DECENTRALIZATION, COLLUSION, AND COAL MINE DEATHS

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Abstract—This paper investigates how collusion between regulators and firms affects workplace safety using the case of China's coal mine deaths. We argue that decentralization makes collusion more likely and that its effect is strengthened if the transaction costs of collusion are lower. These hypotheses are tested by investigating the impact of decentralization contingent on regulators' characteristics. Exploring both decentralization and centralization reforms in the coal mine industry, we find that decentralization is correlated with an increase in coal mine death rates. Moreover, this increase in mortality is larger for the regulators with lower transaction costs (proxied by the locality of origin).

I. Introduction

HEALTH and safety in the workplace are essential issues in both developing and developed countries. Many examples suggest that collusion between regulators and regulated firms plays a first-order role in workplace safety problems. For instance, the explosion at the Upper Big Branch mine in southern West Virginia in 2010 was found to be due to collusion between regulators and coal companies.[1] The Fukushima nuclear power plant accident was also disclosed to be driven by "the collusion between the government, the regulators and Tepco."[2] In academic research, scholars have provided fruitful theories to understand collusion, especially on how decentralization of regulatory authority may affect collusion in organizations (Tirole, 1986; Kofman & Lawarree, 1993; Laffont & Martimort, 1998). However, there is little empirical evidence on collusion, and the theoretical link between decentralization and collusion has thus not been established empirically. In this paper, we use data on the coal mine industry and safety regulation in China to study how collusion between regulators and firms affects coal mine deaths. The findings on this particular sector may shed light on broader issues of general workplace safety. In addition, we investigate how decentralization of authority affects collusion, providing empirical evidence on the link between decentralization and collusion.

We focus on China's coal mine industry for two reasons. The coal mine sector in China provides a testing ground for the role of collusion as well as the link between decentralization and collusion in theory. Collusion between regulators and coal mine firms is so paramount that China's mass media have even coined a phrase for this phenomenon: *guanmei goujie* ("official coal collusion"). Moreover, a unique decentralization experiment took place in the key state coal mines: in March 1998, the management of all 94 key state coal mines was delegated to the provincial governments. This gave both management and safety supervision powers to the local governments and made collusion possible, or at least much easier. This decentralization experiment lasted until February 2001, when the State Administration of Work Safety was established and coal mine safety supervision recentralized. Hence, we have two centralization periods (1995–1997 and 2001–2005) and one decentralization period (1998–2000, when collusion became more feasible). Since the decentralization and recentralization decisions are national policies, they are not correlated with individual province characteristics.

The second reason is that this industry is important for understanding the weak occupational health and safety protection in China's rapid industrialization. Coal constitutes about 70% of the total energy consumption in China. In 2007, China produced 41.1% and United States produced 18.7% of all coal in the world. In the same year, at least 3,598 people died in coal mine accidents in China compared to 34 in the United States. In fact, the death rate (i.e., the number of deaths per million tons of coal output) in China is not only much higher than that of developed countries such as the United States, Japan, and Germany but also more than ten times higher than that of many other developing economies such as India and African countries.[3]

To examine the impact of decentralization on death rates, we collect provincial-level panel data on key state coal mines from 1995 to 2005 and find that death rates under decentralization increased by about 0.7 deaths per million tons of coal production in an average province-year. The mean and standard deviation of death rates under decentralization are 2.8 and 4.5, respectively.[4] Thus, the magnitude of the effect is around 25% of the mean and 15% of the standard deviation.

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[1] See Barry Grey, "Miners Doomed by Collusion between Regulators and Coal Companies" (2010), http://www.wsws.org/en/articles/2010/04/mine-a10.html.

[2] See the information disclosed in Fukushima Nuclear Accident Independent Investigation Commission (2012).

[3] As Wright (2004) noted, the head of China's safety bureaucracy admitted in 2001 that China's coal mine death rate was eleven times higher than that in Russia and fifteen times higher than that in India.

[4] Death rates measured by deaths per million tons of production are frequently used for cross-country comparisons. An alternative way of measuring death rates is to look at deaths divided by employment in coal mine industries. This does not work well for China as many miners are not permanent workers. We do not have provincial-level information on the number of coal mine workers.

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A competing hypothesis is that death rate is an increasing function of production, and, hence, decentralization leads to higher death rates just because it is correlated with higher levels of production. When we include a flexible function of the production level in the estimation, we do not find this to be the case.

The positive correlation between decentralization and death rates is consistent with the interpretation that decentralization facilitates collusion. To further test the collusion hypothesis, we explore the variation in the transaction costs of collusion. In particular, we proxy transaction costs by exploring the information on the locality of origin for all 57 provincial safety regulators between 1995 and 2005.[5] The safety regulator in a province is the vice governor responsible for industrial-production safety, which includes coal mine safety. We focus on safety regulators rather than provincial governors because these regulators are directly in charge of coal production permits.[6] Assuming that a native of the province has lower transaction costs of collusion, we find three more deaths per million tons of coal production in provinces with native safety regulators under decentralization, around 67% of the standard deviation of death rates.[7]

Although the decentralization decision is a national policy and exogenous to individual provinces, there might still be a concern that native safety regulators are appointed to provinces with higher death rates. As 22 of the 57 safety regulators experience at least one switch of decentralization and centralization, we can explore within-regulator variations. We find that the within-regulator estimates are very close to the within-province estimates, which confirms that endogenous appointment in response to decentralization is not a serious concern.

One important concern is the misreporting of coal mine death rates. Since we find a higher death rate in decentralization with native regulators, underreporting by the regulators is unlikely to explain our finding. As further checks, we use traffic deaths per capita and death rates in the local state coal mines to conduct two placebo tests.[8] We also conduct various other robustness checks, including examining pretrends, evaluating the impacts on deaths and output separately and comparing the impacts of decentralization and recentralization. Additionally, we present two sets of further evidence for the collusion hypothesis, using information on media exposure and coal mine firms.

Generally trust plays an important role in informal contract enforcement (Karlan et al., 2009). In our context, since collusion is illegal, trust is essential in the agreement of collusion. For example, Li and Wu (2010) provide qualitative evidence on the transactions between bribers and bribees in China and the Philippines. They show that personal networks play an important role in facilitating corruption, especially in a relation-based governance system such as the Chinese one. Hence, having a native safety regulator naturally decreases the collusion cost. All the findings in this study deliver the same message that both decentralization and having a native regulator decrease collusion costs and hence increase deaths. We realize that native safety regulators can be different in other dimensions besides decreasing the transaction costs of collusion. Although the difference in the ability to underreport deaths cannot explain our finding, native regulators can be different in their preferences and information. For these two factors to explain our finding, one needs to assume that the native regulators care less about the safety of the workers or have less information about safety. Neither of hypotheses seems reasonable.[9] It is also worthwhile stressing that our finding holds for a given regulator, while the preference of regulators is unlikely to vary with decentralization.

Our study contributes to several strands of literature. First, it relates to a large empirical literature on the impact of decentralization.[10] One challenge in this literature is how to find exogenous variations in decentralization. The existing studies explore either cross-sectional comparison or change in one direction (from centralization to decentralization or vice versa).[11] We explore sharp regime changes in both directions, which helps relieve empirical concerns such as time trends. Our findings on the downside of decentralization share some flavor of the findings on regional protectionism in Young (2000), who argues that increased autonomy and incentives induced local governments to engage in provincial protectionism. Our finding of bad outcomes due to the

[5] The dominant networks in China are locality of origin, kinship, and job-related colleagues (Guo, 2001; Luo, 2007). We do not have kinship information. As most of the safety governors built their careers within the province, the main variation is the origin of locality.

[6] We control for characteristics of provincial governors and party secretaries in our estimations.

[7] The effect is sizable. One might be concerned about outliers. However, as shown in Table 6, the magnitude is similar when we used logged deaths as the dependent variable.

[8] The key state coal mines were supervised by the central government before decentralization, whereas local state coal mines are always managed by local governments.

[9] Another potential reason is that nonnative regulators are appointed only when they are highly qualified. But this cannot explain the effect of decentralization.

[10] The literature has examined the impacts of both fiscal decentralization and political decentralization. Much of the empirical evidence has stressed the virtues of fiscal decentralization (measured by fiscal expenditures or revenues) in terms of economic performance and government accountability. For example, Fisman and Gatti (2002) and Arikan (2004) find that fiscal decentralization in government expenditures is associated with less corruption. Bardhan and Mookherjee (2006) provide a survey of existing research along the same line. Within the context of China, fiscal decentralization since 1994 is often seen as one of the driving forces of China's growth miracle. For example, Jin, Qian, and Weingast (2005) and Lin and Liu (2000) find a positive impact of decentralization on growth, despite some opposite findings in Zhang and Zou (1998). In contrast, studies on political decentralization find that political decentralization (measured by the number of administrative tiers) can lead to lower accountability. For instance, using different sources of data, Treisman (2002) and Fan, Lin, and Treisman (2009) find that larger numbers of administrative or governmental tiers are correlated with increased corruption.

[11] For example, Galiani, Gertler, and Schargrodsky (2008) investigate how the change from centralization to decentralization in the Argentina's education system has affected rich and poor municipalities differently.

combination of decentralization and collusion is in line with the theory in Blanchard and Shleifer (2001) and the cross-country evidence in Enikolopov and Zhuravskaya (2007), where the impact of economic decentralization depends on political institutions.

Second, our study provides some empirical evidence for theories in the organizational literature that have focused on the costs and benefits of decentralization and delegation (Tirole, 1986; Kofman and Lawarree 1993; Baliga & Sjostrom, 1998; Laffont & Martimort, 1998; Mookherjee & Tsumagari, 2004; Mookherjee, 2006). This literature generally argues that decentralization of authority to regulators induces collusion. However, because decentralization is often endogenous and collusion is often covert, there is little clear evidence.[12] We explore a national decentralization policy and further exploit the heterogeneous effect of decentralization contingent on the characteristics of supervisors.

Third, our study contributes to the literature on evaluating political connections. This body of work has documented the benefits captured by agents with strong political connections (Fisman, 2001; Faccio, 2006).[13] Arguably, such private benefits are captured at the cost of the public interest. Our study provides new evidence on the cost of political connections. The closest study to ours is Fisman and Wang (2015), who document that politically connected firms in China have higher mortality using firm-level data from different industries between 2008 and 2011.[14]

Finally, our study is related to the literature on how potentially corrupt local bureaucrats and politicians affect the provision of public goods or bads. For example, using the case of deforestation in Indonesia, Burgess et al. (2012) document that local officials' incentives affect the environment. Our paper shows that the incentives of local bureaucrats affect workplace safety.

To explore institutional change in our identification, we focus on only key state coal mines, which are usually large mines. Nevertheless, our perspective also sheds possible light on death rates in smaller coal mines. For example, Wright (2008) mentions that township and village coal mines are closely related to local governments in a nexus of local state corporatism (Oi, 1999). Given the anecdotal evidence such as the coal mine disaster in West Virginia, the collusion logic documented in this paper may also be relevant to countries beyond China. However, the relevant characteristics of local regulators naturally depend on the specific context.

The rest of the paper is organized as follows. Section II describes the centralization-decentralization background and provides some qualitative evidence to clarify how collusion works. Section III describes the data. Section IV presents the baseline results, and section V presents various robustness checks and two sets of additional evidence. Section VI concludes.

II. Institutional Background and Qualitative Evidence

In this section, we first describe the decentralization process. Then we present some qualitative evidence to illustrate how collusion works and discuss why decentralization and collusion can affect coal mine deaths even in a short period.

A. *Decentralization of Key State Coal Mines*

According to their ownership, Chinese coal mines can be divided into three types: key state coal mines, local state coal mines, and township and village coal mines. In 2003, the state coal mine firms produced 47.8% of the total coal extracted in China, the local state coal mines produced 16.9%, and the township and village coal mines produced 35.3% (State Administration of Coal Mine Safety, 2004).

We focus on the management of the key state coal mines because the national policy changes we exploit concerned their management and safety supervision. Before 1998, all key state coal mines were overseen by the Ministry of Coal Industry in the central government. Due to many policy burdens for state-owned enterprises and the competition of small coal mines, the profits of the key state mines were negative in the 1990s. To provide more incentives for profitability, the management of the key state mines was shifted to provincial governments through a delegation decision at China's Ninth National People's Congress in March 1998 (State Council, 1998, document 22). This delegation also involved 206 enterprises affiliated with the coal mines, assets of 237.9 billion yuan ($30 billion), and 4.35 million employees. After delegation, the powers of management and safety supervision were shifted to the provincial governments. This decentralization period lasted until February 2001, when the State Administration of Work Safety (SAWS) was established and recentralized the safety supervision authority.[15] However, management remains in the hands of the provincial governments. Centralization was further increased in 2003, when SAWS became part of the general offices of the State Council.

Hence, we take the period between 1998 and 2000 as the decentralized (treatment) period when collusion became possible, or at least much easier, whereas 1995 to 1997

[12] Nie and Jiang (2011) suggest that possible collusion between local governments and coal mines is one of the reasons for coal mine accidents, but their argument is based on very rough correlations.

[13] Other work investigates the impact of political connections in China measured in different ways, such as connections with China's central government (Shih, Adolph, & Liu, 2012) and whether a leader advanced his career in a region (Persson & Zhuravskaya, 2016). Unlike these papers, we exploit within-individual variation in this paper, which helps relieve the concern of endogenous appointments.

[14] In contrast to their study, we focus on the characteristics of regulators rather than firms. The findings from both sides of collusion are complementary. Moreover, we explore switches of decentralization, which helps our identification and also speaks directly to the effect of decentralization. The time period in this paper is also longer, but we focus on only one industry.

[15] The official document on the establishment of SAWS is document 1 of the State Council in 2001. When SAWS exerts its regulatory and supervisory power over the coal mine industry, it is also known as the State Administration of Coal Mine Safety (SACMS).

and 2001 to 2005 are centralized comparison periods. We will also examine whether the impacts of decentralization and recentralization differ, as decentralization concerns both management and safety regulation, whereas recentralization focuses on safety regulation.

B. *Collusion between Coal Mines and Regulators*

Li Tieying (vice chairman of the Standing Committee of the National People's Congress) acknowledged in 2005, "Coal mine accidents that have already been investigated and prosecuted have revealed that corruption was behind almost every accident that caused exceptional loss of life" (China Labor Bulletin, 2008). Investigations of accidents often report the number of officials involved in the accidents, although they often do not disclose the identity of officials or collusion details. We briefly describe some qualitative evidence to illustrate how collusion works.

Zheng Maoqing, a vice governor in charge of safety in Hunan Province between 1998 and 2006, reportedly attempted suicide after being accused of corruption. The report also links his corruption to coal mine fatalities. For example, he permitted a coal mine that should have been closed resume production. Three days later, 39 individuals died in a gas explosion.[16] As disclosed in the accident investigation report, the miners were asked to drill a much shallower depth than the safe level and no gas drainage was conducted.

Collusion happens at different levels of coal mines and officials. The collusion often benefits a group of officials and the local government rather than one specific regulator. For example, it is common for officials to own stock in the coal mine companies under their supervision. In 2005, the State Council issued regulations barring officials from holding stocks in coal mine companies. However, it is difficult to implement such regulations because officials can easily transfer their stocks to family members.

Li Yizhong, the SAWS director, has identified five types of collusion between corrupt officials and mine operators: (a) officials own coal mine shares; (b) officials secretly operate coal mines or protect those connected with them operating illegal mines; (c) officials flout regulations and abuse their authority to review and approve mines in exchange for bribes from mine operators; (d) officials turn a blind eye to or help conceal illegally run mines; and (e) officials take part in or tacitly consent to accident cover-ups (China Labor Bulletin, 2008). In this paper, as we cannot directly measure these collusion types; we focus instead on how collusion opportunities affect deaths.

Most of the coal mine accidents in China are caused by human factors: employers or employees who neglect to follow regulations. Chen et al. (2012) investigated the causes of coal mine accidents in China between 2001 and 2010 and showed that intentional violation of regulations, mismanagement, and defective design account for, respectively, 35.43%, 55.12%, and 3.54% of causes of accidents. Intentional violation of regulations and mismanagement are usually driven by the desire to cut costs to increase profits. In other words, many coal mine accidents are not caused by any systematic change in the investment of safety equipment. Instead, they are often driven by factors that can be changed quickly, such as allowing unsafe drilling or requiring longer work hours. Under collusion, employers are more likely to neglect safety regulations because they do not need to worry about being detected.[17] Therefore, decentralization that renders collusion easier can have important consequences for coal mine safety. (Section A1 in the online appendix presents a model formalizing the role of decentralization and collusion in coal mine accidents. We model intentional violation of regulations and mismanagement as a cheaper but more dangerous technology).

III. Data

We collect a panel data set on the key state coal mines, safety regulators, and provincial characteristics for 22 provinces across China between 1995 and 2005.[18] As noted, we focus on the key state coal mines because they were subject to the decentralization and centralization policies. Figure 1 maps the distribution of key coal mines across China in terms of production. Among China's remaining provinces, Tianjin, Shanghai, Hainan, and Tibet do not produce any coal at all, and there are no key state coal mines in Fujian, Hubei, Gungdong, Guangxi, and Qinghai.

A. *Death Rates and Number of Deaths*

Our main dependent variable is death rates, measured by number of deaths per million tons of coal production. The number of deaths and the yearly production of key state coal mines come from the annual *China Coal Industry Yearbook*. As shown in table 1, the mean death rates is about 2.38 people per 1 million tons of production in the period. In contrast, the mean is about 2.20 in the centralization periods but 2.84 in the decentralization period. As an alternative measure of safety, we also use the logged number of deaths as another dependent variable.

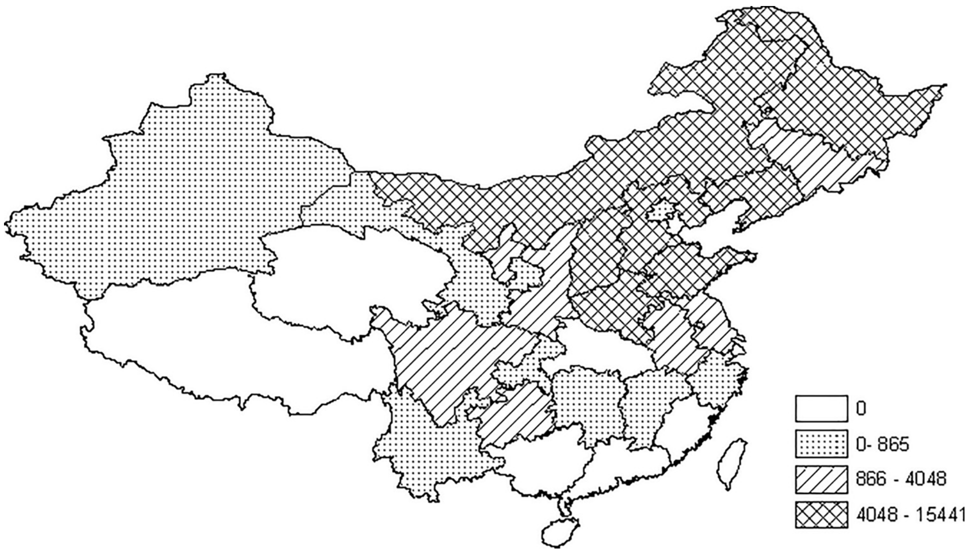
We have a few comments on the quality of the data. First, the death rate at key state coal mines is believed to be more reliable than that at smaller coal mines, another reason why we focus on key state coal mines. Second, suppose the provincial governments have incentives to underreport deaths. For this concern to matter for our finding, one has

[16] One report can be found at http://www.boxun.com/news/gb/china/2006/01/200601032341.shtml. Note that this information has not been confirmed by the government. Zheng was dismissed from office in 2006 and his offenses were not disclosed.

[17] This seems to be a general phenomenon that goes beyond coal mine safety. For example, when examining the pollution problem in China, Van Rooij (2006) finds that some firms stop using their environmental equipment when they think that they will not be detected.

[18] This are no systematic data for the key state coal mines beyond this period.

FIGURE 1.—AVERAGE PRODUCTION OF KEY STATE COAL MINES BETWEEN 1995 AND 2005



The production level is measured in million tons. Twenty-two of 31 provinces in China have key state coal mines, which are the provinces in our sample.

TABLE 1.—SUMMARY STATISTICS

Variable	Observations	Mean	SD	Minimum	Maximum	Data Source
Key state coal mines						
Death Rate (Centralized)	169	2.20	2.47	0	15.49	1
Death Rate (Decentralized)	65	2.84	4.48	0.14	27.70	1
ln Death	231	3.28	1.02	0	6.37	1
ln Output	234	7.34	1.24	3.76	10.15	1
Decentralized	234	0.28	0.45	0	1	2
Safety regulator characteristics						
Native	234	0.42	0.50	0	1	3
Tenure	234	4.65	2.33	2	11	3
Age	234	52.53	4.69	36	61	3
Provincial characteristics						
ln (Coal Mine Wage)	234	9.15	0.43	8.39	10.16	1
ln (GDP per capita)	234	8.82	0.57	7.51	10.72	4
ln (1+ Distance to Beijing)	234	6.48	1.55	0.00	7.80	5
ln (Electricity Consumption)	234	6.05	0.61	4.53	7.69	4
Native Provincial Governor	234	0.42	0.49	0	1	6
Native Party Secretary	234	0.19	0.39	0	1	6
Traffic Deaths per 100,000	234	7.50	3.17	2.05	17.25	4
Death Rate of Local State Coal Mines	222	4.82	5.12	0.00	33.71	1
Newspaper number	214	27.90	14.45	2	71	7
Newspaper published per 1,000	214	1.53	1.29	0.05	8.00	7
Firm-level information						
ln Output	590	13.14	1.37	8.14	16.85	8
ln Employment	590	9.73	1.02	6.80	11.94	8
ln (Average Wage)	589	9.11	0.49	6.40	10.89	8
ln (Average Welfare Exp.)	578	0.25	0.59	−3.32	2.64	8

Data sources: (1) China Coal Industry Yearbook; (2) State Council (document 22, 1998; document 1, 2001); (3) provincial government documents collected by the authors; (4) China Statistical Yearbook; (5) calculated based on the latitudes and longitudes of provincial capitals; (6) China Vitae, http://chinavitae.com; (7) China statistical data of press and publication; (8) annual surveys of industrial firms.

to assume that native regulators tend to overreport and that this preference varies with decentralization, which is highly unlikely. Third, we check whether the distribution of the number of deaths exhibits any bunching. In particular, we explore the classification of accidents that might affect the careers of regulators. From 1995 to 2007, workplace accidents were classified into three levels: a general accident (one or two people died), a major accident (more than two people and no more than nine people died), and extraordinarily severe accident (ten or more people died).[19] Since these levels can potentially affect the punishment of regulators, we check whether the distribution of the number of deaths exhibits bunching at two and nine. As shown in figure A1 in

[19] The information is based on document GB/T15236-1994 of the State Bureau of Technical Supervision. This classification was revised in 2007, and an extra threshold was added: accidents with between 10 and 29 deaths are counted as severe ones, and those with 30 or more deaths are classified as extraordinarily severe ones.

the appendix, we do not find any evidence of such bunching. This is not to say that the data quality on the number of deaths is perfect, but at least there appears to be no clear evidence of bunching. Moreover, we conduct two placebo tests using deaths in traffic accidents and the local state coal mines in our robustness checks.

B. *Transaction Costs of Collusion*

Collusion between firms and regulators involves transaction costs. To reduce transaction costs, firms often rely on personal networks to bribe regulators (Li & Wu, 2010). Empirically, we gauge the transaction costs of collusion by examining the biographical information of safety regulators. Every province has one provincial governor and four to six vice governors. The safety regulator is one of the vice governors and has a tenure of at most ten years. Besides coal mine safety, the vice governor is also in charge of safety in other industries such as at constructions sites and road traffic. We trace the careers of all 57 safety regulators across 22 provinces between 1995 and 2005. These data come from yearly provincial government reports and CVs found on *People's Daily* online. The average length in office is very close for native governors and nonnative governors: around four years. Compared with the major politicians (governors and party secretaries) whose characteristics we also control for, these regulators are less motivated by the incentives of promotion. Most of these regulators move to a position of a similar rank or retire after their service.[20] Therefore, incentives to collude for rents are more important than career concerns.

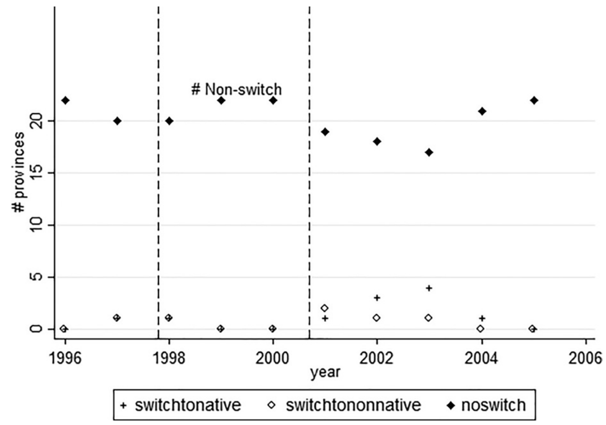
We proxy the transaction costs of collusion by whether the governor in charge of coal mine safety is a native—born in the same province as the one he supervises. Since all the governors work some years before coming to office, being native naturally implies longer experience in a certain province. As shown in table 1, about 40% of the safety regulators are native. The average death rate is 2.96 when the regulator is a native and 1.94 when the regulator is a nonnative.

The appointment of the regulators can be influenced by provincial governments. Therefore, the main empirical concern is that native regulators may be endogenously appointed in regions with higher or lower death rates. This concern is not serious in this context because regulators are usually switched during congress years, which is not correlated with the timing of decentralization.

Figure 2 shows the number of provinces that switched from a nonnative safety regulator to a native safety regulator, and vice versa, by year. As it shows, there is no systematic correlation between the switches and decentralization. This is expected, because regulators are often switched along with the political reshuffling that takes place every five years with each party congress rather than a national policy of decentralization.

[20] In our data set, none of the regulators were promoted to be the provincial governor.

FIGURE 2.—SWITCHES OF SAFETY REGULATORS BETWEEN 1995 AND 2005



The figure shows that the number of provinces that switched from a nonnative governor to a native governor and vice versa by year has no systematic correlation with the decentralization period (1998–2000).

Another way to examine the concern is to check whether having a native regulator is positively correlated with the past death record. Table A1 in the appendix reports the correlations between the probability of having a native regulator in year t and the death rates in year $t-1$ and year $t-2$. As it shows, there is no significant correlation between having a native regulator and the lagged death rates.

Moreover, 22 of the 57 regulators experience at least one switch of the centralization and decentralization regimes. Therefore, we can explore within-regulator variations for identification by examining the interaction effect of decentralization and nativeness given a regulator. The concern that the characteristics of regulators are endogenous is unlikely to be critical once we explore within-regulator variations.

C. *Control Variables*

We collect additional information on the characteristics of coal mines, other characteristics of the regulators, and a set of provincial characteristics.

Coalmine characteristics. Data on coal mines include the production level and average yearly wages in the coal mine industry. The average yearly wage can be seen as a proxy for labor quality. These data also come from *China Coal Industry Yearbook* and *China Statistical Yearbook*, with summary statistics presented in table 1.

Other characteristics of regulators. Other characteristics of the safety regulators include their age and how many years they have been in office. We use these variables to control for the career concerns and the experience of the governors. We present results using age and tenure linearly, which are robust to using dummies to indicate whether a particular individual is older or is in office longer than average. Like the proxies for transaction costs of collusion, these data come from yearly provincial government reports, with summary statistics presented in table 1.

Provincial characteristics. Provincial characteristics include real GDP per capita, whether the main provincial governor and the secretary are natives, the distance of the provincial capital to Beijing, and the amount of electricity consumption. GDP per capita comes from the *China Statistical Yearbook*. The biographical information on the provincial governors and secretaries is from *China Vitae*.[21] The distance of the provincial capital to Beijing, calculated with ArcGIS, works as a proxy for the supervision intensity by the central government. In practice, we use log (1 + distance to Beijing) to take account of the 0 observation for Beijing. Electricity consumption captures any potential demand effect on coal production. The summary statistics for these variables are presented in table 1.

Ideally, one would also like to know provincial-level these prices. Given that these prices are highly regulated by the central government during this period, we do not have coal prices by province. Figure A2 in the appendix plots the trend of national coal prices over time. The information comes from the *Price Statistical Yearbook of China*. One concern for our finding is whether decentralization actually reflects the rise of coal prices. This is clearly not the case, as shown in figure A2.

To further test the reliability of death rates in the key state coal mines, we collect information on two other types of deaths. In particular, the information on traffic deaths provides a good placebo. Coal mine accidents and traffic accidents are under the supervision of the same safety regulator, and their reports can be influenced by the same statistical bureau. In our empirical analysis, we control for traffic deaths when we use coal mine deaths as our dependent variable. We also use the death rates in local state coal mines that are not subject to the decentralization and centralization reforms as another placebo. The information on traffic deaths comes from the *China Statistical Yearbooks* and that on deaths in local state coal mines from the *China Coal Industry Yearbook*.

IV. Empirical Strategy and Baseline Results

A. Correlation between Decentralization and Death Rates

To examine the correlation between decentralization and death rates, we run the following specification:

$$Deathrate_{pt} = \beta D_t + \lambda_p + \lambda_p \times t + \varepsilon_{pt}, \quad (1)$$

where D_t is the decentralization dummy for 1998 to 2000. Since the decentralization policy is not staggered, we cannot control for year fixed effects when looking at the impact of decentralization. However, we can include $\lambda_p \times t$ to control for provincial specific trends.

Table 2 presents the correlation between decentralization and death rates. Columns 1 and 2 are the results after

TABLE 2.—CORRELATION BETWEEN DECENTRALIZATION AND DEATH RATES
DEPENDENT VARIABLE: DEATH RATES

	(1)	(2)	(3)	(4)
Decentralization	0.610	0.749*	0.768*	0.753*
	(0.378)	(0.390)	(0.411)	(0.416)
ln Output			0.123	1.445
			(0.822)	(5.868)
(ln Output)^2				−0.089
				(0.390)
Province FE	Yes	Yes	Yes	Yes
Provincial trends		Yes	Yes	Yes
Number of observations	234	234	234	234
R^2	0.40	0.44	0.44	0.44

This table shows that decentralization is positively associated with death rates. The dependent variable is the number of deaths per 1 million tons of coal output. Decentralization refers to the years 1998, 1999, and 2000. Significant at *10%, **5%, and ***1%.

including province fixed effects, with and without province-specific trends. Columns 3 and 4 also include logged output, as well as the quadratic term of logged output. The coefficients are stable across different specifications. Decentralization is correlated with 0.7 more deaths per million tons of coal production, about 25% of the mean death rate in the decentralized period (2.8). The median coal output in the province-year data set is 12 million tons. Therefore, this finding implies that decentralization is correlated with eight more deaths in an average province-year.

Because we cannot control for year fixed effects in the estimation and the results are significant at the 10% level, this finding provides only suggestive evidence.[22] Below, we explore the interaction effect of decentralization and the characteristics of regulators, which provides more cleanly identified evidence.

B. Decentralization and Collusion: Within-Province Evidence

To examine whether the impact of decentralization depends on the characteristics of regulators, we explore both within-province and within-governor variations. The within-province specification is as follows:

$$Deathrate_{spt} = \beta_1 N_{spt} \times D_t + \beta_N N_{spt} + \gamma' X_{spt} \times D_t + \nu' X_{spt} + \lambda_p + \gamma_t + \lambda_p \times t + \varepsilon_{spt}, \quad (2)$$

where N_{spt} is a binary indicator of whether the safety regulator s is a native in province p and year t. We can also control for both province and year fixed effects (λ_p and γ_t). Naturally the D_t dummy is redundant once we have controlled for year fixed effects γ_t.

X_{spt} is a vector of controls discussed above: (a) the logs of coal output and coalmine industry wages, (b) other characteristics of safety regulators (age and tenure), (c) different provincial characteristics (the logs of GDP per capita, electricity consumption, distance to Beijing, and whether the

[21] China Vitae is a website providing detailed career information on China's top leadership. It is run by a non-profit organization based in the United States: http://www.chinavitae.com/.

[22] With the addition of controls, the estimates are not only stable but also increase in magnitude. As long as the index of the observed variables that determine decentralization is positively correlated with the index of the unobserved variables, the increasing pattern in magnitudes indicates that the effect of decentralization is underestimated (Altonji, Elder, & Taber, 2005).

Table 3.—Decentralization and Collusion

Department Variable: Death Rates

	(1)	(2)	(3)	(4)	(5)	
A: Within-Province Evidence						
Decentralization × Native	2.617**	3.105**	3.122**	3.081***	3.235***	
	(1.230)	(1.313)	(1.336)	(0.945)	(0.933)	
Native	0.339	0.246	0.200	0.420	0.073	
	(0.339)	(0.407)	(0.391)	(0.362)	(0.607)	
Province FE	Yes	Yes	Yes	Yes	Yes	
Year FE		Yes	Yes	Yes	Yes	
Controls			Yes	Yes	Yes	
Decentralization × Controls				Yes	Yes	
Provincial Trends					Yes	
Number of observations	234	234	234	234	234	
R^2	0.44	0.47	0.49	0.55	0.58	
	(1) All	(2) All	(3) All	(4) Switchers	(5) Switchers	(6) Switchers
B. Within-Regulator Evidence						
Decentralization × Native	3.444**	3.553**	2.888***	3.351**	3.471**	2.814**
	(1.713)	(1.635)	(1.034)	(1.664)	(1.653)	(1.116)
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Regulator FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls		Yes	Yes		Yes	Yes
Decentralization × Controls			Yes			Yes
Number of observations	234	234	234	134	134	134
R^2	0.52	0.54	0.58	0.50	0.53	0.59

The table shows that the impact of decentralization on death rates is much higher for native regulators, using within regulator estimations and within-province but cross-regulator estimations. Controls include (a) the logs of coal output and coal mine industry wages, (b) other characteristics of safety regulators (age and tenure), (c) different provincial characteristics (the logs of GDP per capita, electricity consumption, distance to Beijing as well as whether the provincial governor or secretary is a native), and (d) traffic deaths per capita. Standard errors, reported in parentheses, are clustered at the Province×Regime level. Significant at *10%, **5%, and ***1%.

provincial governor or secretary is a native), and (d) traffic deaths per capita.

This estimation strategy is a generalized difference-in-difference (DD) strategy, where we compare the impact of nativeness before and after decentralization across regulators. To take into account the concern of serial correlation using the DD strategy (pointed out by (Bertrand, Duflo, & Mullainathan, 2004) and capture the fact that there are three regimes (centralization-decentralization-centralization), we cluster the standard errors by Province × Regime. The results are robust to clustering at the province level and the regulator level, as shown in table A2 in the appendix.

The results are presented in table 3A. Column 1 includes province fixed effects and column 2 both province and year fixed effects. Column 3 reports the results, including the four sets of controls discussed in the data section, and column 4 also includes the interactions of decentralization and these controls. Column 5 further controls for provincial trends. The coefficients are similar across these specifications: decentralization with a native safety regulator increases the death rates by about three deaths per 1 million tons of coal production, which is four times the impact of decentralization.

To save space, the coefficients of the control variables are not reported. Among these control variables, the log of output decreases death rates under decentralization. This is reasonable considering that bigger coal mines are safer. It also shows that the increase in death rates is not due to the increase in output alone. The effects of the other control variables are not significant.

C. *Decentralization and Collusion: Within-Regulator Evidence*

A subgroup of regulators experienced both centralization and decentralization periods. For example, the safety regulator of Beijing from 1998 to 2002 experienced the decentralized period and the second centralized period. The safety regulator of Hebei from 1995 to 2001 experienced the first centralized period and the decentralized period. The safety regulator who served in Shaanxi for ten years experienced all three periods. Given this advantage of the data, we can also compare the impact of nativeness before and after decentralization within the office tenure of the same regulator by including regulator fixed effects (μ_s) in equation (2). This way, the concern that native regulators are more likely to be assigned to certain provinces is relieved.

The results are presented in table 3B. Columns 1 to 3 show the results using the full sample, whereas columns 4 to 6 limit the sample to regulators who experienced at least one switch of the centralization and decentralization regimes. In fact, the within-regulator estimates are very close to those from within-province estimations. Consistent with figure 2, the similarity in magnitudes also suggests that endogeneity in the appointment of native regulators is not a big concern.

V. Robustness Checks and Additional Evidence

We conduct different robustness checks regarding our main results. First, an important concern is the quality of

TABLE 4.—CHECKING THE QUALITY OF THE DEATH RATES WITH TWO PLACEBO TESTS

	(1) Traffic	(2) Traffic	(3) Traffic	(4) Local Mine	(5) Local Mine	(6) Local Mine
Decentralization × Native	0.022	−0.015	0.147	−1.823	−2.124	−2.359*
	(0.303)	(0.401)	(0.326)	(1.183)	(1.335)	(1.186)
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Regulator FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls		Yes	Yes		Yes	Yes
Decentralization × Controls			Yes			Yes
Number of observations	234	234	234	222	222	222
R^2	0.95	0.95	0.96	0.70	0.71	0.72

This table shows that decentralization and having a native regulator have no similar impact on the death rates of traffic accidents or in the local state coal mines as that on death rates in the key state coalmines. Controls include (a) the logs of coal output and coal mine industry wages, (b) other characteristics of safety regulators (age and tenure), and (c) different provincial characteristics (the logs of GDP per capita, electricity consumption, distance to Beijing, and whether the provincial governor or secretary is a native). Standard errors reported in parentheses are clustered at the Province×Regime level. Significant at *10%, **5%, and ***1%.

the death records. We use other types of death records to conduct two placebo tests. Second, to check whether there exist different pretrends in our difference-in-difference analysis, we use a more flexible specification to evaluate the effect of having a native regulator year by year. Third, to ensure that the finding is robust to the way we measure death rates, we examine deaths and production separately. Finally, we look at the impact of decentralization and centralization separately.[23]

We also present two sets of additional results using information on media exposure and coal mine firms. Both provide further support for our hypothesis of decentralization and collusion.

A. Robustness Checks

Investigating misreporting. As discussed in section IIIA, misreporting by the safety regulators is unlikely for our finding, as we find higher death rates for native regulators under decentralization. However, there can still be misreporting by a statistical bureau or the coal mine firms.

Misreporting by the statistical bureau is unlikely to explain our finding because its officials are not rewarded or punished by coal mine death data. Nevertheless, we conduct a further check by exploring traffic deaths as a placebo. Traffic safety is supervised by the same regulator as coal mine safety, and its reporting can be influenced by the same statistical bureau. We would expect a similar impact of decentralization and having a native regulator on traffic deaths if misreporting by the statistical bureau is the main driver of our finding. Columns 1 to 3 in table 4 present the results using traffic deaths per capita as our dependent variable, using similar specifications to those in columns 1 to 3 in table 3B. Unlike the impact on death rates in the key state coal mines, we do not find that decentralization and having a native regulator affect traffic deaths per capita.

Another possibility of misreporting is that coal mine firms tend to underreport death rates. Both decentralization and having a native regulator may reduce the asymmetry of information between safety regulators and coal mine firms and hence lead to higher (and more accurate) reporting of deaths. If information asymmetry were the main driver of our finding, one would expect a positive correlation between having a native regulator and death rates even without decentralization. However, as shown in table 3A, we find that having a negative regulator matters only when decentralization makes collusion with local regulators feasible.

As another placebo test, we examine whether death rates in the local state coal mines exhibit the same pattern as those in the key state coal mines under decentralization and the supervision of native regulators. The results in columns 4 to 6 of table 4 show that this is not the case. Together with the placebo test on traffic deaths, misreporting is unlikely to be the driver of our main finding.

Moreover, death rates in the local state coal mines also provide a natural comparison group for a difference-in-difference-in-difference (DDD) analysis. The results are presented in table A3 in the appendix and show that death rates in the key state coal mines are much higher under decentralization and the supervision of native regulators, compared with that in the local state coalmines.

Examining Pretrends. Our baseline estimates evaluate the average effect under decentralization. We can allow for more flexible specifications and evaluate the dynamic effects. This way, we can also test whether the concern of different pretrends matters. The specification is as follows:

$$Deathrate_{spt} = \sum_{\tau} \beta_\tau N_{sp\tau} \times year_\tau + \beta_N N_{spt} + \gamma' X_{spt} \times D_t + \nu' X_{spt} + \lambda_p + \gamma_t + \varepsilon_{spt},$$

where $\sum_\tau N_{sp\tau} \times year_\tau$ are the interactions between the dummy for being native and different year dummies and the year before decentralization (1997) is left as the comparison year.

The results are presented in table 5. As we examine the effects year by year, we focus on the within-province estimates. Column 1 reports the OLS results without fixed effects. Column 2 reports the results after including fixed effects. Column 3 includes the controls, and column 4 further includes the interactions of decentralization and the controls.

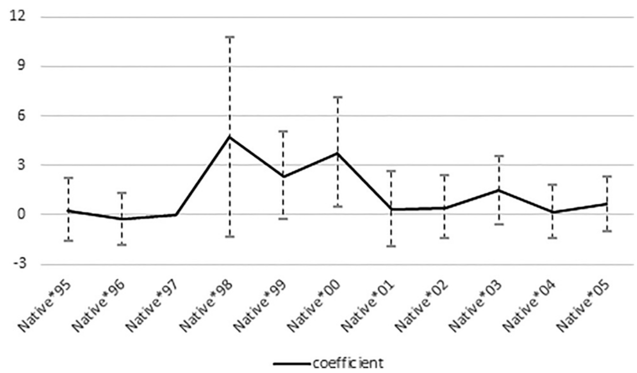
[23] We realize that the recentralization in 2001 might be endogenous. However, it will not affect our main identification as long as the nativeness of regulators is not correlated with the decision.

TABLE 5.—EXAMINING PRETRENDS: THE DYNAMIC IMPACTS
DEPENDENT VARIABLE: DEATH RATE

	(1)	(2)	(3)	(4)
Native × Year 1995	0.075	−0.400	−0.540	0.275
	(0.714)	(0.958)	(1.090)	(0.946)
Native × Year 1996	−0.279	−0.888	−1.049	−0.288
	(0.601)	(0.920)	(0.958)	(0.771)
Native × Year 1998	3.798	4.174	4.205	4.711
	(3.565)	(3.198)	(3.205)	(3.033)
Native × Year 1999	2.081	2.153	2.196	2.346*
	(1.604)	(1.387)	(1.356)	(1.325)
Native × Year 2000	3.673*	3.509**	3.518**	3.751**
	(2.098)	(1.665)	(1.706)	(1.669)
Native × Year 2001	0.721	−0.155	−0.147	0.334
	(1.423)	(1.156)	(1.182)	(1.144)
Native × Year 2002	1.348	0.285	0.005	0.424
	(1.180)	(0.805)	(0.888)	(0.956)
Native × Year 2003	1.154	1.675	1.692	1.468
	(1.435)	(1.133)	(1.067)	(1.037)
Native × Year 2004	−0.494	0.412	0.425	0.154
	(0.439)	(0.787)	(0.838)	(0.794)
Native × Year 2005	−0.119	0.955	1.006	0.626
	(0.562)	(0.896)	(0.860)	(0.822)
Province FE		Yes	Yes	Yes
Year FE		Yes	Yes	Yes
Controls			Yes	Yes
Decentralization × Controls				Yes
Number of observations	234	234	234	234
R^2	0.10	0.48	0.50	0.55

This table reports the year-to-year impact of having a regulator; the positive impact restricts to the decentralization period. Controls are the same as in Table 3. Standard errors reported in parentheses are clustered at the Province×Regime level. Significant at *10%, **5%, and ***1%.

FIGURE 3.—THE DYNAMIC IMPACTS



The figure graphs the results in column 4 of table 5. It shows that the positive effect of native × year dummy is restricted to the decentralization period. The dashed line indicates the 95% confidence interval, with standard errors clustered at the province × regime level. Every estimated effect is relative to 1997, which is displayed as an "effect" of 0 to aid visual analysis.

These results are close to the baseline estimates and also show that the positive effect on death rates is limited to the decentralization period. Moreover, they also show that β_{1995} and β_{1996} are not different from 0.

The results in column 4 are graphed in figure 3.[24] The dashed line indicates the 95% confidence interval. Every estimated effect is relative to the year 1997, which is displayed as an effect of 0 to aid visual analysis. It can be seen clearly that there were no significant pretrends before decentralization.

Consistent with our hypothesis, death rates increase under decentralization and decrease after recentralization. However, there is no clear pattern regarding the differences in the impacts from 1998 to 2000. On the one hand, the magnitude of the coefficient is slightly larger in 1998. On the other hand, it is much less precisely estimated. The precision of the estimates increases during the three years of decentralization.

B. *Evaluating the impacts on deaths and output*

In our baseline estimates, we use the number of deaths per 1 million tons of coal production as an indicator of safety. It is an easure often discussed in the media. There are two limitations of this measure. First, the number of deaths and production are both endogenous. Second, the results might be affected by a few extreme values. As a robustness check, we examine the impact on the logged number of deaths as well as the logged coal output. In the province-year data set, only three observations are zeros for the number of deaths.

The specification is similar to equation (2) except that the dependent variable is replaced by the logged number of deaths and coal production. The controls are also the same as those in equation (2) but the logged production is naturally excluded. Column 1 of table 6 presents the estimate for the logged number of deaths from within-province specifications, and columns 2 and 3 report the results from the within-regulator estimation with different sets of controls. They show that deaths increase by around 80% to 100% for the provinces with native regulators. Similarly, columns 4 to 6 present the results for the logged coal output. Indeed, output is also increased under collusion. However, the magnitude is much smaller than that of deaths—only around one-eighth of the impact on deaths.

Comparing the impacts of decentralization and recentralization. The decentralization policy in 1998 concerns both management and safety regulation power, whereas the recentralization policy in 2001 focuses on safety regulation power. If safety supervision plays a critical role in deterring collusion, we should see an effect both when decentralization is introduced and when it is taken away. Thus, we can estimate separate regressions for different subperiods.

We replicate the same regressions as in equation (2) but separately for two sample periods: 1995–2000 and 1998–2005. In the first subsample, 1995–1997 is the centralization period, whereas 1998–2000 is the decentralization period. In the second subsample, 1998–2000 is the decentralization period whereas 2001-2005 is the centralization period.

The results are presented in table 7. Columns 1 to 3 present the results using data between 1995 and 2000; column 1 reports the within-province estimates and columns 2 and 3 report the within-regulator estimates with different sets of

[24] Figure A3 in the appendix plots the average death rates by native and nonnative regulators. It also shows a clear increase in death rates under decentralization for native regulators. However, this comparison has to be taken with a grain of salt as because of the compositional changes of regulators between the two groups.

TABLE 6.—EVALUATING THE IMPACTS ON DEATH AND OUTPUT

	(1) ln Death	(2) ln Death	(3) ln Death	(4) ln Output	(5) ln Output	(6) ln Output
Decentralization × Native	0.831***	1.125***	1.032***	0.102*	0.095*	0.102**
	(0.230)	(0.329)	(0.380)	(0.052)	(0.052)	(0.048)
Native	−0.093			0.016		
	(0.150)			(0.043)		
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Provincial trends	Yes	Yes	Yes	Yes	Yes	Yes
Regulator FE		Yes	Yes		Yes	Yes
Controls		Yes	Yes		Yes	Yes
Decentralization × Controls			Yes			Yes
Number of observations	231	231	231	234	234	234
R^2	0.73	0.80	0.80	0.99	0.99	0.99

This table shows that Decentralization × Native increases both deaths and output, but the impact on deaths is much larger. Columns 1 to 4 present the impacts on the log of deaths, and columns 5 to 8 present the impacts on the log of coal output. Controls include (a) the log of coal mine industry wages, (b) other characteristics of safety regulators (age and tenure), and (c) different provincial characteristics (the logs of GDP per capita, electricity consumption, distance to Beijing, and whether the provincial governor or secretary is a native). Standard errors reported in parentheses are clustered at the Province×Regime level. Significant at *10%, **5%, and ***1%.

TABLE 7.—COMPARING THE IMPACTS OF DECENTRALIZATION AND CENTRALIZATION DEPENDENT VARIABLE DEATH RATE

	(1) 95-00	(2) 95-00	(3) 95-00	(4) 98-05	(5) 98-05	(6) 98-05
Decentralization × Native	3.820**	3.988*	2.353**	2.676**	3.026	3.595***
	(1.456)	(2.153)	(0.976)	(1.231)	(2.164)	(1.031)
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Regulator FE		Yes	Yes		Yes	Yes
Controls		Yes	Yes		Yes	Yes
Decentralization × Controls			Yes			Yes
Number of observations	126	126	126	173	173	173
R^2	0.49	0.55	0.58	0.53	0.59	0.60

This table presents the impact of decentralization in 1998 and that of recentralization in 2001, respectively. Columns 1 to 4 present the results using data between 1995 and 2000. Columns 5 to 8 present results using data between 1998 and 2005. Controls include (a) the logs of coal output and coal mine industry wages, (b) other characteristics of safety regulators (age and tenure), (c) different provincial characteristics (the logs of GDP per capita, electricity consumption, distance to Beijing, and whether the provincial governor or secretary is a native), and (d) traffic deaths per capita. Standard errors reported in parentheses are clustered at the Province×Regime level. Significant at *10%, **5%, and ***1%.

controls. Similarly, columns 4 and 6 present the results using data between 1998 and 2005.

While the effect of decentralization is generally larger, the effects of the two switches are not dramatically different. This finding suggests that separating safety regulation from interest groups rather than general management is the key to reducing collusion.[25]

C. Additional Evidence

Estimating the impact of media exposure. As an additional test for our hypothesis, we investigate the effect of media exposure. In particular, we are interested in whether media exposure decreases the interaction effect of decentralization and having native regulators—the triple effect of media exposure, decentralization, and native regulators.[26]

We measure media exposure using two variables: the number of newspapers and total circulation of newspapers per 1,000 inhabitants. The first proxy measures media pluralism in a province (emphasized in Besley & Prat, 2006), whereas the second proxy measures the extent of news received by the inhabitants. Naturally, these measures are not exogenous and are correlated with economic development. Given this limitation, we use the lagged numbers and always control for GDP per capita in our analysis. Our aim is not to identify a causal impact of media exposure. Instead, we attempt to provide correlations that speak to the logic of collusion.

The data are taken from *China Statistical Data of Press and Publication* published since 1996. Because we use the lagged number of newspapers, we have a shorter sample (from 1997 and 2005) when we examine the impact of newspapers. The number of newspapers varies from 2 to 71, with a mean of 28. The circulation of newspapers per 1,000 inhabitants varies from 0.05 to 8, with a mean of 1.5.

The estimates on the triple effects are presented in table 8. Column 1 presents the results for the number of newspapers, exploring within-province variations. Column 2 presents the results from within-regulator analysis, which are very similar to those in column 1. Similarly, columns 3 and 4 report the results using the circulation of newspapers per 1,000 inhabitants to proxy media exposure. The triple effect is negative across all specifications. This finding is consistent with the interpretation that media exposure deters collusion and provides further evidence for our hypothesis.

Little is known about the role of media in a nondemocracy like China. Our finding provides suggestive evidence

[25] This logic is consistent with the reaction of accidents in a different context. To help prevent a recurrence of the Deepwater Horizon spill, an offshore safety institute was established to be separate from the American Petroleum Institute, a lobbying organization.

[26] The simple model in the appendix also formalizes the role of media exposure.

TABLE 8.—INVESTIGATING THE IMPACT OF MEDIA EXPOSURE

Dependent Variable: Death Rates

	(1)	(2)	(3)	(4)
#Newspaper($t-1$) × Decentralization × Native	−0.190**	−0.199*		
	(0.090)	(0.104)		
#Newspaper($t-1$) × Native	0.030	0.073		
	(0.042)	(0.064)		
#Newspaper($t-1$) × Decentralization	−0.039	−0.059		
	(0.053)	(0.070)		
#Newspaper($t-1$)	−0.040	−0.069		
	(0.039)	(0.059)		
#Circulation per 1,000($t-1$) × Decentralization × Native			−3.211*	−4.336**
			(1.653)	(2.127)
#Circulation per 1,000($t-1$) × Native			−0.001	1.966*
			(0.545)	(1.119)
#Circulation per 1,000($t-1$) × Decentralization			−1.048	−0.470
			(0.731)	(0.994)
#Circulation per 1,000($t-1$)			−0.319	−1.955*
			(0.463)	(1.035)
Decentralization × Native	7.939***	8.302**	5.975***	7.060***
	(2.708)	(3.134)	(2.204)	(2.610)
Native	−0.303		0.702	
	(1.303)		(0.907)	
Province FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Decentralization × Controls	Yes	Yes	Yes	Yes
Regulator FE		Yes		Yes
Number of observations	194	194	194	194
R^2	0.62	0.67	0.62	0.67

This table shows that media exposure has a deterrent effect on collusion. The data on newspapers are available since 1996. Since we used lagged variables, the sample is limited between 1997 and 2005. Controls are the same as in table 3. Standard errors reported in parentheses are clustered at the Province×Regime level. Significant at *10%, **5%, and ***1%.

for the role of media. The logic is similar to that in Egorov, Guriev, and Sonin (2009), where dictators employ media to monitor bureaucrats. Clearly, a conclusive answer requires exogenous measures of media exposure.

Using firm-level information. Our framework predicts that local regulators and firms benefit from collusion. Because we cannot observe the wealth of regulators, we focus on the impact on coal mine firms. The firm-level data come from the Annual Surveys of Industrial Firms conducted by National Bureau of Statistics of China since 1998. We have managed to match the province-level data with the balance sheets of 90 (out of 94) key state coal mine firms between 1998 and 2005. Thus, we only have the policy change in 2001 to examine. The summary statistics are presented in table 1.

We are interested in three sets of outcomes. First, we look at the impact on firm-level output. Using provincial-level data, we find a positive impact on coal output. The firm-level data provide a sanity check for our finding.

Second, we examine the impacts on employment and average wages as proxies for the ex ante compensation for coal mine workers. In addition, we would like to know ex post compensation for accidents. The exact compensation for deaths is not reported on the balance sheet. Because these expenses are part of welfare expenditure, we also examine the impact on welfare expenditure. These results provide a better understanding of the consequences of decentralization and collusion.

The specification is similar to the baseline, except that we also include firm fixed effects to control for time-invariant firm characteristics,

$$Y_{fspt} = \beta_1 N_{spt} \times D_t + \beta_N N_{spt} + \gamma' X_{spt} \times D_t + \nu' X_{spt} + \lambda_p + \gamma_t + \mu_s + \delta_f + \varepsilon_{fspt},$$

where δ_f indicates firm fixed effects. X_{spt} is similar to those in the baseline specification, but we do not control for the logged output or wages here.

The results are presented in table 9. Columns 1 and 2 show that the interaction of decentralization and nativeness of the safety regulator increases coal mine output by about 16%, which is consistent with the finding using provincial level data.

Columns 3 and 4 show that employment is also weakly increased. However, columns 5 and 6 show that average wages are not affected by decentralization and collusion, which suggests that the benefits are not shared by coal mine workers despite larger health hazards. As shown in columns 7 and 8, there is no evidence that welfare expenditure per worker responds to the reforms either. These findings are not surprising given the labor-supply surplus in rural China during this period.

Together, these results show that decentralization and collusion increase firm-level coal output. However, no evidence suggests that coal mine workers benefit from the increase in output.

TABLE 9.—USING INFORMATION ON THE KEY STATE COAL MINE FIRMS

	(1) ln Output	(2) ln Output	(3) ln Employment	(4) ln Employment	(5) ln Wage	(6) ln Wage	(7) ln Welfare	(8) ln Welfare
Decentralization × Native	0.131**	0.161**	0.131	0.092*	−0.011	−0.010	0.086	0.094
	(0.055)	(0.065)	(0.087)	(0.051)	(0.078)	(0.048)	(0.108)	(0.090)
Province and Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regulator FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls		Yes		Yes		Yes		Yes
Decentralization × Controls		Yes		Yes		Yes		Yes
Number of observations	590	590	590	590	589	589	578	578
R^2	0.96	0.96	0.97	0.97	0.77	0.78	0.65	0.66

This table shows that decentralization and collusion increase firm output but have no significant impact on average wages. Controls include other characteristics of safety regulators (age and tenure), different provincial characteristics (the logs of GDP per capita, electricity consumption, distance to Beijing, and whether the provincial governor or secretary is a native). Standard errors reported in parentheses are clustered the Province×Regime level. Significant at *10%, **5%, and ***1%.

VI. Conclusion

We argue that China's abysmal record on coal mine safety can be partly explained through a political-economic channel: local regulators allow firms to choose dangerous but profitable production technologies when collusion is feasible. We explore an institutional change in the management of key state coal mines to test our hypothesis, using a provincial-level panel data set from 1995 and 2005.

Our finding that decentralization increases coal mine deaths supports the collusion channel in the theoretical literature. It also implies that public sector decentralization can have unintended consequences. Our finding that the impact of decentralization is much larger for native safety governors provides further evidence on the collusion channel, because natives are likely to have lower transaction costs of collusion.

We might be the first to document the collusion logic in coal mine accidents with systematic empirical evidence. While our study focuses on a specific industry, the political logic may be applied to other industries and other types of safety problems.

REFERENCES

Altonji, Joseph G., Todd E. Elder, and Christopher R. Taber, "Selection on Observed and Unobserved Variables: Assessing the Effectiveness of Catholic Schools," *Journal of Political Economy* 113:1 (2005), 151–184.

Arikan, G. Gulsun, "Fiscal Decentralization: A Remedy for Corruption?" *International Tax and Public Finance* 11:2 (2004), 175–195.

Baliga, Sandeep, and Tomas Sjostrom, "Decentralization and Collusion," *Journal of Economic Theory* 83:2 (1998), 196–232.

Bardhan Pranab, P., and Dilip Mookherjee, "Decentralization, Corruption and Government Accountability," *International Handbook on the Economics of Corruption* 6 (2006), 161–188.

Bertrand, Marianne, Esther Duflo, and Sendhil Mullainathan, "How Much Should We Trust Differences-in-Differences Estimates?" *Quarterly Journal of Economics* 119:1 (2004), 249–275.

Besley, Tim, and Andrea Prat, "Handcuffs for the Grabbing Hand? The Role of the Media in Political Accountability," *American Economic Review* 96:3 (2006), 720–736.

Blanchard, Olivier, and Andrei Shleifer, "Federalism with and without Political Centralization: China versus Russia," IMF staff papers 48:4 (2001), 171–179.

Burgess, Robin, Matthew Hansen, Benjamin A. Olken, Peter Potapov, and Stefanie Sieber, "The Political Economy of Deforestation in the Tropics," *Quarterly Journal of Economics* 127:4 (2012), 1707–1754.

Chen, Hong, Hui Qi, Ruyin Long, and Maolong Zhang, "Research on 10-Year Tendency of China Coal Mine Accidents and the Characteristics of Human Factors," *Safety Science* 50:4 (2012), 745–750.

China Labor Bulletin, "Bone and Blood: The Price of Coal in China," CLB research report 6 (2008).

Egorov, Georgy, Sergei Guriev, and Konstantin Sonin, "Why Resource-Poor Dictators Allow Freer Media: A Theory and Evidence from Panel Data," *American Political Science Review* 103:4 (2009), 645–668.

Enikolopov, Ruben, and Ekaterina Zhuravskaya, "Decentralization and Political Institutions," *Journal of Public Economics* 91:11 (2007), 2261–2290.

Faccio, Mara, "Politically Connected Firms," *American Economic Review* 96:1 (2006), 369–386.

Fan, C. Simon, Chen Lin, and Daniel Treisman, "Political Decentralization and Corruption: Evidence from around the World," *Journal of Public Economics* 93:1 (2009), 14–34.

Fisman, Raymond, "Estimating the Value of Political Connections," *American Economic Review*, 91:4 (2001), 1095–1102.

Fisman, Raymond, and Roberta Gatti, "Decentralization and Corruption: Evidence across Countries," *Journal of Public Economics* 83:3 (2002), 325–345.

Fisman, Raymond, and Yongxiang Wang, "The Mortality Cost of Political Connections," *Review of Economic Studies*, 82:4 (2015).

Fukushima Nuclear Accident Independent Investigation Commission, *The Official Report* (National Diet of Japan, 2012).

Galiani, Sebastian, Paul Gertler, and Ernesto Schargrodsky, "School Decentralization: Helping the Good Get Better, but Leaving the Poor Behind," *Journal of Public Economics* 92 (2008), 2106–2120.

Guo, Xuezhi, "Dimensions of Guanxi in Chinese Elite Politics," *The China Journal* 46 (2001), 69–90.

Jin, Hehui, Yingyi Qian, and Barry Weingast, "Regional Decentralization and Fiscal Incentives: Federalism, Chinese Style," *Journal of Public Economics* 89:9 (2005), 1719–1742.

Karlan, Dean, Markus Mobius, Tanya Rosenblat, and Adam Szeidl, "Trust and Social Collateral," *Quarterly Journal of Economics* 124:3 (2009), 1307–1361.

Kofman, Fred, and Jacques Lawarree, "Collusion in Hierarchical Agency," *Econometrica* 61:3 (1993), 629–656.

Laffont, Jean-Jacques, and David Martimort, "Collusion and Delegation," *Rand Journal of Economics* 29:2 (1998), 280–305.

Li, Shaomin, and Jun Wu, "Why Some Countries Thrive Despite Corruption: The Role of Trust in the Corruption-Efficiency Relationship," *Review of International Political Economy* 17:1 (2010), 129–154.

Lin, Yifu, and Zhiqiang Liu, "Fiscal Decentralization and Economic Growth in China," *Economic Development and Cultural Change* 49:1 (2000), 1–21.

Luo, Yadong, *Guanxi and Business* (Singapore: World Scientific, 2007).

Mookherjee, Dilip, "Decentralization, Hierarchies, and Incentives: A Mechanism Design Perspective," *Journal of Economic Literature* 44:2 (2006), 367–390.

Mookherjee, Dilip, and Masatoshi Tsumagari, "The Organization of Supplier Networks: Effects of Delegation and Intermediation," *Econometrica* 72:4 (2004), 1179–1219.

Nie, Huihua, and Minjie Jiang, "Zhengqi hemou yu kuangnan (Coal mine accidents and collusion between local governments and firms)," *Jingjiyanjiu (Economic research journal)* 6 (2011), 146–156.

Oi, Jean, *Rural China Takes Off: Institutional Foundations of Economic Reform* (Berkeley: University of California Press, 1999).
Persson, Petra, and Ekaterina Zhuravskaya, "The Limits of Career Concerns in Federalism: Evidence from China," *Journal of European Economic Association* 14 (2016), 338–374.
Shih, Victor, Christoper Adolph, and Mingxing Liu, "Getting Ahead in the Communist Party: Explaining the Advancement of Central Committee Members in China," *American Political Science Review* 106:1 (2012), 166–187.
State Administration of Coal Mine Safety, ed., *China Coal Industry Yearbook* (Beijing: Coal Industry Press, 2004).
State Council, "Guanyu guoyou zhongdian meikuang guanli tizhi youguan wenti de tongzhi (Notice on the reform of the key state coal mines)" (1998).
Tirole, Jean, "Hierarchies and Bureaucracies: On the Role of Collusion in Organizations," *Journal of Law, Economics, and Organization* 2:2 (1986), 181–214.
Treisman, Daniel, "Decentralization and the Quality of Government," UCLA mimeograph (2002).
Tu, Jianjun, "Coal Mining Safety: China's Achilles Heel," *China Security* 3 (2007), 36–63.
Van Rooij, Benjamin, *Regulating Land and Pollution in China: Lawmaking, Compliance, and Enforcement: Theory and Cases*, (Amsterdam: Amsterdam University Press, 2006).
Wright, Tim, "The Political Economy of Coal Mine Disasters in China: Your Rice Bowl or Your Life," *China Quarterly* 179 (2004), 629–646.
——— "Rents and Rent Seeking in China's Coal Industry" in Tak-wing Ngo and Yongping Wu, eds., *Rent Seeking in China* (London: Routledge, 2008).
Young, Alwyn, "The Razor's Edge: Distortions and Incremental Reform in the People's Republic of China," *Quarterly Journal of Economics* 115:4 (2000), 1091–1135.
Zhang, Tao, and Hengfu Zou, "Fiscal Decentralization, Public Spending, and Economic Growth in China," *Journal of Public Economics* 67:2 (1998), 221–240.