

Collusion Heterogeneity and Coal Mine Deaths in China

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Abstract: China government adopted two distinctly different yet related policies towards the two kind of coal mines in the late 1990s: delegated the key state coalmines to provincial government and shut down the township mines. Along with the regime changes in safety supervision, we find that “neutral collusion” can increase the death rates of key state coalmines significantly, the impact of decentralization on accidents is much larger for native safety governors. “Corrupt collusion” is correlated with an increase in coal mine death rate of township mines, but provinces with native safety governors are correlated with a lower death rate of township mines under the decentralization and shutdown period. The collusions are heterogeneous both in formations and impacts.

1. Introduction

Over a long period of time, China's coal mine safety has been significantly improved, the deaths per millions of tons dropped from 7.65 in 1986 to 0.093 in 2018. However, it is not difficult to find the extremely terrible safety records of coal mines around 2000. First, the mortality rate of China's coal mines exceeded 5, was much higher than that of other major coal-producing countries in 2000 (Wang, 2006) [1]. Secondly, the death rate jumped significantly during this period, showing a "peak". There are three types' coal mines in China: key state coal mines (KSC), local state coal mines (LSC), and township and village coal mines (TVC). In 2000, the death rate of TVC was 14.61, more than 10 times that in KSC.

In terms of time series, the drastic fluctuation of death rate of TVC corresponds to a series of policy and institutional changes. In July 1998, the power of safety supervision and management of KSC was delegated to the province. At the end of the same year, the central government implemented "shut down and production reduction" for small coal mines in villages and towns. The two policies constitute the policy combination of "one promotion and one suppression". At the beginning of 2001, the State Council approved the establishment of the State Administration of Work Safety and the withdrawal of the power of safety supervision from the Central Committee. 1998-2000 is the period of decentralization of state-owned key coal mines, 1999-2000 is the period of decentralization and shutdown of township coal mines (see Fig.1).

Under the background of decentralization, local officials and enterprises are more likely to form collusion, which leads to mine accidents (Nie et al., 2013; Jia and Nie, 2017) [2] [3]. We argue that the collusion between government and enterprise can not only analyze the causes of mine accidents in KSC, but also explain the violent fluctuation of the death rate in township coal mines (TVC). In theory, collusion between officials and enterprise should include, but not limited to corruption. Local governments and their officials acquiesce or condone "bad" production modes (less innovation, unsafe, environmental protection, low quality) may be aimed at seeking local economic interests and achievements rather than corruption. Therefore, there is a difference between "neutral collusion" and "corruption collusion".

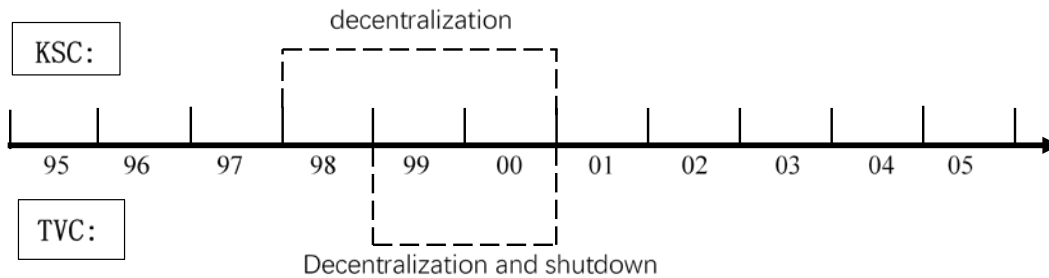


Figure 1. Policy Changes: TVC vs KSC

Based on the provincial panel data of KSC and TVC from 1995 to 2005, we find that “neutral collusion” can increase the death rates of key state coalmines significantly, the impact of decentralization on accidents is much larger for native safety governors. “Corrupt collusion” is correlated with an increase in coal mine death rates of township mines under the decentralization and shutting down period.

2. Theoretical Framework

Nie huihua et al [4] put forward the theory of "collusion", which provides an insightful perspective for understanding mining accidents. We argue that the collusion–mortality relationship should be heterogeneous, the pursuit of economic performance and rent-seeking both can induce a looser regulation. The KSC are only delegated to the province level and may only collude with the senior officials. TVC are more likely to collude with the grassroots officials. The characteristics of "small, scattered, numerous and chaotic" in TVC and the disguise illegal production intensify the information asymmetry. The object identification, specific execution and follow-up supervision of shutdown are more dependent on the grassroots government. Collusion is established on the basis of repeated games [5]. Therefore, TVC are more likely to collude with the "closer" grassroots officials.

Jia et al. (2017) focus on the key state coal mines, they argue that a native safety regulator may have lower transaction costs of collusion, thus increasing the death rates, especially during the decentralization period. Bai et al., (2012) [6] argue that shutdown policy leads to a lower property rights stability of village coal mines. They find that shutdown policy significantly decreases output while also increasing mortality in TVC. Fisman and Wang (2015) [7] find that the worker death rate for connected companies is two to three times that of unconnected firms.

In fact, some literature has hinted at the heterogeneity of collusion. Xu et al. (2018) [8] find evidence that provinces with stronger exposure to the anti-corruption campaign have experienced a significantly larger decrease in coalmine death rates. Zhang and Sun (2018) evaluate the complementary effect of anti-corruption and “no safety, no promotion” laws on coal mine mortality in China [9]. Tian and Fan (2018) find that more tax is evaded for similar amounts of business entertainment expenses in regions with high levels of corruption. However, enterprises' political connections substitute for the incentive to collude, thereby weakening the relationship between business entertainment expenses and tax evasion [10]. Fig.2 depicts two types of collusion.

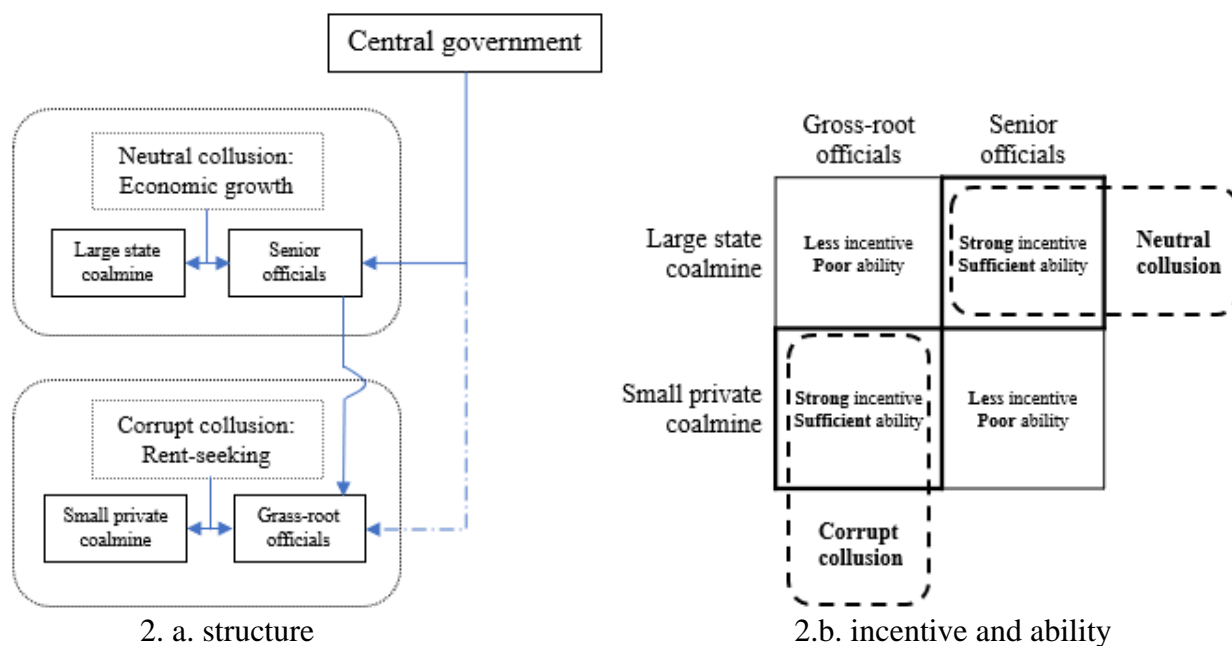


Figure 2. Two Types of Collusion

3. Data

We collect a panel data set on the coalmine accidents, provincial corruption levels and senior officials' characteristics for 22 provinces across China between 1995 and 2005. There are both KSC and TVC in the 22 provinces such as Beijing, Hebei etc. We focus on the period 1995 to 2005 for two reasons. First, Chinese government cleaned up the coal mines where officials had taken stakes in 2006, then provincial government NSNP (“no safety, no promotion”) laws came into force. Second, we can only collect the data of KSC and TVC between 1995 to 2005, a large number of TVC were merged by KSC and LSC since 2006.

Coal mine death rate, the main dependent variable in this study, is calculated as the number of deaths per 100 million tons of coal production. The key independent variables are neutral collusion and corruption. Refer to the study of Jia and Nie (2017), we define the variable Native as the proxy variable for neutral collusion, Native equal to 1 where the vice province governors responsible for industrial-production safety are native-born. We measure the provincial corruption by the ratio of the registered corruption cases (the number of cases per 10 thousand officials). We also collect data on the characteristics of coal mines and safety regulators as well as a series of provincial socioeconomic variables from various sources (Table 1).

Table 1. Summary Statistics and Data Sources

Variable	Definition	Obs	Mean	Max	Min	Sources
Provincial coalmine data						
Deathratev (Dev_Close)	Deaths per million tons of TVC in decentralized and shutdown period	44	19.94	83.33	2.53	1
Deathratev (Un_Close_de)	Deaths per million tons of TVC in centralized or non-shutdown period	191	14.64	400.00	0.00	1
Deathratteg (Decentralized)	Deaths per million tons of KSC in decentralized period	66	3.30	46.25	0.12	1
Deathratteg (Centralized)	Deaths per million tons of KSC in centralized period	169	2.22	15.49	0.00	1
Deathratel	Deaths per million tons of LSC	224	5.00	114.07	0.00	1

ln_v	Log of TVC Output	235	7.00	9.96	0.0 0	1
ln_g	Log of KSC Output	231	6.82	10.3 0	0.0 0	1
ln_l	Log of LSC Output	235	7.33	10.1 5	3.7 0	1
Key explanatory variable						
Corruption	Corruption cases per 10 thousand officials	236	34.4 3	65.4 8	8.3 3	2,5
Native	Native-born governor	234	0.42	1.00	0.0 0	3
Decentralized Dev_close	Decentralized period	242	0.1 8	1.00	0.0 0	4
	Decentralized also shutdown period	242	0.2 7	1.00	0.0 0	4
Other controls						
lnWage	Wages of coalmine industry(logged)	234	9.15	10.1 6	8.3 9	5
lnWagev	Wages of TVC (logged)	234	8.86	10.1 4	7.8 3	6
lnWageg	Wages of KSC (logged)	234	9.10	10.3 1	8.2 0	6
lnGDPper	Real GDP per capita(logged)	234	8.82	10.7 2	7.5 1	5
lnElectricity	Electricity consumption(logged)	234	6.05	7.69	4.5 3	5
ln(Distance+1)	Distance to Beijing(logged)	234	6.48	7.80	0.0 0	3
Firm level data						
lnAddg	KSC added value	661	12.4 6	16.3 0	7.2 2	6
lnWelfareg	KSC welfare expenditure	653	10.0 1	14.3 7	5.1 4	6
lnAddv	TVC added value	634 5	8.59	13.0 0	1.6 1	6
lnWelfarev	TVC welfare expenditure	539 8	5.32	10.4 7	0.6 9	6

Sources: 1. China Coal Mine Industrial Yearbook; 2. Provincial Statistcal Yearbooks; 3. Jia and Nie (2017); 4. Documents collected by the authors; 5. China Statistcal Yearbooks; 6. Annual surveys of Chinese industrial firms.

4. Empirical Results

To examine whether the effect of collusion heterogeneity on coal mine mortality, we explore both within-province variations. The specification is as follows:

$$Deathrateg_{pt} = \beta'_g Collusion_g + v'_g Controls_{gpt} + \lambda_{gp} + \lambda_{gp} \times t + \tau_{gt} \quad (1)$$

$$Collusion_g = (Native_{pt}, Native_{pt} \times Decentralizedg) \quad (2)$$

$$Deathratev_{pt} = \beta'_v Collusion_v + v'_v Controls_{vpt} + \lambda_{vp} + \lambda_{vp} \times t + \varepsilon_{vt} \quad (3)$$

$$Collusion_v = (Corruption_{vt}, Corruption_{vt} \times Decentralizedv_Close) \quad (4)$$

To take into account the concern of serial correlation and capture the fact that there are two regimes (decentralized and centralized for KSC and shutdown-decentralized and non-shutdown-

decentralized for TVC), where regime1 (Decentralized) equals 1 over the period 1998 to 2000 for KSC, regime2 (Dev_close) equals 1 over the period 1999 to 2000 for TVC, we cluster the standard errors by province \times regimes (1/2). We also control the number of cases that officials above the vice county level involved. The results are presented in Table 2. Column 1 includes both corruption and the interactions term of Corruption and Dev_close, the coefficient of interactions term is positive, significant at the 5% level. Column 2 further the number of cases that officials above the vice county level involved, the coefficient keeps positive and significant. The result for column 3 is similar. In Column 4, we includes Native and the interaction of Native and Dev_Close, the coefficient of interactions term is negative, significant at the 5% level. In column 5 where Deathrateg is dependent variable and Native and Native*Decentralized are independent variables, it shows that the coefficient of interactions term is positive, significant at the 1% level. Column 6 is similar. Column 7 shows that corruption cannot explain the death rate of KSC.

Table 2. Baseline Test: Collusion Heterogeneity and Death Rate: TVC vs KSC

	(1) Deathrate v	(2) Deathrate v	(3) Deathrate v	(4) Deathrate v	(5) Deathrate g	(6) Deathrate g	(7) Deathrate g
Corruption	0.122 (0.163)	0.103 (0.172)	0.106 (0.165)				0.010 (0.055)
Corruption*Dev_Close	1.020** (0.452)	1.052** (0.475)	1.056** (0.465)				
Native				-4.105 (4.748)	0.087 (0.458)	-0.048 (0.484)	
Native*Dev_Close				-19.785* *			
Native*Decentralizedg				(8.281)	2.675*** (0.868)	2.732*** (0.891)	
Corruption*Decentralize dg						1.817 (2.267)	-0.025 (0.052)
In Wage	0.796 (18.084)						
In Wagev		0.299 (17.271)	-2.779 (6.586)	-6.358 (6.225)			
In Wageg					1.949** (0.949)		2.035** (0.970)
Province FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County-division cases	No	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regime(1/2)* Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes
#Obs	225	225	225	228	234	234	231
R ²	0.86	0.86	0.86	0.86	0.60	0.59	0.57

Notes: Standard errors reported in the parenthesis are clustered at the Province \times Regime level. ***, ** and * denote significance at 1%, 5% and 10%, respectively.

Table 3 provides some evidence from firm level data and robust check. We examine the impacts on firm-level output measured by added value. 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. The interaction of decentralization and nativeness of the safety regulator increases

added value of KSC, and in regions with high levels of corruption, welfare expenditure of TVC is significantly higher. As a placebo test, we examine whether death rates in the LSC exhibit the same pattern as those in the TVC and KSC. The results in columns 3 to 4 of table 3 show that this is not the case.

Table 3. Firm Level Evidence and Robust Check

	(1) lnWelfarev	(2) lnAddg	(3) Deathratel	(4) Deathratel
Corr*Dev_Close	0.015* (0.009)		-0.015 (0.080)	
Naitve*Decentralizedg		0.253** (0.096)		0.006(0.998)
Province FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Province Trend	Yes	Yes	Yes	Yes
Regime(1/2)*Controls	Yes	Yes	Yes	Yes
#Obs	4560	660	214	223
R ²	0.34	0.90	0.61	0.57

Notes: Standard errors reported in the parenthesis are clustered at the Province \times Regime level. ***, ** and * denote significance at 1%, 5% and 10%, respectively.

5. Conclusion

We find that “neutral collusion” can increase the death rates of key state coalmines significantly, the impact of decentralization on accidents is much larger for native safety governors. “Corrupt collusion” is correlated with an increase in coal mine death rate of township mines, but provinces with native safety governors are correlated with a lower death rate of township mines under the decentralization and shutdown period. The collusions are heterogeneous both in formations and impacts.

References

- [1] Wang, Shaoguang. Regulating Death at Coalmines: Changing Mode of Governance in China. *Journal of Contemporary China*, 2006, 15 (46): 1 - 30.
- [2] Nie H, Jiang M, Wang X. The impact of political cycle: Evidence from coalmine accidents in China [J]. *Journal of Comparative Economics*, 2013, 41 (4): 995 - 1011.
- [3] Jia, Ruixue and Huihua Nie. Decentralization, Collusion and Coalmine Deaths [J]. *Review of Economics and Statistics*, 2017, 99 (1): 105 - 118.
- [4] Huihua, Nie, and J. Li. Collusion and Economic Growth: A New Perspective on the China Model." *Economic and Political Studies* 1.2013: 18 - 39.
- [5] Tirole, Jean. Hierarchies and Bureaucracies: On the Role of Collusion in Organizations [J]. *Journal of Law Economics & Organization*, 1986, 2 (2): 181 - 214.
- [6] Bai, Chong-en, Xin Wang, and Xiaohan Zhong. Regulation or Property Rights: The Effect of China’s Coal Mine Shutdown Policy on Work Safety [J]. *China Economist*, 2012, 7 (3): 114 - 127.
- [7] Fisman R, Wang Y. The Mortality Cost of Political Connections [J]. *Review of Economic Studies*, 2015.
- [8] Xu G, Yano G, Zou R. Anti-Corruption, Safety Compliance and Mining Accidents: Evidence from China [J]. *Social Science Electronic Publishing*. 2018.

[9] Zhang, Xueyuan and Fengwei Sun. Anti-corruption, NSNP and Coal Mine Deaths: Evidence from China, Working Paper, 2018.

[10] Tian binbin and Ziyang Fan. Zhengna hemou, xunzu yu qiye taoshui (Collusion, Rent-seeking and Tax Evasion [J]. Jingjiyanjiu (Economic research journal) (in Chinese), 2018 (5).