Extractive Resource Policy and Civil Conflict: Evidence from Mining Reform in the Philippines

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Abstract

Many developing countries have vast endowments of natural resources and face the decision of how to regulate their extraction. Policy regimes that encourage resource extraction can help generate employment, economic growth and tax revenue, but can also lead to conflicts over the distribution of resource rents. We estimate how a shift towards a more extractive resource policy, brought about by a regulatory reform of the mining sector, affected civil conflict in the Philippines. Our empirical strategy uses a difference-in-differences approach that compares provinces with and without mineral deposits before and after the reform. We find that the reform led to a large increase in conflict violence, most likely due to increased competition over control of resource-rich areas. The estimated welfare cost of this increase in violence is several orders of magnitude larger than the country's total revenue from taxes on mineral production.

Keywords: Natural Resources, Minerals, Mining, Extractive Policy, Reform, Civil Conflict

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1. Introduction

Many developing countries have vast endowments of natural resources. Harnessing these resources for pro-poor growth is one of the great development challenges of the coming decades. There is considerable disagreement about how to best regulate resource extraction (World Bank, 2002; UNDP, 2011; Barma et al., 2012). Proponents of policies that encourage resource extraction argue that these policies can help generate employment, economic growth and tax revenue. Opponents argue that extractive resource policies can lead to environmental degradation and conflicts over the distribution of resource rents.

The evidence on resource extraction and conflict is mixed (see Ross, 2015; Nillesen and Bulte, 2014, for recent reviews). Some studies find that extraction, particularly of oil and diamonds, is associated with higher conflict risk (e.g. Ross, 2006; Lujala, 2009; Collier and Hoeffler, 1998, 2004). Others either find no evidence for this effect, or find that its direction depends on the exact type of resource (Ross, 2003; Lujala et al., 2005; Brunnschweiler and Bulte, 2009; Bazzi and Blattman, 2014).

An important open question is how resource policy mediates the effect of resource endowments on civil conflict. Evidence on this question is pertinent as many developing country governments weigh the costs and benefits of different resource policy regimes. For instance, the World Bank-led Mining Investment and Governance Review is currently reviewing mining policy in a large number of countries, including ones that have experienced civil conflict, such as the Democratic Republic of Congo, Mozambique, Kenya, India and Peru. The potential damages from civil conflict are enormous and well-documented (Imai and Weinstein, 2000; Mueller, 2013; World Bank, 2017). Evidence that extractive natural resource policies exacerbate conflict could substantially change the cost-benefit calculus of implementing them.

This paper examines how a shift towards a more extractive resource policy, brought about by a regulatory reform of the mining sector, affected conflict in the Philippines. The government of the Philippines launched this reform program, called the Minerals Action Plan (MAP), in January 2004 with the goal of increasing investment in mining. Most significantly, the MAP streamlined the application process for mining permits, increased the number of permits issued, and made it more difficult to hold up the permitting process with legal challenges. As a result, the average lag between application and grant of a permit was reduced from 3-5 years to 6 months in 2005 (Fong-Sam, 2005). The improved investment climate was hailed by the mining industry and generated an estimated $5 billion of commitments for new investments by February 2005 (Cruz et al., 2005; Fong-Sam, 2005). Yet, critics of large-scale mining worried that this increase in investment would exacerbate the countrys existing civil conflicts, either by aggravating environmental grievances or by creating extortion opportunities for rebel groups (Cordillera Peoples Alliance, 2004; Holden and Jacobson, 2007; Hatcher, 2014).

The previous literature can only give limited guidance on how this kind of policy affects civil conflict. Theoretical studies suggest that a more extractive resource policy can affect conflict through two main channels. First, it could reduce conflict by generating employment in the mining sector, which increases returns to peaceful economic activity and the opportunity cost of joining a rebel group. Second, it could exacerbate conflict by increasing possible revenues from taxation or extortion, leading to intensified competition over control of the resource. The aggregate effect of the policy depends on the relative sizes of these two opposing channels (Dal Bo and Dal Bo, 2011; Dube and Vargas, 2013).

The empirical literature has only recently begun to analyze the effect of resource-related policies on civil conflict. Parker and Vadheim (2017) find that a U.S. ban on trade in so-called conflict minerals led to an increase in violence against civilians in the Democratic Republic of Congo. Similarly, Chimeli and Soares (2017) find that a ban on trade in mahogany led to a temporary increase in violence in mahogany-rich areas in Brazil. Additional evidence comes from van den Eynde (2015) who finds that an increase in taxes on iron production in India led to an increase in conflict in districts with iron deposits. All three of these policies discourage resource extraction and most likely reduce employment in the (legal) extraction sector, which could partly explain their conflict-increasing effects.[1] Our study is unique in analyzing a policy that encourages resource extraction and is therefore likely to simultaneously increase employment and competition over resource control.

Additional relevant evidence comes from studies of price shocks. Dube and Vargas (2013) find that an increase in world market mineral prices leads to increased conflict in mineral producing regions of Colombia. Similarly, Berman et al. (2017) find that higher mineral prices lead to increased conflict in the proximity of African mines. This evidence suggests that, for mineral price shocks, the competition channel outweighs the opportunity cost channel, so that higher prices lead to more resource-related conflict. It is, however, not clear whether the same will be true for a permanent policy shift that makes mineral extraction more profitable. Such a shift is likely to have larger employment effects than a temporary price shock, since firms make investment decisions based on forward-looking assessments of expected returns. This would imply a larger opportunity cost effect, which would make the policy more conflict-reducing on aggregate. In addition, the conflict-increasing effect of higher mineral prices does not appear to be universal in a cross-country setting: Bazzi and Blattman (2014) find that an increase in the value of a country's resource exports has little effect on the likelihood of conflict onset, and weakly decreases the duration and intensity of existing conflicts.

Our empirical strategy uses a difference-in-differences approach that compares provinces with and without mineral deposits before and after the start of mining reform.[2] We estimate that the reform caused a large and statistically significant increase in conflict violence, both in

[1] In addition, the tax studied by van den Eynde (2015) could increase conflict by increasing the government's incentive to establish control over resource-rich areas in order to collect taxes.

[2] We focus on deposits of three minerals – gold, copper and nickel – which account for 97% of the country's mineral production during the period of observation.

terms of casualties and violent incidents. Our results are robust to controlling for differential effects of mineral prices on provinces with deposits, and to the inclusion of administrative-region-by-year fixed effects. We also show that provinces with and without mineral deposits were on parallel trends with respect to conflict outcomes before the start of the reform.

Looking at conflict dynamics, we find that the reform's effect on casualties was only temporary, disappearing after 2007, though its effect on the number of incidents appears to have persisted at least until 2009. The violence caused by the reform is evenly divided between government-initiated and rebel-initiated incidents, though most casualties are from government forces. We further find that the increase in violence is largest in provinces where new large-scale mines were opened after the start of the reform. These results are consistent with the hypothesis that the reform caused increased competition over control of resource-rich areas that were targets of new investment. We find no evidence that the reform caused spillovers in conflict between nearby provinces.

Our estimates suggest that mining reform led to an additional 3,100 casualties during the period of observation. Assuming no spillovers across provinces, we estimate the cost of this loss of life at approximately 1.8 billion U.S. dollars. This cost is several orders of magnitude larger than the country's total revenue from mining taxes and fees[3] and likely to be a substantial fraction of the value of additional mineral production generated by the reform. The conflict-increasing effect of the reform is also large relative to the effects of price movements in our data and in the previous literature (Dube and Vargas, 2013; Bazzi and Blattman, 2014).

We conclude that resource policy plays an important role in mediating the effect of resource endowments on civil conflict. A shift towards a more extractive policy regime can cause a

[3]The additional tax revenue generated by the reform is likely to be substantially smaller, since the country already produced a substantial amount of minerals before the reform and would likely have continued to do so without it.

substantial increase in conflict violence, which should be taken into account for cost-benefit analyses of mining reform.

2. Background

2.1. Mining in the Philippines

The Philippines is one of the world's most mineral rich countries. In 2010, the value of its known mineral reserves was estimated at over 1.3 trillion U.S. dollars (Pavlova and Hincks, 2013). During the period of observation of this paper, 2001-2009, the Philippines' largest mineral exports were gold, copper and nickel, which made up over 97 percent of the country's total mineral production.[4] The most important of the three minerals was gold, which accounted for 68 percent of the total value of mineral production in the country, followed by nickel and copper, which accounted for 19 and 10 percent, respectively.

Despite the country's large amount of mineral wealth, the contribution of mining to the Philippine economy has historically been relatively small. In 2001, at the beginning of our period of observation, mining accounted for approximately 0.5% of GDP, 1.7% of exports and 0.3% of employment. Disappointed with this performance, the Arroyo administration launched a program to revitalize the mining sector through an executive order issued in January of 2004. This program, called the Mineral Action Plan, included over 100 regulatory measures, with the overall goal of increasing both foreign and domestic investment in mining. In the words of President Arroyo, the policy marked a shift in the government's position "from tolerance to promotion of the mining industry."

[4] The country also produced small amounts of silver, chromite and zinc.

Among the most significant provisions of the MAP were its changes to the permitting process, which was streamlined and allowed to move forward in the presence of pending legal challenges. As a result, the average lag between application and grant of a permit was reduced from 3-5 years to 6 months in 2005 (Fong-Sam, 2005). The MAP also cleared 84 dormant mining permits and made the areas covered by them available for new applications. In addition, it created the Minerals Development Council under the office of the President to harmonize mining regulations across a large number of government departments, and serve as a "one-stop-shop" for the needs of mining investors. The business environment for mining was further improved by a ruling of the Supreme Court of the Philippines in December 2004, in which the court upheld crucial provisions of the Mining Act of 1995, allowing majority foreign ownership of mining companies.[5] Taken together the MAP and the Supreme Court ruling led to a substantially improved investment climate, which was widely hailed by the international mining industry (Cruz et al., 2005). In early 2005, government representatives embarked on an investor "road show", which generated an estimated $5 billion of commitments for new investments in mining (Cruz et al., 2005; Fong-Sam, 2005).

Figure 1 shows the trend of foreign direct investment, employment and production (both in quantity and value terms) in the mining sector during the period of observation. The figure shows that the trends of all four variables were fairly flat before the start of reform in 2004 and began to increase afterward. The increase in FDI and production occurs with a lag of approximately two years, perhaps because of planning delays, or because mineral-rich areas had to be secured before the start of mining operations. We can, of course, not be sure that the increased mining activity is entirely due to a causal effect of mining reform. Still the data in Figure 1 are consistent with the argument of the reform's proponents, that it would revitalize the mining sector and generate employment in mineral-rich provinces.

[5]In this paper, we do not attempt to disentangle the effects of the MAP and the Supreme Court ruling and treat them as part of the same shift towards a more extractive resource policy regime.

2.2. Mining and Civil Conflict in the Philippines

The Philippines is involved in long-running conflicts with three major rebel groups: the communist New People's Army, the Muslim-separatist Moro-Islamic Liberation Front, and the Jihadist Abu Sayyaf Group (see Crost et al., 2016, for a more detailed description of the three rebel groups)). Observers have argued that mining fuels these conflicts mainly through two mechanisms: extortion and environmental grievances (Holden and Jacobson, 2007; Quimpo, 2014).

Mining companies and other businesses are lucrative targets for extortion by rebel groups. The New People's Army in particular is well-known for raising "revolutionary taxes" on mining firms under the threat of destroying their equipment and disrupting their operations. Revenue from these extortion activities is thought to make up a substantial amount of the group's total revenue (Quimpo, 2014). For instance, the government of the Philippines estimates that the group collects over 28 mio U.S. dollars per year in extortion payments from mining and agricultural companies in the Mindanao region alone (Colina, 2018). There is also anecdotal evidence for extortion activities by other rebel groups. For example, there have been allegations that the Candian mining firm Echo Bay Mines paid over 1.7 million U.S. dollars to several armed groups, including the Moro-Islamic Liberation Front and the Abu Sayyaf Group (Holden and Jacobson, 2007).

The government sees extortion as a major threat to national security, since the revenue it generates allows rebels to fund their operations. This concern has recently received considerable media attention after Dole Philippines announced the closure of its banana plantations in Mindanao due to the rising costs of extortion Jones (2016). In response, the government launched a campaign to urge businesses not to submit to extortion attempts, stating that "giving financial aid to the rebels will give them more strength and this must be stopped."[6] As part of the effort to prevent financial flows to rebels, President Duterte threatened to prosecute mining companies that make extortion payments for money laundering (Ranada, 2017).

To counter the threat of extortion, the government tries to provide security for mining firms in conflict-affected areas, either by defending mines against rebel attacks or by pre-emptively clearing the area of rebel positions (Holden and Jacobson, 2007). These security efforts are, however, not always successful. There are numerous examples of rebel attacks that cause substantial damage to mining operations (Colina, 2018; Ocampo, 2017; Caliguid, 2011).

The second mechanism through which mining reform could affect conflict are environmental grievances. Mining operations often entail substantial environmental risks, particularly when regulatory oversight is weak (Dudka and Adriano, 1995). The mining process can release hazardous substances, such as radioactive elements and toxic mineral dust into the atmosphere (Csavina et al., 2012). In addition, chemicals used to extract metals from their ore can contaminate the groundwater, with potentially devastating effects for health and agriculture (Castilhos et al., 2006). Environmental activists have therefore protested the expansion of mining activities into new areas in the Philippines. Armed rebel groups, particularly the communist New People's Army, often cite concerns about environmental damages in statements that justify their attacks on mining firms (Montana, 2017; Sanchez, 2017, 2018).

Overall, the anecdotal evidence suggests that increased investment in mining can have a direct effect on conflict violence by increasing rebel attacks on mining firms, either to punish them for environmental violations or to follow through on extortion threats. In addition, it can have an indirect effect by increasing extortion revenue that rebels use to fund attacks on

[6] Quote from a joint statement of the commanders of the Armed Forces of the Philippines and Philippine National Police (Crismundo, 2017).

other targets. Finally, it can increase attacks by government forces on rebel positions, with the goal to preempt rebel attacks and preclude extortion attempts.

3. Data

Data on conflict intensity come from incident reports by Philippine military units operating in the field during the period 2001-2009. This data was initially collected by Felter (2005). Updated versions were used by several subsequent studies on the determinants of civil conflict in the Philippines (e.g. Berman et al., 2011; Crost et al., 2014, 2016). A concern about this data is possible reporting bias, since reports come from the Philippine military, which is a party to the Philippine conflict. This concern is limited by the fact that the reports were used by the military to plan operations and were not originally intended for public release. This makes the reports an unusually reliable and complete source of information on conflict in the Philippines. By comparison, datasets based on newspaper reports, such as the UCDP Georeferenced Event Database, record a substantially smaller number of casualties and violent incidents, which suggests that underreporting of conflict events may be more severe in newspapers than in the AFP field reports.

Our preferred measures of conflict intensity are the number of casualties and the number of violent incidents, defined as incidents resulting in at least one casualty. Both measures have been used by a large number of previous studies of civil conflict. To allow a more in-depth analysis of conflict dynamics, we also analyze how many violent incidents and casualties were initiated and suffered by government forces and different rebel groups.

Data on mineral deposits come from two sources, the United Nations Environmental Program (UNEP, 2011), and the U.S. Geological Survey's global database of major mineral deposits (United States Geological Survey, 2017). Both of these sources contain qualitative information on the location of mineral deposits in a given province. Data on the exact quantity of minerals by province is not readily available. In any case, a qualitative indicator for the presence of minerals is preferable for the purpose of our study, since the quantity of known deposits is a function of exploratory activities that may themselves be affected by mining reform.

Additional data on control variables come from the Philippine Statistics Authority. These include province-level data on poverty rate, human development index, population density, Gini coefficient, percent agricultural area, and percent landowners. All control variables are measured in the year 2000, before the start of the period of observation.

4. Empirical strategy

Our empirical strategy uses a difference-in-differences approach that compares conflict outcomes in provinces with and without mineral deposits, before and after the start of mining reform in 2004. The difference-in-differences estimator is based on the assumption that these provinces would have been on parallel trends with respect to conflict outcomes, if the reform had not been implemented. This assumption is violated if provinces with and without mineral deposits are subject to different unobserved shocks or trends, perhaps because they have different characteristics or are located in different parts of the country.

We address this concern in several ways. First, we include region-by-year fixed effects, which flexibly control for time-varying unobserved shocks that differ across the country's 18 administrative regions. By including this set of fixed effects, we ensure that our estimates are identified by comparing provinces with and without mineral deposits in the same administrative region. Administrative regions in which either all or none of the provinces have mineral deposits do not inform our estimates and we exclude them from our preferred regressions.[7]

The map in Figure 3 illustrates the identifying variation. Provinces with mineral deposits are shaded in yellow, provinces without them are shaded in gray. Administrative regions in which either all or no provinces have mineral deposits are left blank. The map shows that mineral deposits are geographically well dispersed over the country, with relatively little spatial clustering, which makes us more confident that our estimates are not driven by unobserved shocks to specific parts of the country.

As an additional robustness test, we estimate regressions that control for the interaction between year fixed effects and the following province characteristics, measured in the baseline year 2000: poverty rate, human development index, population density, Gini coefficient, and percent landowners. This strategy controls for time-varying shocks that differentially affect provinces with different observed baseline characteristics.

Another potential threat to our identification strategy comes from possible effects of movements in mineral prices. Figure 2, shows that the world market prices of gold, copper and nickel increased substantially over the period of observation. Previous evidence by Dube and Vargas (2013) suggests that an increase in mineral prices has the potential to increase conflict in mineral-rich regions. We therefore control for the interactions between indicators for the three minerals and their respective prices, to avoid confounding the effect of price increases with the effect of mining reform. As a robustness test, we also estimate regressions that control for lagged prices, and ones that model price effects with logarithmic or quadratic functional forms.

[7]Additional results presented in Appendix Tables A.1 show that these choices are not essential: our estimates change little when we include all provinces and/or only control for year fixed effects instead of region-byyear fixed effects.

Our baseline specification is described by the following equation:

$$Y_{irt} = \beta_0 + \alpha_i + \lambda_{rt} + \beta_1 M_i \times Post04_t + X_{irt}\gamma + \varepsilon_{irt} \tag{1}$$

In this equation, Y_{it} denotes the conflict outcome of interest, which is either the number of casualties or the number of violent incidents, in province i in administrative region r in year t. The variable M_i is an indicator for whether province i has deposits of any of the three main mineral exports of the Philippines, gold, copper and nickel.[8] $Post04_t$ is an indicator for observations from the years 2004-2009; α_i and λ_{rt} are province and region-by-year fixed effects. The vector X_{irt} contains the following climate-related control variables: average annual temperature, precipitation in the wet season and the dry season, and an indicator for whether the province experienced a major typhoon. In additional specifications, we also include interactions between mineral indicators and mineral prices, as well as interactions between year fixed effects and a wide range of baseline province characteristics.

We conduct two robustness tests for the parallel trends assumption that underlies our estimator. First, we estimate the following equation that includes the "lead" of the treatment indicator:

$$Y_{irt} = \beta_0 + \alpha_i + \lambda_{rt} + \beta_1 M_i \times Post04_t + \beta_2 M_i \times Year03_t + X_{irt}\gamma + \varepsilon_{irt} \tag{2}$$

The variable $Year03_t$ denotes an indicator for observations in 2003, the year before the start of mining reform. The coefficient β_2 therefore reflects how the difference in conflict between

[8]The three minerals exhibit a high rate of co-occurrence, which makes it difficult to disentangle their effects. For example, all provinces with nickel deposits also have copper deposits and all but one province with copper deposits also has gold deposits. We therefore do not attempt to separately estimate the effects of the three minerals.

provinces with and without mineral deposits changed between the baseline period 2001-2002 and the year 2003. A positive estimate would suggest that conflict in the two groups of provinces was already on a non-parallel time trend before the start of reform. Second, we estimate an "event-study" type regression based on the following equation:

$$Y_{irt} = \beta_0 + \alpha_i + \lambda_{rt} + \sum_{j=2002}^{2009} \theta_j M_i \times \mathbb{1}(Year_t = j) + X_{irt}\gamma + \varepsilon_{irt} \tag{3}$$

In this equation, $\mathbb{1}(Year_t = j)$ denotes an indicator for observations in year j. The coefficients θ_{2002} through θ_{2009} reflect how the difference in conflict between provinces with and without mineral deposits evolved in the years 2002 through 2009, relative to the baseline year 2001. This regression allows us to test whether conflict in provinces with and without mineral deposits followed a parallel time trend in the pre-reform period, and whether the effect of mining reform was stable or evolved over time.

5. Results

Table 1 shows summary statistics of control variables and baseline conflict outcomes separately for provinces with and without mineral deposits. Provinces with mineral deposits are slightly poorer, have a lower population density, less agricultural area and more landowners. In the pre-reform period, 2001-2003, provinces with mineral deposits experienced slightly fewer violent incidents and casualties. None of the differences in baseline observable characteristics are statistically significant.

The first column of Table 2 shows the results of our baseline model described by Equation 1. The results suggest that provinces with mineral deposits experienced 3.63 additional violent incidents after the start of mining reform relative to provinces without mineral deposits. Column 2 shows that controlling for world market prices increases this estimate slightly to 3.84 violent incidents. Column 3 shows that the estimated effect of mining reform changes little when we control for the interaction between year fixed effects and the province characteristics listed in Table 1. We find some evidence that an increase in the price of copper exacerbates conflict in provinces with copper deposits. Estimates for the price of gold and nickel are statistically insignificant in all specifications, though the confidence intervals cannot rule out effects of considerable magnitude.

The estimated effect of the reform is large, corresponding to an increase of approximately 60 percent relative to the sample mean of 6.25 violent incidents. It is also large relative to the effects of price movements. To generate the same increase in violent incidents as the reform, the price of copper would have to increase by 4,800 U.S. dollars per metric ton (estimates in column 2), which corresponds to an increase of over 100% relative to the mean copper price of 4,100 dollars .

Columns 4 through 6 present results of the robustness test for the parallel trends assumption described by Equation 2. In all three specifications, the coefficient associated with the interaction between the mineral indicator and the year 2003 indicator is small in magnitude and statistically insignificant. This suggests that conflict in provinces with and without mineral deposits was on approximately parallel time trends in the years before mining reform.

Table 3 shows that results are qualitatively similar when using the number of casualties as the outcome of interest. Our preferred estimate in column 3, with full control variables, suggests that provinces with mineral deposits experienced 9.4 additional violent incidents after the start of mining reform. Columns 7 and 8 show that approximately 70 percent of the casualties caused by the reform are fatalities and 30 percent are injuries. The results of the robustness test in columns 4 through 6 show that casualty numbers followed parallel trends in the years leading up to the reform.

Figure 4 displays the coefficients of the "event-study" regressions described by Equation 3. These coefficients reflect how the difference in conflict outcomes between provinces with and without mineral deposits evolved over time, relative to the omitted year 2003. Our estimates are consistent with the timing of mining reform. The difference in conflict outcomes between the two groups of provinces stayed fairly constant in 2001-2003 before increasing in 2004, the first year of the reform program. Interestingly, the reform appears to cause an immediate increase in conflict occurs, even though its effects on FDI and mineral production, shown in Figure 1 are realized with a two-year lag. This result is most likely due to preemptive government efforts to make mineral-rich areas safe for investors. These efforts lead to an initial increase in violence, followed by an increase in FDI after security operations have successfully concluded.

The graphs also show that the effect of mining reform on casualties was temporary, only lasting approximately until 2007 before becoming smaller and statistically insignificant in 2008-2009. The effect on violent incidents also began to decrease after 2006, but remained positive throughout the period of observation.

Table 4 shows results of regressions that flexibly control for the effect of mineral prices. While the regressions presented so far allow for a differential effect of price movements on provinces with and without mineral deposits, they assume that this effect increases linearly with price. The regressions in Table 4 allow the price effects to have a one-year lag, as well as logarithmic or quadratic functional forms. The results confirm that the functional form of the price effect has little influence on our estimates, which are slightly larger than those in Tables 2 and 3.

The regressions presented in Table 5 show that the effect of the mining reform was more than twice as large in provinces where new large-scale mines were established after 2004, relative to provinces with mineral deposits but no new large-scale mines.[9] Our preferred estimates in columns 3 and 6 suggest that provinces with new mines experienced an additional 7.5 violent incidents and 22.1 casualties.[10] The establishment of new mines is of course potentially endogenous to the conflict environment, so we cannot necessarily interpret these estimates as the causal effect of new mines. Nevertheless, these results provide suggestive evidence consistent with the hypotheses that the reform caused increased competition over control of resource-rich areas that were targets of new investment.

Tables 6 and 7 investigate whether mining reform differently affected violence initiated and suffered by different actors. We find that the effect of the reform on violent incidents was more or less evenly split between incidents initiated by the government and rebel group. Approximately 47 percent of the additional casualties were suffered by government forces, 25 percent by rebels and 28 percent by civilians. The larger toll on government combatants is consistent with the hypothesis that the reform causes government forces to operate in areas over which they have no firm control, making them vulnerable targets. Table 7 shows that the majority of violence caused by the reform occurs in incidents involving the communist NPA, consistent with the anecdotal evidence that this group is heavily involved in extorting mining firms.

Finally, Table 8 presents tests for potential spillovers in conflict between nearby provinces in the same administrative region. Negative spillovers could occur if the government moved troops from non-mineral-rich provinces to mineral-rich ones, positive ones could occur if extortion revenues allow rebels to increase their attacks in nearby provinces. We test for

[9] Information on newly established mines comes from various issues of the annual publication "The Mineral Industry of the Philippines" by the United States Geological Survey, e.g. United States Geological Survey (2009).

[10] Since all provinces with new large-scale mines also have mineral deposits, the total effect of the reform on these provinces is represented by the sum of the coefficients associated with mineral deposit and newly established mine.

spillovers by including an interaction between the post-reform indicator and the fraction of provinces with mineral deposits in province i's administrative region. A negative coefficient on this interaction would indicate that conflict increased less strongly in provinces with many nearby mineral-rich provinces, suggesting a displacement of conflict within the region. We choose the administrative region as the relevant "neighborhood" since provinces in the same region are not only geographically proximate but also culturally and linguistically similar, so that troop movements are much more likely to occur within regions than across. As a consequence, our regressions cannot control for region-by-year fixed effects due to collinearity. For this tes, we cluster standard errors at the administrative region level. The estimated spillover effects for both conflict outcomes are positive and not statistically significant, indicating no evidence of conflict displacement. The confidence interval associated with the estimates is, however, quite large, so that we cannot conclusively rule out economically relevant spillovers.

6. Conclusion

The results presented in this paper are early evidence that natural resource policy plays an important role in mediating the effect of resource endowments on civil conflict. The Philippines' mining reform that began in 2004 under the Mineral Action Plan led to a large increase in conflict violence. Our preferred estimates suggest that, during the post-reform period 2004 to 2009, the average mineral-rich province experienced an additional 3.7 violent incidents and 9.4 casualties (6.7 fatalities) per year because of the reform. This effect represents a 60 percent increase in the intensity of violence relative to the sample means of the two conflict outcomes. The effect of the reform is also large relative to the effects of price movements. Our estimates suggest that the price of copper would have to increase by over 100 percent relative to its sample means to generate an increase in conflict of the same magnitude as the reform. These estimates are consistent with the moderate price effects found by previous studies. For instance, Dube and Vargas (2013) found that a 137 percent increase in the price of oil led to a 14 percent increase in violence in oil producing municipalities. We find no evidence that the reform caused spillovers in conflict between nearby provinces, though the confidence intervals associated with these estimates are large. Under the assumption of no spillovers, the reform caused approximately 3,100 casualties (2,200 fatalities) in the 55 mineral-rich provinces in the country over the six post-reform years.

The welfare cost of this increase in violence is likely to be large compared to the surplus generated by the reform program. Assuming a value of statistical life in the Philippines of approximately 800,000 U.S. dollars,[11] the additional fatalities caused by the reform had a welfare cost of approximately 1.8 billion U.S. dollars. This estimate is several orders of magnitude larger than the country's total revenue from mining taxes and fees over the post-reform period, which was approximately 0.5 million U.S. dollars (Mines and Geosciences Bureau, 2013). It is also likely to be large compared to the value of the additional mineral production generated by the reform. The value of mineral production increased by approximately 690 million U.S. dollars per year (in constant 2001 terms) between the pre-reform and post-reform periods (Mines and Geosciences Bureau, 2013). Assuming that the entire increase in production value was due to the reform, this corresponds to a value of approximately 3.5 billion dollars generated by the reform in the five years following 2004.[12]

While we find no evidence of conflict spillovers, it is of course possible that the no-spillovers assumption is violated, perhaps because the government moved troops from non-mineral-rich provinces to mineral-rich ones. If this were the case, the reform's aggregate effect on

[11] Since we are not aware of direct estimates of the value of statistical life in the Philippines, we derive this estimate by taking the VSL in the U.S. of approximately 8 million U.S. dollars and adjusting it by the differences in per capita income between the U.S. and the Philippines, using an income elasticity of 1.25, following Becker et al. (2005).

[12] This is likely to be a substantial overestimate of the causal effect of the reform, since the increased value of production in the post-reform period is partly due to the substantial increase in world market mineral prices.

casualties in the entire country would be smaller than the 3,600 we calculated above. On the other hand, our cost estimates ignore costs beyond the loss of life, which could be substantial. For instance, our cost calculation does not include the costs of medical treatment and reduced quality of life for the estimated 900 injuries caused by the reform. In addition, the government of the Philippines estimates that attacks on mining and agricultural firms cause substantial material damages from destroyed equipment and infrastructure (Colina, 2018). Finally, mining reform may have prompted the government to buy additional equipment or hire new recruits to deploy in mineral-rich provinces, so that the estimate reported above might underestimate the total military cost of reform.

Overall, our results suggest that a shift towards a more extractive policy regime can cause a substantial increase in violence in countries with pre-existing conflicts and limited state control over resource-rich areas. The welfare costs of this violence can be large and should be taken into account for cost-benefit analyses of mining reform.

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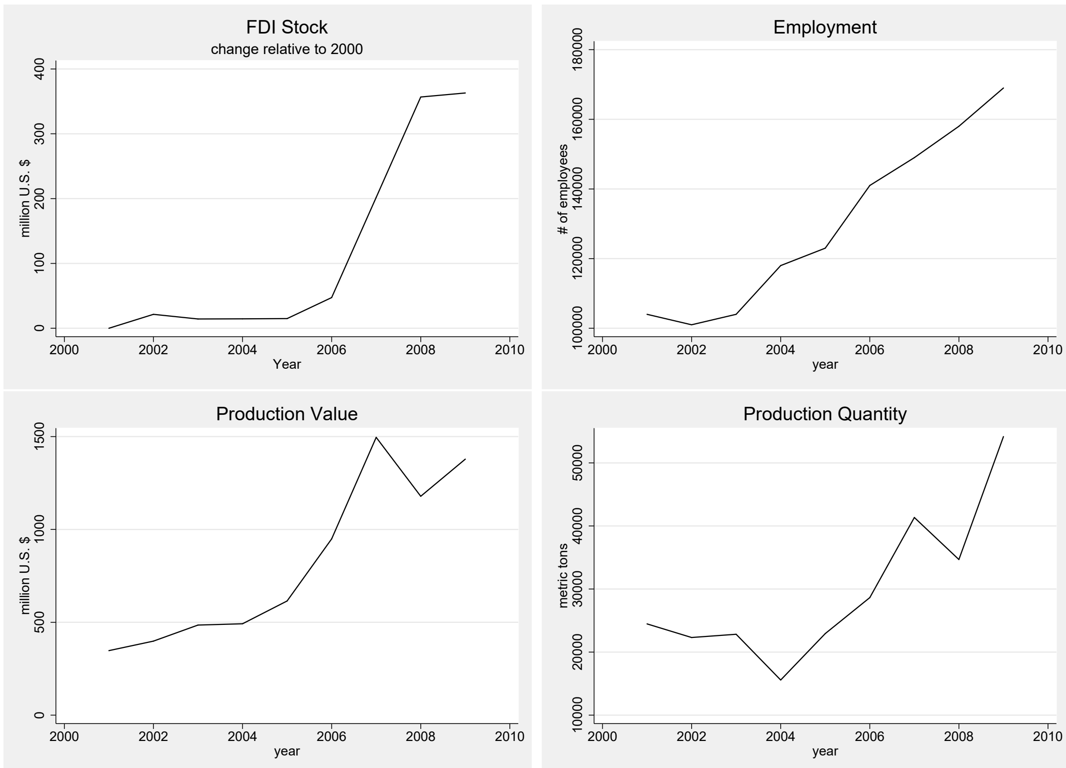
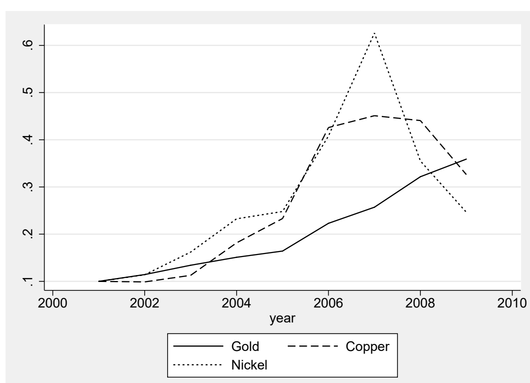
Figure 1. Foreign Direct Investment, Employment and Production in the Philippines' Mining Sector



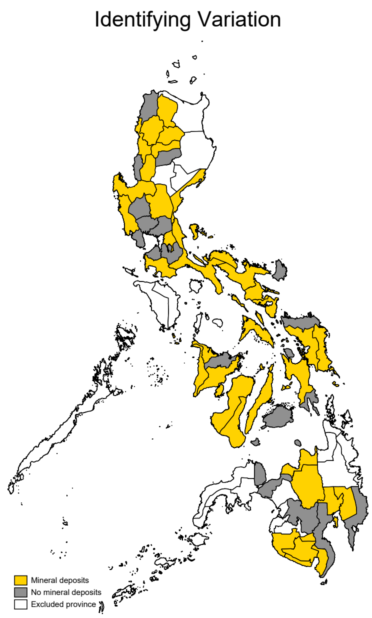
Sources: Central Bank of the Philippines, and Bureau of Mines and Geosciences. Values are expressed in constant 2001 U.S. dollars.

Figure 2. World Mineral Price Movements, 2001-2009



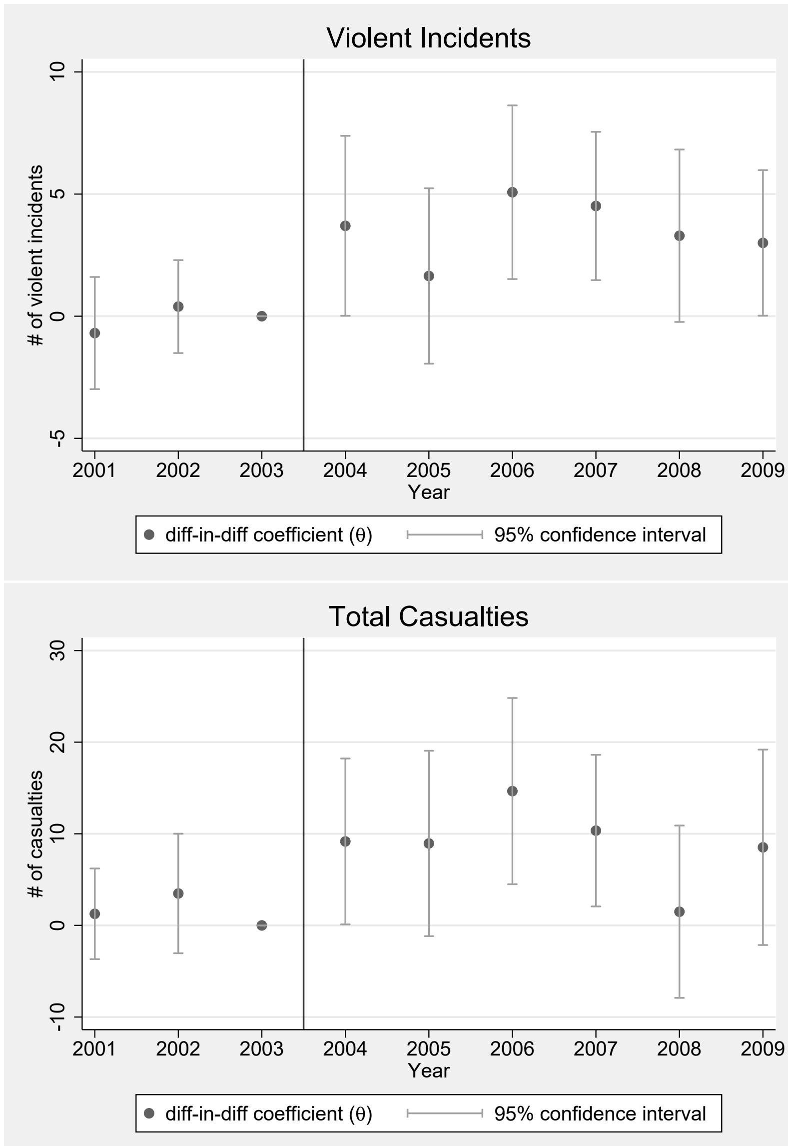
Source: IMF Primary Commodity Prices ("Pink Sheet"). All prices are converted to an index that equals 100 in the year 2001.

Figure 3. Provinces with Mineral Deposits



The figure shows the identifying variation for the difference-in-differences estimator described in Equation 1. Data comes from UNEP (2011). Provinces with mineral deposits are shaded in yellow, provinces without mineral deposits are shaded in gray. Administrative regions in which either all or no provinces have mineral deposits do not inform the estimator with region-by-year fixed effects and are left blank.

Figure 4. Mining Reform and Civil Conflict: Event-Study Estimates



The graphs plot the coefficients of event-study regressions described by Equation 3 on the vertical axis against time on the horizontal axis. The left panel shows the results of regressions with the number of violent incidents as the outcome, the right panel shows the same regressions with total casualties as the outcome. All regressions control for province fixed effects, region-by-year fixed effects, as well as rainfall and temperature during the wet and dry seasons and an indicator for whether the province was hit by a major typhoon.

Table 1. Summary Statistics: Provinces with and without mineral deposits

	Mineral deposits	No mineral deposits	p-value of diff.
Poverty rate (%)	31.6	29.1	0.54
	(14.2)	(15.6)	
Human development index	59.0	60.4	0.43
	(4.6)	(7.6)	
Gini coefficient	37.7	38.0	0.78
	(4.3)	(4.9)	
Population density (/sq. km)	237	355	0.14
	(241)	(323)	
Percent agricultural area	13.8	15.7	0.62
	(12.4)	(11.6)	
Percent landowners (%)	27.1	25.7	0.74
	(11.7)	(12.3)	
Violent inc. per year 2001-03	5.2	5.6	0.73
	(4.2)	(7.7)	
Casualties per year 2001-03	9.0	11.0	0.43
	(7.3)	(15.4)	
No. of provinces	35	22	57
No. of observations	314	198	512

Data on conflict outcomes come from field reports of units of the Armed Forces of the Philippines. Data on all other variables come from the Philippine Statistics Authority and are measured in 2000.

Table 2. Mining Reform and Conflict: Violent Incidents

	Outcome: Number of Violent Incidents					
	(1)	(2)	(3)	(4)	(5)	(6)
Mineral Deposit × Year ≥ 2004	3.63***	3.84***	3.70***	3.68***	3.96***	3.75***
	(0.93)	(1.23)	(1.29)	(0.95)	(1.24)	(1.31)
Mineral Deposit × Year = 2003				0.14	0.31	0.13
				(0.81)	(0.79)	(0.76)
Gold Deposit × Gold Price		–3.14	–3.25		–3.19	–3.27
		(3.00)	(3.14)		(3.01)	(3.13)
Copper Deposit × Copper Price		0.80**	1.02**		0.80**	1.02**
		(0.39)	(0.41)		(0.39)	(0.41)
Nickel Deposit × Nickel Price		–0.0081	0.059		–0.0088	0.058
		(0.037)	(0.10)		(0.037)	(0.10)
Mean of Dependent Variable	6.25	6.25	6.25	6.25	6.25	6.25
Year FE × Controls	No	No	Yes	No	No	Yes
No. of Provinces	57	57	57	57	57	57
No. of Observations	512	512	512	512	512	512

All regressions control for province fixed effects, region-by-year fixed effects, as well as rainfall and temperature during the wet and dry seasons and an indicator for whether the province was hit by a major typhoon. Columns 3 and 6 also control for the interactions between year fixed effects and the following baseline characteristics: poverty rate, human development index, population density, Gini coefficient, and percent landowners. Standard errors, clustered at the province level, are in parenthesis. ***, ** and * denote statistical significance at the 1, 5 and 10 percent levels, respectively.

Table 3. Mining Reform and Conflict: Casualties

	Total Casualties						Fatalities	Wounded
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Mineral Deposit × Year ≥ 2004	7.27***	9.98***	9.40***	6.21***	9.31***	8.71***	6.74**	2.66
	(1.79)	(2.97)	(3.40)	(1.69)	(2.68)	(3.09)	(2.99)	(1.72)
Mineral Deposit × Year = 2003				–2.70	–1.69	–1.74		
				(2.56)	(2.28)	(2.47)		
Gold Deposit × Gold Price		–11.8	–12.0		–11.5	–11.7	–4.04	–7.97*
		(8.21)	(8.82)		(8.17)	(8.74)	(4.87)	(4.61)
Copper Deposit × Copper Price		1.22	1.80*		1.23	1.81*	0.51	1.30**
		(0.81)	(0.95)		(0.81)	(0.95)	(0.50)	(0.62)
Nickel Deposit × Nickel Price		–0.087	–0.096		–0.084	–0.093	–0.015	–0.081
		(0.12)	(0.22)		(0.12)	(0.22)	(0.15)	(0.13)
Mean of Dependent Variable	12.79	12.79	12.79	12.79	12.79	12.79	8.93	3.86
Year FE × Controls	No	No	Yes	No	No	Yes	Yes	Yes
No. of Provinces	57	57	57	57	57	57	57	57
No. of Observations	512	512	512	512	512	512	512	512

All regressions control for province fixed effects, region-by-year fixed effects, as well as rainfall and temperature during the wet and dry seasons and an indicator for whether the province was hit by a major typhoon. Columns 3 and 6 also control for the interactions between year fixed effects and the following baseline characteristics: poverty rate, human development index, population density, Gini coefficient, and percent landowners. Standard errors, clustered at the province level, are in parenthesis. ***, ** and * denote statistical significance at the 1, 5 and 10 percent levels, respectively.

Table 4. Robustness Tests for Functional From of Mineral Price Effects

	Violent Incidents			Casualties		
	(1)	(2)	(3)	(4)	(5)	(6)
Mineral Deposit × Year ≥ 2004	3.86***	3.81**	4.14**	9.45***	10.1**	11.0***
	(1.25)	(1.48)	(1.64)	(3.34)	(3.93)	(3.58)
Gold Deposit × Gold Price	2.91		–6.58	–21.2		–28.2
	(9.73)		(17.2)	(24.1)		(35.1)
Copper Deposit × Copper Price	0.35		–0.45	1.96		–2.20
	(0.51)		(1.42)	(1.59)		(3.26)
Nickel Deposit × Nickel Price	0.067		–0.46	0.059		–1.44
	(0.12)		(0.51)	(0.32)		(1.06)
Gold Deposit × Gold Price at t-1	–8.21			11.5		
	(10.1)			(29.2)		
Copper Deposit × Copper Price at t-1	0.74*			–0.18		
	(0.44)			(1.81)		
Nickel Deposit × Nickel Price at t-1	–0.029			–0.23		
	(0.13)			(0.36)		
Gold Deposit × ln(Gold Price)		–1.87			–7.12	
		(1.95)			(5.15)	
Copper Deposit × ln(Copper Price)		3.62**			6.23*	
		(1.50)			(3.48)	
Nickel Deposit × ln(Nickel Price)		0.61			–1.86	
		(1.82)			(3.61)	
Gold Deposit × Gold Price Squared			2.42			11.9
			(12.1)			(28.2)
Copper Deposit × Copper Price Squared			0.17			0.45
			(0.17)			(0.38)
Nickel Deposit × Nickel Price Squared			0.012			0.032
			(0.011)			(0.025)
Mean of Dependent Variable	6.25	6.25	6.25	12.79	12.79	12.79
Year FE × Controls	Yes	Yes	Yes	Yes	Yes	Yes
No. of Provinces	57	57	57	57	57	57
No. of Observations	512	512	512	512	512	512

All regressions control for province fixed effects, region-by-year fixed effects, as well as rainfall and temperature during the wet and dry seasons and an indicator for whether the province was hit by a major typhoon. All models also control for the interactions between year fixed effects and the following baseline characteristics: poverty rate, human development index, population density, Gini coefficient, and percent landowners. Standard errors, clustered at the province level, are in parenthesis. ***, ** and * denote statistical significance at the 1, 5 and 10 percent levels, respectively.

Table 5. Newly Established Mines and Conflict

	Violent Incidents			Casualties		
	(1)	(2)	(3)	(4)	(5)	(6)
Mineral Deposit $\times$ Year $\geq$ 2004	3.23***	3.45***	3.36**	6.33***	9.07***	8.29**
	(0.92)	(1.27)	(1.35)	(1.72)	(3.04)	(3.51)
Large-Scale Mine Est.$\times$ After 2004	4.32*	4.29**	4.17*	10.3*	10.3*	13.8**
	(2.27)	(1.91)	(2.19)	(6.11)	(5.38)	(5.93)
Mean of Dependent Variable	6.25	6.25	6.25	12.79	12.79	12.79
Year FE $\times$ Controls	No	No	Yes	No	No	Yes
No. of Provinces	57	57	57	57	57	57
No. of Observations	512	512	512	512	512	512

All regressions control for province fixed effects, region-by-year fixed effects, as well as rainfall and temperature during the wet and dry seasons and an indicator for whether the province was hit by a major typhoon. Columns 3 and 6 also control for the interactions between year fixed effects and the following baseline characteristics: poverty rate, human development index, population density, Gini coefficient, and percent landowners. Standard errors, clustered at the province level, are in parenthesis. ***, ** and * denote statistical significance at the 1, 5 and 10 percent levels, respectively.

Table 6. Conflict Violence by Initiator and Victim

	Incidents Initiated by:		Casualties Suffered by:		
	Govt.	Rebel	Govt.	Rebel	Civilian
	(1)	(2)	(3)	(4)	(5)
Mineral Deposit $\times$ Year $\geq$ 2004	1.51*	2.01***	4.44**	2.32	2.64**
	(0.81)	(0.74)	(1.68)	(1.70)	(1.19)
Mean of Dependent Variable	2.37	3.84	5.95	3.70	3.14
Price Controls	Yes	Yes	Yes	Yes	Yes
Year FE $\times$ Controls	Yes	Yes	Yes	Yes	Yes
No. of Provinces	57	57	57	57	57
No. of Observations	512	512	512	512	512

All regressions control for province fixed effects, region-by-year fixed effects, interactions between mineral deposits and the prices of minerals, as well as rainfall and temperature during the wet and dry season and an indicator for whether the province was hit by a major typhoon. All models also control for the interactions between year fixed effects and the following baseline characteristics: poverty rate, human development index, population density, Gini coefficient, and percent landowners. Standard errors, clustered at the province level, are in parenthesis. ***, ** and * denote statistical significance at the 1, 5 and 10 percent levels, respectively.

Table 7. Incidents and Casualties by Rebel Group

	Incidents involving:			Casualties involving:		
	NPA	MILF	ASG	NPA	MILF	ASG
	(1)	(2)	(3)	(4)	(5)	(6)
Mineral Deposit $\times$ Year $\geq$ 2004	2.25**	0.84	0.039	5.14**	2.87	–0.018
	(1.11)	(0.57)	(0.093)	(2.42)	(2.11)	(0.21)
Mean of Dependent Variable	4.35	0.37	0.023	8.81	1.25	0.084
Price Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE $\times$ Controls	Yes	Yes	Yes	Yes	Yes	Yes
No. of Provinces	57	57	57	57	57	57
No. of Observations	512	512	512	512	512	512

All regressions control for province fixed effects, region-by-year fixed effects, interactions between mineral deposits and the prices of minerals, as well as rainfall and temperature during the wet and dry season and an indicator for whether the province was hit by a major typhoon. All models also control for the interactions between year fixed effects and the following baseline characteristics: poverty rate, human development index, population density, Gini coefficient, and percent landowners. Standard errors, clustered at the province level, are in parenthesis. ***, ** and * denote statistical significance at the 1, 5 and 10 percent levels, respectively.

Table 8. Testing for Spillovers within Administrative Regions

	Violent Incidents			Casualties		
	(1)	(2)	(3)	(4)	(5)	(6)
Mineral Deposit $\times$ Year $\geq$ 2004	3.71***	4.32**	4.14**	7.26***	10.7***	10.6***
	(1.13)	(1.64)	(1.40)	(2.03)	(2.53)	(2.37)
Fraction with Mineral Deposits in Region $\times$ Year $\geq$ 2004	0.0046	0.47	0.93	3.42	3.92	5.92
	(4.47)	(4.58)	(3.65)	(6.75)	(7.17)	(4.78)
Mean of Dependent Variable	6.25	6.25	6.25	12.79	12.79	12.79
Year FE $\times$ Controls	No	No	Yes	No	No	Yes
No. of Provinces	11	11	11	11	11	11
No. of Observations	512	512	512	512	512	512

All regressions control for province fixed effects, region-by-year fixed effects, as well as rainfall and temperature during the wet and dry seasons and an indicator for whether the province was hit by a major typhoon. Columns 3 and 6 also control for the interactions between year fixed effects and the following baseline characteristics: poverty rate, human development index, population density, Gini coefficient, and percent landowners. Standard errors, clustered at the region level, are in parenthesis. ***, ** and * denote statistical significance at the 1, 5 and 10 percent levels, respectively.

Appendix:

Table A.1. Estimates Without Sample Restrictions and Region-by-Year FE

	Violent Incidents			Casualties		
	(1)	(2)	(3)	(4)	(5)	(6)
Mineral Deposit × Year $\geq$ 2004	2.52***	4.13***	5.28***	6.10***	10.1***	10.9**
	(0.51)	(0.63)	(1.61)	(1.22)	(1.77)	(4.44)
Gold Deposit × Gold Price		–5.99***	–3.49		–14.2**	–24.7**
		(1.80)	(3.27)		(5.82)	(12.4)
Copper Deposit × Copper Price		0.37	0.37		0.60	0.75
		(0.40)	(0.42)		(0.77)	(0.85)
Nickel Deposit × Nickel Price		–0.080	–0.068		–0.16	–0.099
		(0.059)	(0.069)		(0.11)	(0.16)
Mean of Dependent Variable	6.25	6.25	6.25	12.79	12.79	12.79
Year FE × Controls	No	No	Yes	No	No	Yes
No. of Provinces	77	77	77	77	77	77
No. of Observations	691	691	691	691	691	691

All regressions control for province fixed effects, region-by-year fixed effects, as well as rainfall and temperature during the wet and dry seasons and an indicator for whether the province was hit by a major typhoon. Columns 2 and 4 also control for the interactions between year fixed effects and the following baseline characteristics: poverty incidence, human development index, pupolation density, Gini coefficient, and percent landowners. Standard errors, clustered at the province level, are in parenthesis. ***, ** and * denote statistical significance at the 1, 5 and 10 percent levels, respectively.