm between concentric circles with a 20 and 150 km radius. Remaining reserves are estimated on the basis of current field size by applying a half-life time of 10 years, which corresponds to the average half-life of fields in North America, Europe, and the former Soviet Union.	Horn (2003)	-
Night-time light	Night-time light intensity as captured by satellite imagery	NGDC EOG	
Small firm	Dummy variable that is '1' if firm employs between 5 and 19 people; '0' otherwise	Enterprise Surveys	0/1
Medium-sized firm	Dummy variable that is '1' if firm employs between 20 and 99 people; '0' otherwise	Enterprise Surveys	0/1
Large firm	Dummy variable that is '1' if firm employs 100 or more people; '0' otherwise	Enterprise Surveys	0/1
Firm age	Number of years since the firm was established	Enterprise Surveys	-
Foreign firm	Dummy variable that is '1' if foreigners own 10 percent or more of the firm's equity; '0' otherwise	Enterprise Surveys	0/1
State firm	Dummy variable that is '1' if state entities own 10 percent or more of the firm's equity; '0' otherwise	Enterprise Surveys	0/1
Firm competes internationally	Dummy variable that is '1' if main product sold mostly on international markets or more than 25% of sales are earned overseas; '0' otherwise	Enterprise Surveys	0/1
Employment (ln)	Number of permanent full-time employees plus the number of part-time or temporary employees of the firm at the end of the last fiscal year	Enterprise Surveys	-
Assets (ln)	Total replacement value of the physical equipment owned and used by the firm (in US$)	Enterprise Surveys	-
Sales (ln)	Total annual turnover of the firm (in US$)	Enterprise Surveys	-

Notes: This table gives the definition, source and unit for each of the variables used in the analysis. SNL: SNL Metals and Mining database. NGDC EOG: National Geophysical Data Center Earth Observation Group.

Table A2
Frequency table of minerals

Mineral produced	Percent	Cum.	Mineral produced	Percent	Cum.
Missing	*5.67*	*5.67*	Nickel	1.05	80.33
Antimony	0.3	5.97	Niobium	0.33	80.66
Bauxite	1.07	7.04	PGMs	0.67	81.33
Boron	0.08	7.11	Palladium	0.45	81.79
Chromite	0.5	7.61	Platinum	0.59	82.38
Coal	35.42	43.03	Potash	0.23	82.61
Cobalt	0.46	43.49	Rhodium	0.22	82.83
Copper	8.69	52.19	Silver	9.26	92.1
Diamonds	0.22	52.4	Tantalum	0.21	92.3
Gold	11.72	64.13	Tin	0.96	93.26
Iron ore	8.37	72.49	Titanium	0.09	93.35
Lead	3.66	76.15	Tungsten	1.02	94.37
Lithium	0.29	76.43	Uranium oxide	0.52	94.9
Manganese ore	1.31	77.74	Vanadium	0.05	94.95
Mercury	0.02	77.76	Zinc	4.86	99.81
Molybdenum	1.52	79.28	Zirconium	0.19	100

Notes: This frequency table summarises the minerals produced by the mines in our data set. The unit of observation is a mine-mineral-year (each mine can produce several minerals). Source: SNL Metal & Mining.

Table A3
Number of firms by country, survey year and sector type

	All				Tradeable sectors				Non-tradeable sectors				Construction				Natural resources			
	2005	2007	2009	2011	2005	2007	2009	2011	2005	2007	2009	2011	2005	2007	2009	2011	2005	2007	2009	2011
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]	[20]
Brazil		1,791				1,614				158				19						
Chile	421		344		280		254		81		63		31		8		1		19	
China	11,900			2,549	9,849			1,793				408				120	2,051			228
Kazakhstan	512	496			n.a.	243			n.a.	178			54	62			n.a.	13		
Mexico	1,145		1,084		833		902		103		139		29		18		135		25	
Mongolia		153				57				65				22				9		
Russia	444	990			n.a.	715			n.a.	197			61	52			n.a.	26		
Ukraine	499	722			n.a.	531			n.a.	155			68	22			n.a.	14		

Notes: This table shows the number of sample firms by country, the fiscal year that the survey refers to, and sector type. For some countries the 2005 sample cannot be fully split up by sector type. These instances are indicated by "n.a.". Source: World Bank Enterprise Surveys and BEEPS.

Table A4
Sector breakdown of the firm sample

	Freq.	Percent	Sector type	Tradeable and not downstream
	[1]	[2]	[3]	[4]
Other manufacturing	2,655	11.99	T	No
Chemicals	2,410	10.88	T	No
Food	2,305	10.41	T	Yes
Machinery and equipment	2,264	10.22	T	No
Electronics	1,625	7.34	T	No
Non-metallic mineral products	1,554	7.02	R	No
Other	1,339	6.04	-	-
Textiles	1,325	5.98	T	Yes
Garments	1,053	4.75	T	Yes
Retail	956	4.32	NT	No
Basic metals	947	4.28	R	No
Fabricated metal products	814	3.67	T	No
Plastics and rubber	633	2.86	T	No
Construction	555	2.51	C	No
IT	378	1.71	T	No
Wholesale	303	1.37	T	No
Hotels and restaurants	251	1.13	NT	No
Services of motor vehicles	234	1.06	NT	No
Transport	230	1.04	T	No
Furniture	125	0.56	T	Yes
Auto parts	105	0.47	T	No
Shoes and leather	89	0.4	T	Yes
Total	*22,150*	*100*		

Notes: This table provides a breakdown of our firm sample by sector. T=Tradeables sectors; R=Natural resources sector; C=Construction; NT=Non-tradeables sectors.

Table A5

Average business constraints as a function of mines at varying distances from firms

Panel A	*s=10*	*s=20*	*s=50*	*s=100*	*s=150*	*s=300*	*s=450*	*s=20*	*s=20*
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
	s=10	*s=20*	*s=50*	*s=100*	*s=150*	*s=300*	*s=450*	*s=20*	*s=20*
№ active mines within *s* km	0.068	0.162	-0.149***	-0.243***	-0.207**	-0.097***	-0.068**	0.331*	0.348**
	(0.228)	(0.100)	(0.023)	(0.039)	(0.085)	(0.031)	(0.032)	(0.176)	(0.135)
№ active mines 21-150 km								-0.157*	-0.247**
								(0.079)	(0.113)
№ active mines 151-450 km								-0.059*	
								(0.030)	
Country-Year-Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for inactive mines	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	22,150	22,150	22,150	22,150	22,150	22,150	22,150	22,150	22,150
R-squared	0.266	0.266	0.266	0.269	0.270	0.272	0.275	0.277	0.272

Panel B		*s=10*	*s=20*	*s=50*	*s=100*	*s=150*	*s=300*	*s=450*	*s=20*	*s=20*
	Interaction with:	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
№ active mines within *s* km	x Traded	0.580***	0.389***	-0.054***	-0.231***	-0.215**	-0.102***	-0.069**	0.570***	0.588***
		(0.204)	(0.112)	(0.020)	(0.039)	(0.081)	(0.032)	(0.032)	(0.194)	(0.158)
	x Construction	-1.841***	-0.536*	-0.288***	-0.375***	-0.346***	-0.158***	-0.069	-0.045	-0.322
		(0.524)	(0.288)	(0.072)	(0.073)	(0.103)	(0.049)	(0.044)	(0.410)	(0.378)
	x Non-traded	-1.510***	-0.656***	-0.271***	-0.259***	-0.171*	-0.050**	-0.032	-1.170**	-1.171**
		(0.466)	(0.215)	(0.059)	(0.058)	(0.086)	(0.025)	(0.020)	(0.470)	(0.527)
	x Natural resources	-0.935***	-0.456***	-0.438***	-0.438***	-0.346***	-0.139***	-0.099***	-0.139	-0.209***
		(0.029)	(0.021)	(0.042)	(0.035)	(0.076)	(0.029)	(0.027)	(0.098)	(0.034)
№ active mines 21-150 km	x Traded								-0.190**	-0.275**
									(0.092)	(0.115)
	x Construction								-0.284**	-0.332**
									(0.114)	(0.132)
	x Non-traded								-0.088	-0.132
									(0.078)	(0.093)
	x Natural resources								-0.184***	-0.360***
									(0.068)	(0.089)
№ active mines 151-450 km	x Traded								-0.056*	
									(0.031)	
	x Construction								-0.009	
									(0.038)	
	x Non-traded								-0.017	
									(0.018)	
	x Natural resources								-0.085***	
									(0.022)	
Country-Year-Sector FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm controls		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for inactive mines		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations		20,812	20,812	20,812	20,812	20,812	20,812	20,812	20,812	20,812
R-squared		0.279	0.279	0.279	0.281	0.285	0.286	0.289	0.293	0.288

Notes: This table shows OLS regressions to estimate the impact of local mining activity, measured at varying distances from firms, on firms' average business constraints. Robust standard errors are clustered by country-year-sector and shown in parentheses. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively. All specifications include country-year-sector fixed effects, firm controls (size, age, international exporter, and ownership), controls for inactive mines measured within the same distance from firms as the number of active mines, and a dummy for whether a mine of any status exists in the administrative region of the firm. Constant included but not shown. Table 1 contains summary statistics and Appendix Table A1 contains variable definitions and data sources.

Table A6
Local mining measured at varying time lags

Lag of mine variables:		*t*	*t-1*	*t-2* *(baseline)*	*t-3*
	Interaction with:	[1]	[2]	[3]	[4]
№ active mines 0-20 km	x Traded	0.613***	0.518**	0.587***	0.618***
		(0.060)	(0.193)	(0.158)	(0.157)
	x Construction	-0.483	-0.556*	-0.322	-0.207
		(0.370)	(0.318)	(0.377)	(0.286)
	x Non-traded	-1.656***	-1.190**	-1.172**	-1.095**
		(0.390)	(0.475)	(0.527)	(0.518)
	x Natural resources	-0.232***	-0.202***	-0.209***	-0.221***
		(0.015)	(0.040)	(0.034)	(0.025)
№ active mines 21-150 km	x Traded	-0.262***	-0.233**	-0.275**	-0.247***
		(0.036)	(0.098)	(0.115)	(0.083)
	x Construction	-0.287***	-0.281**	-0.332**	-0.253***
		(0.077)	(0.110)	(0.132)	(0.082)
	x Non-traded	-0.081	-0.084	-0.132	-0.105
		(0.064)	(0.074)	(0.092)	(0.064)
	x Natural resources	-0.388***	-0.351***	-0.360***	-0.351***
		(0.017)	(0.086)	(0.089)	(0.081)
Country-Year-Sector FE		Yes	Yes	Yes	Yes
Firm controls		Yes	Yes	Yes	Yes
Controls for inactive mines		Yes	Yes	Yes	Yes
Observations		18,340	20,812	20,812	20,812
R-squared		0.217	0.286	0.288	0.286

Notes: This table shows OLS regressions to estimate the impact of local mining activity, measured at varying time lags, on firms' business constraints related to inputs (access to land, access to adequately educated workforce, access to finance), infrastructure (electricity and transport) and institutions (crime, competition from informal sector, ease of obtaining an operating licence, corruption, political instability, court quality). The sample is smaller in column 1 because the mine status is not known for 2011. Robust standard errors are clustered by country-year-sector and shown in parentheses. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively. All specifications include country-year-sector fixed effects, firm controls (size, age, international exporter and ownership), controls for inactive mines in the vicinity of firms, and a dummy for whether a mine of any status exists in the administrative region of the firm. Constant included but not shown. Table 1 contains summary statistics and Appendix Table A1 contains variable definitions and data sources.

Table A7
Sectoral firm distribution by classification method

Classification method →	Mian-Sufi			Ellison-Glaeser
	I: Baseline	II	III	index
	[1]	[2]	[3]	[4]
Tradeable	19,470	16,280	16,280	19,603
Construction	673	673	673	673
Non-tradeable	1,879	1,879	592	1,746
Natural resources	2,648	2,648	2,648	2,648
Other	0	3,190	4,477	0
Total number of firms	24,670	24,670	24,670	24,670

Notes: This table summarizes various ways to classify firms into tradeable versus non-tradeable sectors. Columns 1-3 follow Mian and Sufi (2014). Retail, restaurants, hotels and motor vehicle services are categorized as non-tradeable. Column 2 further restricts tradeables to sectors in which firms export on average at least 5 per cent of output either directly or through intermediaries (source: World Bank Enterprise Surveys). Column 3 also excludes the retail sector from non-tradeables (and labels it Other). Column 4 follows Ellison and Glaeser (1997) and defines (non-)tradeables according to their geographical concentration. The index is a measure of excess concentration with respect to a random distribution of sectors across space, where excess concentration may either reflect natural advantages or agglomeration economies.

Table A8
Robustness: Alternative classifications of tradeable versus non-tradeable sectors

		Average business constraints			
		Mian-Sufi			Ellison-Glaeser
		I: Baseline	II	III	index
	Interaction with:	[1]	[2]	[3]	[4]
№ active mines 0-20 km	x Traded	0.588***	0.589***	0.581***	0.581***
		(0.158)	(0.159)	(0.163)	(0.136)
	x Construction	-0.322	-0.321	-0.375	-0.233
		(0.378)	(0.382)	(0.379)	(0.394)
	x Non-traded	-1.171**	-1.170**	-0.733	0.278
		(0.527)	(0.531)	(0.569)	(0.599)
	x Natural resources	-0.209***	-0.208***	-0.211***	-0.205***
		(0.034)	(0.034)	(0.034)	(0.035)
	x Other		0.589*	-0.025	
			(0.347)	(0.413)	
№ active mines 21-150 km	x Traded	-0.275**	-0.276**	-0.276**	-0.292**
		(0.115)	(0.114)	(0.115)	(0.108)
	x Construction	-0.332**	-0.330**	-0.328**	-0.349***
		(0.132)	(0.133)	(0.135)	(0.126)
	x Non-traded	-0.132	-0.130	-0.143*	-0.182**
		(0.093)	(0.092)	(0.083)	(0.090)
	x Natural resources	-0.360***	-0.360***	-0.360***	-0.364***
		(0.089)	(0.089)	(0.089)	(0.088)
	x Other		-0.264**	-0.228*	
			(0.125)	(0.122)	
Country-Year-Sector FE		Yes	Yes	Yes	Yes
Firm controls		Yes	Yes	Yes	Yes
Controls for inactive mines		Yes	Yes	Yes	Yes
Clusters		44	53	52	42
Observations		20,812	20,812	20,812	20,812
R-squared		0.288	0.288	0.288	0.287

Notes: This table shows OLS regressions to estimate the impact of local mining activity on firms' business constraints. Column 1 replicates our results of column 1 in Table 3. The following columns show similar regressions while using different ways to classify firms into tradeable versus non-tradeable sectors. Columns 1-3 follow Mian and Sufi (2014). Retail, restaurants, hotels and motor vehicle services are categorized as non-tradeable. Column 2 further restricts tradeables to sectors in which firms export on average at least 5 per cent of output either directly or through intermediaries (source: World Bank Enterprise Surveys). Column 3 also excludes the retail sector from non-tradeables (and labels it *Other*). Column 4 follows Ellison and Glaeser (1997) and defines (non-)tradeables according to their geographical concentration. The index is a measure of excess concentration with respect to a random distribution of sectors across space, where excess concentration may either reflect natural advantages or agglomeration economies. Robust standard errors are clustered by country-year-sector and shown in parentheses. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively. All specifications include country-year-sector fixed effects, firm controls (size, age, international exporter, and ownership), controls for inactive mines in the vicinity of firms, and a dummy for whether a mine of any status exists in the administrative region of the firm. Constant included but not shown. Table 1 contains summary statistics and Appendix Table A1 contains variable definitions and data sources.

Table A9
Local mining and business constraints: Controlling for NTL near firms

		Baseline		Mines: NTL	
	Interaction with:	[1]	[2]	[3]	[4]
№ active mines 0-20 km		0.355***		0.007*	
		(0.120)		(0.004)	
№ active mines 0-20 km	x Traded		0.582***		0.013**
			(0.141)		(0.005)
	x Construction		-0.272		-0.021**
			(0.371)		(0.009)
	x Non-traded		-1.109*		-0.019
			(0.560)		(0.014)
	x Natural resources		-0.174***		-0.007***
			(0.038)		(0.001)
№ active mines 21-150 km		-0.249**		-0.009**	
		(0.103)		(0.004)	
№ active mines 21-150 km	x Traded		-0.278**		-0.010**
			(0.106)		(0.004)
	x Construction		-0.346***		-0.012**
			(0.124)		(0.005)
	x Non-traded		-0.143		-0.003
			(0.087)		(0.003)
	x Natural resources		-0.365***		-0.017***
			(0.085)		(0.006)
Average luminosity within a		0.058**	0.066**	0.053*	0.061**
20 km radius at t-2		(0.026)	(0.027)	(0.028)	(0.030)
Average luminosity within a		-0.148*	-0.142*	-0.094	-0.084
20 to 150 km band at t-2		(0.080)	(0.071)	(0.072)	(0.072)
№ gas flares within 150 km (=		-0.802**	-0.843*	-0.797**	-0.849*
0 within 20km)		(0.323)	(0.433)	(0.317)	(0.434)
Country-Year-Sector FE		Yes	Yes	Yes	Yes
Firm controls		Yes	Yes	Yes	Yes
Controls for inactive mines		Yes	Yes	Yes	Yes
Observations		22,150	20,812	22,150	20,812
R-squared		0.274	0.289	0.272	0.287

Notes: This table shows OLS regressions to estimate the impact of local mining activity on firms' business constraints. In columns 3-4 mining activity is measured by the sum of NTL emitted within a 1 km radius around mines. Robust standard errors are clustered by country-year-sector and shown in parentheses. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively. All specifications include firm controls (size, age, international exporter, and ownership), controls for inactive mines in the vicinity of firms, and a dummy for whether a mine of any status exists in the administrative region of the firm. The number of gas flares controls for the possibility that night-time light reflects the intense light emitted by burning natural gas that is extracted as a by-product of oil fields. Constant included but not shown. Table 1 contains summary statistics and Appendix Table A1 contains variable definitions and data sources.

Table A10
Local mining and business constraints: Regions without any nearby or distant mines

Sample →	Firms without any mines between 21-150km			Firms without any mines within 20km		
Dependent variable →	Average business constraints					
	[1]	[2]	[3]	[4]	[5]	[6]
№ active mines 0-20 km	2.266***					
	(0.260)					
x Traded		2.362***	2.207*			
		(0.102)	(1.283)			
x Construction		0.831	1.826			
		(10.889)	(10.914)			
x Non-traded		0.217	-0.510			
		(0.237)	(2.987)			
x Natural resources		1.560	-			
		(1.119)	-			
№ active mines 21-150 km				-0.327**		
				(0.137)		
x Traded					-0.330**	-0.175*
					(0.148)	(0.093)
x Construction					-0.413**	-0.257**
					(0.176)	(0.122)
x Non-traded					-0.198	-0.061
					(0.132)	(0.087)
x Natural resources					-0.366***	-0.167**
					(0.102)	(0.080)
Country-Year-Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	No	No	Yes	No	No	Yes
Observations	3,327	3,327	3,327	15,687	15,687	15,687
R-squared	0.317	0.317	0.359	0.300	0.300	0.372

Notes : This table shows OLS regressions to estimate the impact of local mining activity on firms' business constraints. The regressions are estimated using a sample of firms without any mines within a distance band of 21-150 km (columns 1-3) or within a radius of 20 km (columns 4-6). Robust standard errors are clustered by country-year-sector and shown in parentheses. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively. All specifications include firm controls (size, age, international exporter, and ownership), controls for inactive mines in the vicinity of firms, and a dummy for whether a mine of any status exists in the administrative region of the firm. Constant included but not shown. Table 1 contains summary statistics and Appendix Table A1 contains variable definitions and data sources.

Table A11
Local mining, business constraints and firm performance

Sample →	All	Exclude 2.5% largest firms	Exclude 5% largest firms	Exclude 10% largest firms					
				All	Traded only	Traded only and not down-stream	All	Traded only	Traded only and not down-stream
Dependent variable →	Employment (ln)								
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
	-0.020**	-0.019**	-0.016*	-0.017**	-0.010	-0.014**	-0.027***	-0.030*	-0.069***
	(0.010)	(0.008)	(0.009)	(0.008)	(0.009)	(0.005)	(0.009)	(0.015)	(0.019)
Observations	20,821	20,205	19,589	18,378	14,262	4,408	18.377	14,262	4,408
№ clusters	44	44	44	44	11	11	44	11	11
Dependent variable →	Sales (ln)								
	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]
	-0.025**	-0.026**	-0.026**	-0.031**	-0.046	-0.086	0.001	-0.016	-0.095
	(0.011)	(0.012)	(0.013)	(0.014)	(0.031)	(0.051)	(0.025)	(0.062)	(0.082)
Observations	8,023	7,949	7,903	7,787	5,682	1,985	7,787	5,682	1,985
№ clusters	42	42	42	42	10	10	42	10	10
Dependent variable →	Assets (ln)								
	[19]	[20]	[21]	[22]	[23]	[24]	[25]	[26]	[27]
	-0.065***	-0.068***	-0.069***	-0.070***	-0.082**	-0.089	-0.018	-0.030	-0.188
	(0.017)	(0.018)	(0.020)	(0.022)	(0.030)	(0.055)	(0.071)	(0.088)	(0.114)
Observations	4,260	4,230	4,201	4,139	3,813	1,630	4,139	3,813	1,630
№ clusters	22	22	22	22	10	10	22	10	10
Country-Year-Sector FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FEs	No	No	No	No	No	No	Yes	Yes	Yes
Firm and inactive mine controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table shows 2SLS regressions to estimate the impact of local mining activity on firm performance. Robust standard errors are shown in parentheses and clustered by country-year-sector. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively. All specifications include country-year-sector fixed effects, a dummy for whether a region has any mines, firm controls and controls for inactive mines in the vicinity of firms. Constant include but not shown. Table 1 contains summary statistics and Appendix Table A1 contains variable definitions and data sources. Sales are the firm's total annual sales. Assets are the costs to repurchase all of the firm's machinery, land, and buildings.

Table A12
Distribution of the number of active mines and oil & gas fields around firms

	Active mines		Oil & gas fields	
	0-20 km	21-150 km	0-20 km	21-150 km
	[1]	[2]	[3]	[4]
Brazil	0.35	1.30	0.00	0.05
	(1.17)	(3.76)		(0.23)
Chile	0.06	6.68	0.00	0.00
	(0.26)	(3.13)		
China	0.70	8.67	0.01	0.34
	(1.75)	(9.07)	(0.16)	(0.73)
Kazakhstan	0.18	1.29	0.00	0.04
	(0.38)	(2.52)		(0.20)
Mexico	0.00	1.22	0.00	0.00
	(0.07)	(0.90)		
Mongolia	0.05	1.54	0.00	0.00
	(0.22)	(0.80)		
Russia	0.36	5.78	0.03	0.25
	(0.52)	(18.41)	(0.16)	(0.72)
Ukraine	1.34	18.48	0	0.72
	(3.96)	(39.29)	(0.04)	(1.00)
All countries	0.53	7.1	0.01	0.25
	(1.68)	(13.17)	(0.13)	(0.66)

Notes: This table shows for each sample country the mean and (in parentheses) the standard deviation of the number of active mines and oil & gas fields surrounding firms. Mines and oil & gas fields are matched to firms based on a circle with a 20 km radius around each firm (odd columns) or a distance ring of between 21 and 150 km (even columns). Source: World Bank Enterprise Surveys, SNL Metals and Mining, and Horn (2003).

Table A13
Sectoral composition of value added

	Brazil	China	Chile	Kazakhstan	Mexico	Mongolia	Russia	Ukraine
Construction	5%	6%	7%	8%	7%	5%	6%	5%
Natural resources	3%	5%	7%	23%	9%	28%	10%	10%
Non-tradeable	56%	33%	47%	49%	46%	44%	42%	48%
Tradeable	36%	57%	39%	19%	38%	24%	42%	36%
Total	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*

Notes : This table decomposes country-level value added into the four main sector types we use throughout the paper. Data sources: OECD (Chile), Trading Economics (Kazakhstan, Mongolia and Ukraine) and the World Input-Output Database (WIOD, all other countries). For Brazil, Chile, China, Mexico and Russia, we use the average over 2005-09 while for Kazakhstan, Mongolia and Ukraine we use 2010-12 data.